ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

HITS-R22

M.Tech - Electrical Power Systems

M.Tech - Regular Two Year Degree Programme
(For batches admitted from the academic year 2022 - 2023)

Holy Mary Institute of Technology & Science
Bogaram (V), Keesara (M), Medchal (Dist) - 501 301

FOREWORD

The autonomy is conferred on Holy Mary Institute of Technology & Science by UGC based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system and monitoring mechanism**, independent of the affiliating University but under its observance.

Holy Mary Institute of Technology & Science is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a two decades in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the college to order to produce quality engineering graduates to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications, if needed, are to be sought, at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the college and brighter prospects of engineering graduates.

PRINCIPAL

ACADEMIC REGULATIONS

M. Tech. - Regular Two Year Degree Programme
(For batches admitted from the academic year 2022 - 23)

For pursuing two year post graduate Masters Degree Programme of study in Engineering (M.Tech) offered by Holy Mary Institute of Technology & Science under Autonomous status and herein referred to as HITS (Autonomous):

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2022-23 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for Holy Mary Institute of Technology & Science (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, Holy Mary Institute of Technology & Science shall be the Chairman, Academic Council.

1. ADMISSION

Admission into first year of two year M. Tech. degree Program of study in Engineering:
Eligibility:

Admission to the above programme shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt., From time to time.

The medium of instructions for the entire post graduate programme in Engineering & technology will be English only.

2. AWARD OF M. Tech. DEGREE

A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after two academic years of course work, failing which he shall forfeit his seat in M. Tech. programme.

The student shall register for all **68** credits and secure all the **68** credits.

The minimum instruction days in each semester are 90.

3. BRANCH OF STUDY

The following specializations are offered at present for the M. Tech programme of study.

1. Highway Engineering
2. CSE
3. Computer Networks & Information Security
4. Embedded Systems
5. VLSI Design
6. Electrical Power Systems
7. Power Electronics
8. CAD / CAM
9. Machine Design

4. COURSE REGISTRATION

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice / Option for Courses, based on his competence, progress, pre-requisites and interest.

4.2 Academic Section of the College invites 'Registration Forms' from students within 15 days from the commencement of class work, ensuring 'DATE and TIME Stamping'. The 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 Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).

4.4 If the Student submits ambiguous choices or multiple options or erroneous entries - during Registration for the Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Course in that Category will be taken into consideration.

4.5 Course Registrations are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices will also not be considered. However, if the Course that has already been listed for Registration (by the Head of 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 course (subject to offering of such a course), or for another existing course (subject to availability of seats), which may be considered. Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

5. ATTENDANCE

The programmes are offered on a unit basis with each subject being considered a unit.

5.1 Attendance in all classes (Lectures/Laboratories etc.) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the days of attendance in sports, games, NCC and NSS activities for appearing for the End Semester examination. A student shall not be permitted to appear for the Semester End Examinations (SEE) if his attendance is less than 75%.

5.2 Condonation of shortage of attendance in each subject up to 10% (65% and above and below75%) in each semester shall be granted by the College Academic Committee.

5.3 Shortage of Attendance below 65% in each subject shall not be condoned.

5.4 Students whose shortage of attendance is not condoned in any subject are not eligible to write their end semester examination of that subject and their registration shall stand cancelled.

5.5 A prescribed fee shall be payable towards condonation of shortage of attendance.

5.6 A Candidate shall put in a minimum required attendance at least three (3) theory courses in I Year I semester for promoting to I Year II Semester. In order to qualify for the award of the M.Tech. Degree, the candidate shall complete all the academic requirements of the courses, as per the course structure.

5.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present Semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission in to the same class.

6. 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.

6.1 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 (24 out of 60 marks) in the Semester End Examination;
- 40% of Marks in the internal examinations (16 out of 40 marks allotted for CIE); 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 this implies securing **'B'** Grade or above in a subject.

6.2 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, and all **68** credits securing Semester Grade Point Average **(SGPA)**

- **6.0** (in each semester) and final Cumulative Grade Point Average **(CGPA)** (i.e., CGPA at the end of PGP**)**
- **6.0**, and shall ***pass 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.

6.3 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.

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

6.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.1) he has to re appear for the Semester End Examination in that course.

6.6 A candidate shall be given one chance to re-register for the courses if the internal marks secured by a candidate is less than 50% and failed in that course for maximum of two courses and should register within four weeks of commencement of the class work. In such a case, the candidate must re-register for the courses and secure the required minimum attendance. The candidate's attendance in the re-registered course(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those courses. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.

6.7 In case the candidate secures less than the required attendance in any course, he shall not be permitted to write the Semester End Examination in that course. He shall re-register for the course when next offered.

6.8 Offering one open elective courses in III-Semester along with core and specialized courses as a part of inculcating knowledge to the student.

7. EVALUATION - DISTRIBUTION AND WEIGHTAGE OF MARKS

Continuous Internal Evaluation (CIE)

The performance of a student in each semester shall be evaluated subject- wise (irrespective of credits assigned) for a maximum of 100 marks.

7.1 The performance of a student in every subject/course (including practical's and Project) will be Evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination). 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.

7.1.1 **Continuous Internal Evaluation:**

In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each Mid-Term examination consists of two parts,

i) Part – A for 10 marks,

- ✓ Part - A: Objective/quiz paper for 10 marks. (The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks.)

ii) Part – B for 20 marks with a total duration of 2 hours as follows:

- ✓ Part - B : Descriptive paper for 20 marks (The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks.)

iii) The remaining 10 marks of Continuous Internal Evaluation are distributed as

a) Assignment for 5 marks (Average of 2 Assignments each for 5 marks)

b) Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks

7.1.2 While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shall be taken as the final marks for assignment (for 5 marks).

Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks before II Mid-Term Examination.

7.1.3 The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) in CIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

The details of the end semester question paper pattern are as follows:

Semester End Examination (SEE):

The Semester End Examinations (SEE), for theory subjects, will be conducted for 60 marks consisting of two parts viz. i) Part- A for 10 marks, ii) Part - B for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these Questions is from each unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.
- The duration of Semester End Examination is 3 hours.

7.2 For practical subjects there shall be a Continuous Internal Evaluation (CIE) during the semester for 40 marks and 60 marks for semester end examination. Out of the 40 marks for internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of aim, components/procedure, expected outcome) which shall be evaluated for 10 marks
2. 10 marks for viva-voce (or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for 10 marks.
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software /Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

7.3 The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the cluster / other colleges which will be decided by the examination branch of the institution.

In the Semester End Examination, held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course
5. 10 marks for viva-voce on concerned laboratory course.

The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) in CIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

For conducting laboratory end examinations of all PG Programmes, one internal examiner and one external examiner are to be appointed by the Chief Controller of Examination in one week before for commencement of the lab end examinations.

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

7.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6) he has to re appear for the Semester End Examination in that course.

8. RE-ADMISSION/RE-REGISTRATION

8.1 **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 5.1.

8.2 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 6.2.

8.3 ***A candidate shall be given only one-time chance to re-register and attend the classes for a maximum of two subjects in a semester***, if the internal marks secured by a candidate are less than 40% 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, in the next academic year 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.

9. EXAMINATIONS AND ASSESSMENT - THE GRADING SYSTEM

9.1 Marks will be awarded to indicate the performance of each student in each Theory Course, or Lab/ Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item6above, and a corresponding Letter Grade shall be given.

9.2 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 (≥ 90% , ≤ 100%)	O (Outstanding)	10
Below 90% but not less than 80% (≥ 80% , < 90%)	A^+ (Excellent)	9
Below 80% but not less than 70% (≥ 70% , < 80%)	A (Very Good)	8
Below 70% but not less than 60% (≥ 60% , < 70%)	B^+ (Good)	7
Below 60% but not less than 50% (≥ 50% , < 60%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	AB	0

9.3 A student obtaining F Grade in any Course shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Courses will remain the same as those he obtained earlier.

9.4 A student not appeared for examination then 'AB' Grade will be allocated in any Course shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered.

9.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.

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

9.7 A student earns Grade Point (GP) in each Course, on the basis of the Letter Grade obtained by him in that 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

9.8 The Student passes the Course only when he **gets GP>=6 (B Grade or above).**

9.9 A student earns Grade Point (GP) in each Course, on the basis of the Letter Grade obtained by him in that Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Course.

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

9.10 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP)secured from ALL 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 = $\{\sum_{i=1}^{N} C_i\ G_i\}$ / $\{\sum_{i=1}^{N} C_i\}$ …. For each Semester,

where 'i' is the Course indicator index (takes into account all Courses in a Semester), 'N' is the no. of Courses '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 ix Course, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that its Course.

Illustration of Computation of SGPA

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course1	3	A	8	3 x 8 = 24
Course2	3	B+	7	4 x 7 = 28
Course3	3	B	6	3 x 6 = 18
Course4	3	O	10	3 x10= 30
Course5	3	C	5	3 x 5 = 15
Course6	3	B	6	4 x 6 = 24

Thus, **SGPA =139/18 =7.72**

9.11 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 Second Semester onwards, at the end of each Semester, as per the formula

CGPA = { $\sum_{j=1}^{M} C_j G_j$ } / { $\sum_{j=1}^{M} C_j$ } … for all S Semesters registered

(i.e., up to and inclusive of S Semesters, S ≥ 2)

where 'M' is the TOTAL no. of Courses (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Course indicator index (takes into account all Courses from 1 to S Semesters), C_j is the no. of Credits allotted to the jth Course, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Course. 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.

For CGPA Computation

Semester 1	Semester 2	Semester 3	Semester 4
Credits : 18 SGPA : 7.72	Credits : 18 SGPA : 7.8	Credits : 12 SGPA : 5.6	Credits : 20 SGPA : 6.0

Thus, **CGPA =** $\dfrac{18 \times 7.72 + 18 \times 7.8 + 12 \times 5.6 + 20 \times 6.0}{68}$ = 6.86

9.12 For Calculations listed in Item 9.6 – 9.11, performance in failed Courses (securing F Grade) will also be taken into account, and the Credits of such Courses will also be included in the multiplications and summations.

9.13 No SGPA/CGPA is declared, if a candidate is failed in any one of the courses of a given semester.

9.14 Conversion formula for the conversion of GPA into indicative percentage is

% of marks scored = (final CGPA -0.50) x 10

10 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

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

10.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses, both theory and practical.

10.3 After satisfying 10.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.

10.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project 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.

10.5 A candidate shall submit his project status report in two stages at least with a gap of three months between them.

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

10.7 After approval from the PRC, the soft copy of the thesis should be submitted to the College for **ANTI-PLAGIARISM** for the quality check and the plagiarism report should be included in the final thesis. If the copied information is less than **30%**, then only thesis will be accepted for submission.

10.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College.

10.9 For **Dissertation work Review-I** in II Year I Sem. there is an internal marks of 100, the evaluation should be done by the PRC for 50 marks and Supervisor will evaluate for 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work and Literature Survey in the same domain. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Phase-I. If he fails to fulfill minimum marks, he has to reappear during the supplementary examination.

10.10 *For **Dissertation Work Review - II*** 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 - II. If he fails to obtain the required minimum marks, he has to reappear for Dissertation Work Review - II as and when conducted. For Dissertation Evaluation (Viva Voce) in II Year II Semester 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 (Viva-Voce) examination.

10.11 Dissertation Work Reviews - I and II 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 - II (Phase I). These students shall reappear for Dissertation Work Review - II in the next academic year at the time of Dissertation Work Review - II only after completion of Dissertation Work Review - I, and then Dissertation Work Review - II follows. The unsuccessful students in Dissertation Work Review - II (Phase II) shall reappear for Dissertation Work Review – II in the next academic year only at the time of Dissertation Work Review - II (Phase I).

10.12 If he fails to fulfill as specified in 10.10, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.

10.13 The thesis shall be adjudicated by one examiner selected by the Chief Controller of Examinations. For this, the HOD of the Department shall submit a panel of 3 examiners, eminent in that field, with the help of the guide concerned and Head of the Department.

10.14 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected.

10.15 If the report of the examiner is favorable, Project dissertation shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis.

10.16 The Head of the Department shall coordinate and make arrangements for the conduct of Project dissertation.

10.17 For mandatory non-credit 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. No marks or Letter Grade shall be allotted for these courses/activities. However, for non-credit courses '**SATISFACTORY'** or "**UNSATISFACTORY'** shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

11. AWARD OF DEGREE AND CLASS

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

11.2 **Award of Class**

After a student has satisfied 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	Grade to be Secured
First Class with Distinction	CGPA ≥ 7.75
First Class	6.75 to < 7.75 CGPA
Second Class	6.00 to < 6.75 CGPA

11.3 A student with final CGPA (at the end of the PGP) < 6.00 will not be eligible for the Award of Degree.

12. WITHOLDING OF RESULTS

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

13. TRANSITORY REGULATIONS

13.1 If any candidate is detained due to shortage of attendance in one or more courses, they are eligible for re-registration to maximum of two earlier or equivalent courses at a time as and when offered.

13.2 The candidate who fails in any course will be given two chances to pass the same course; otherwise, he has to identify an equivalent course as per HITS21 Academic Regulations.

14. SUPPLEMENTARY EXAMINATIONS

Supplementary examinations for the odd semester shall be conducted with the regular examinations of even semester and vice versa, for those who appeared and failed or absent in regular examinations. Such candidates writing supplementary examinations may have to write more than one examination.

15. REVALUATION

Students shall be permitted for revaluation after the declaration of end semester examination results within due dates by paying prescribed fee. After revaluation if there is any betterment in the grade, then improved grade will be considered. Otherwise old grade shall be retained.

16. AMENDMENTS TO REGULATIONS

The Academic Council of Holy Mary Institute of Technology & Science reserves the right to revise, amend, or change the regulations, scheme of examinations, and / or syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

17. GENERAL

17.1 **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.

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

17.3 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”.

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

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

Malpractices 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 course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the 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 courses of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is course to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is course to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
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 course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is course to the academic regulations in connection with forfeiture of seat.

8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses 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.	

COURSE STRUCTURE

M.Tech –Electrical Power Systems

I M.Tech I Semester									
Course Code	Course Title	Category	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
B2PS101PC	Advanced Power System Analysis	PC	3	-	-	3	40	60	100
B2PS102PC	Economic Operation of Power Systems	PC	3	-	-	3	40	60	100
	Programme Elective-I	PE	3	-	-	3	40	60	100
	Programme Elective-II	PE	3	-	-	3	40	60	100
B2PS101PC	Research methodology and IPR (Mandatory course)	PC	2	-	-	2	40	60	100
B2PS104PC	Power Systems Computation Lab-I	PC	-	-	4	2	40	60	100
B2PS105PC	Advanced Power Systems Lab	PC	-	-	4	2	40	60	100
TOTAL			**14**	**-**	8	**18**	**280**	**420**	**700**
Audit Course (Non-Credit)									
	Audit Course - I	AC	2	-	-	-	100	-	100

I M.Tech II Semester									
Course Code	Course Title	Category	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
B2PS206PC	Digital Protection of Power System	PC	3	-	-	3	40	60	100
B2PS207PC	Power System Dynamics	PC	3	-	-	3	40	60	100
	Programme Elective -III	PE	3	-	-	3	40	60	100
	Programme Elective -IV	PE	3	-	-	3	40	60	100
B2PS208PC	Mini project with seminar	PC	-	-	4	2	100	-	100
B2PS209PC	Power Systems Computation Lab-II	PC	-	-	4	2	40	60	100
B2PS210PC	Power System Protection Lab	PC	-	-	4	2	40	60	100
TOTAL			**12**	**-**	**12**	**18**	**340**	**360**	**700**
Audit Course (Non-Credit)									
	Audit Course - II	AC	2	-	-	-	100	-	100

II M.Tech I Semester									
Course Code	Course Title	Category	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
	Programme Elective-V	PE	3	-	-	3	40	60	100
	Open Elective	OE	3	-	-	3	40	60	100
B2PS301PW	Dissertation work review- I	PWC	-	-	12	6	100	-	100
TOTAL			**6**	**-**	**12**	**12**	**180**	**120**	**300**

II M.Tech II Semester									
Course Code	Course Title	Category	Hours per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal (CIE)	External (SEE)	Total
B2PS401PW	Dissertationwork review -II	PWC	-	-	12	6	100	-	100
B2PS402PW	Dissertation viva voce	PWC	-	-	28	14	-	100	100
TOTAL			**-**	**-**	**40**	**20**	**100**	**100**	**200**

Total Credits = 68

PROGRAMME ELECTIVES			
PE- I		**PE – II**	
B2PS101PE	Advanced power electronic converters	B2PS105PE	HVDC Transmission
B2PS102PE	Renewable energy Technologies	B2PS106PE	Electrical power distribution system
B2PS103PE	Smart grid Technologies	B2PS107PE	Reactive Power Compensation and Management
B2PS104PE	Modern Control Theory	B2PS108PE	Electric Vehicles and design
PE - III		**PE – IV**	
B2PS209PE	Restructured Power Systems	B2PS213PE	AI techniques in Power Systems
B2PS210PE	Power quality improvement techniques	B2PS214PE	Electric vehicle charging techniques
B2PS211PE	EHV AC Transmission	B2PS215PE	Power System Reliability and Planning
B2PS212PE	Swarm intelligence techniques in power systems	B2PS216PE	Industrial load modelling and control
PE – V			
B2PS317PE	Power System Transients		
B2PS318PE	FACTS and custom power devices		
B2PS319PE	Gas insulated systems		
B2PS320PE	SCADA System and Applications		

OPEN ELECTIVES	
B2PS301OE	Business analytics (offered by CSE department)
B2PS302OE	Industrial safety (offered by chemical engineering department)
B2PS303OE	Operations Research (offered by mechanical engineering department)
B2PS304OE	Cost Management of Engineering Projects (offered by civill engineering department)
B2PS305OE	Composite materials (offered by metallurgical engineering department)
B2PS306OE	Photovoltaic systems (offered by EEE department)

AUDIT COURSE-I		AUDIT COURSE-II	
B2PS101AC	English for Research Paper Writing	B2PS205AC	Constitution of india
B2PS102AC	Disaster Management	B2PS206AC	Pedagogy studies
B2PS103AC	Sanskrit for tehnical knowledge	B2PS207AC	Stress management by yoga
B2PS104AC	Value Education	B2PS208AC	Personality development through life enlightenment skills

DETAILED SYLLABUS

I-YEAR (I-SEMESTER)

ADVANCED POWER SYSTEM ANALYSIS

I M. Tech – I Semester **L T P C**
Course Code: B2PS101PC **3 0 0 3**

Prerequisite: Computer Methods in Power Systems

COURSE OBJECTIVES:

1. To build the Nodal admittance and Nodal impedance matrices of a practical network.
2. To study various methods of load flow and their advantages and disadvantages.
3. To understand how to analyze various types of faults in power system.
4. To understand power system security concepts and study the methods to rank the contingencies.
5. To understand need of state estimation and study simple algorithms for state estimation.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Build/construct YBUS and ZBUS of any practical network.
2. Calculate voltage phasors at all buses, given the data using various methods of load flow.
3. Calculate fault currents in each phase.
4. Rank various contingencies according to their severity.
5. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc.

UNIT I NETWORK MATRICES

Introduction, Bus Admittance Matrix, Network Solution, Network Reduction (Kron Reduction), YBUS structure and manipulation, Bus Impedance matrix, Methods to determine columns of ZBUS.

UNIT II LOAD FLOW STUDIES

Overview of Gauss-Seidel, Newton-Raphson, Fast decoupled load flow methods, Convergence properties, Sparsity techniques, Handling Qmax 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 ZBUS, Equivalent circuits, Selection of circuit breakers**,** 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, Observability concepts, tracking state Estimation, Weighted Least Square method, Bad Data detection and estimation.

TEXTBOOKS:

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.

WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119546924.refs
2. http://onlinelibrary.wiley.com/doi/10.1002/9780470411377.refs/pdf
3. https://onlinecourses.nptel.ac.in/noc19_ee62/preview

E-TEXT BOOKS:

1. https://www.amazon.in/Analysis-McGraw-Hill-Electrical-Computer-Engineering/dp/0070612935
2. https://www.amazon.in/Power-System-Analysis-N-Ramana-ebook/dp/B00LOBI8G2
3. https://onlinelibrary.wiley.com/doi/book/10.1002/0471722901

MOOCS COURSES:

1. https://www.openlearning.com/courses/power-system-analysis
2. https://www.coursera.org/learn/electric-power-systems
3. https://www.classcentral.com/course/swayam-power-system-analysis-14243

ECONOMIC OPERATION OF POWER SYSTEMS

I M. Tech – I Semester **L T P C**
Course Code: B2PS102PC **3 0 0 3**

Prerequisite: Electrical Power Systems

COURSE OBJECTIVES:

1. To formulate and derive the necessary conditions for economical load scheduling problem.
2. To understand various constraints, problem formulation and methods to solve the unit commitment problem.
3. To understand the constraints related to hydel power plants, problem formulation and solution techniques for hydro-thermal scheduling problem.
4. To understand the necessity, factors governing the frequency control and analyze the uncontrolled and controlled LFC system.
5. To understand the basic difference between ELS and OPF problem, formulation of the OPF problem and solution techniques.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Solve the economic load scheduling with and without network losses both in classical method and iterative methods.
2. Solve the unit commitment problem using priority-list method and forward-dynamic method.
3. Solve hydro-thermal scheduling problem for short-term and long-term range.
4. Analyze the single area and two area systems for frequency deviation under sudden change in load.
5. Solve the OPF problem using AC and DC load flow methods.

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 considered.

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) and its 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.

TEXTBOOKS:

1. J.J. Grainger & W.D.Stevenson, “Power system analysis”, McGraw Hill, 2003.
2. Allen J. Wood,Bruce F.Wollenberg, Gerald B. Sheblé, “Power Generation Operation and Control” Wiley-Interscience, 2013.

REFERENCES:

1. Olle l. Elgerd, “Electric Energy Systems Theory an Introduction”, TMH, 2nd Edition, 1983.

WEB REFERENCES:

1. https://link.springer.com/chapter/10.1007/978-1-4615-1465-7_2
2. https://www.researchgate.net/publication/282901269_economic_dispatch_in_power_systems
3. https://www.researchgate.net/publication/322256055_economic_operation_of_power_system_in_India

E-TEXT BOOKS:

1. https://www.routledge.com/Power-System-Economic-and-Market-Operations/Zhong/p/book/9781482299045
2. https://www.amazon.in/Economic-Operations-System-Nagendra-Swarnkar/dp/9382247041
3. https://www.amazon.in/Power-System-Operation-Robert-Miller/dp/0070671125

MOOCS COURSES:

1. https://www.mooc-list.com/course/electric-power-systems-coursera
2. https://www.classcentral.com/course/electric-power-systems-12053
3. https://www.coursera.org/learn/electric-power-systems

ADVANCED POWER ELECTRONIC CONVERTERS
(Professional Elective-I.1)

I M. Tech – I Semester **L T P C**
Course Code: B2PS101PE **3 0 0 3**

Prerequisite: Power Electronics, Power Electronic Converters

COURSE OBJECTIVES:
1. To understand various advanced power electronics devices.
2. To describe the operation of multi-level inverters with switching strategies for high power applications.
3. To comprehend the design of resonant converters and switched mode power supplies.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Develop and analyze various converter topologies.
2. Design AC or DC switched mode power supplies.

UNIT I MODERN POWER SEMICONDUCTOR DEVICES
Modern power semiconductor devices – Insulated Gate Bipolar Transistor (IGBT) –MOSFET-MOS Turn off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate-Commutated Thyristor (IGCTs) – MOS controlled thyristors (MCTs)– Power integrated circuits (PICs) – symbol, structure and equivalent circuit – comparison of their features.

UNIT II RESONANT PULSE INVERTERS
Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches – analysis of half bridge resonant inverter – evaluation of currents and voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters – class E resonant inverter – class E resonant rectifier – evaluation of values of *C*'s and *L's* for class E inverter and Class E rectifier – numerical problems.

UNIT III RESONANT CONVERTERS
Resonant converters – zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant converters – Two quadrant ZVS resonant converters – resonant dc-link inverters – evaluation of L and C for a zero current switching inverter – Numerical problems.

UNIT IV MULTILEVEL INVERTERS
Multilevel concept – Classification of multilevel inverters – Diode clamped Multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of operation – Flying capacitors multilevel inverter-principle of operation – main features – cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives - Switching device currents – dc link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters.

UNIT V D.C & A.C POWER SUPPLIES
DC power supplies – classification - switched mode dc power supplies – fly back Converter – forward converter –push-pull converter – half bridge converter – Full bridge converter – Resonant d c power supplies – bidirectional power supplies – Applications.
AC power supplies – classification – switched mode ac power supplies – Resonant AC power supplies – bidirectional ac power supplies – multistage conversions – control circuits – applications. Introduction – power line disturbances – power conditioners – Uninterruptible Power supplies – applications.

TEXTBOOKS

1. Mohammed H. Rashid – "Power Electronics"– Pearson Education-Third Edition – first Indian reprint -2004.
2. Ned Mohan, Tore M. Undeland and William P. Robbins- "Power Electronics"– John Wiley & Sons – Second Edition.

REFERENCES

1. Milliman Shepherd and Lizang – "Power converters circuits" – Chapter 14 (Matrix converter) PP- 415-444,
2. M.H.Rashid - Power electronics hand book –
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition:" Control in power electronics"illustrated Published by Academic Press, 2002.

NPTEL COURSE:

1. NPTEL online course, "Pulse width Modulation for Power Electronic Converters" Dr., G. Narayanan, https://www.youtube.com/playlist?list=PLbMVogVj5nJQoZqyLxx-cg_dYE-Dt2UMH

WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9783527698523
2. https://ieeexplore.ieee.org/document/7497622
3. https://www.wiley.com/enar/Power+Electronic+Converters:+Dynamics+and+Control+in+Conventional+and+Renewable+Energy+Applications-p-9783527340224

E -TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9783527698523
2. https://www.mdpi.com/2079-9292/9/4/654/htm

MOOCS COURSE:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/

RENEWABLE ENERGY TECHNOLOGIES
(Professional Elective-I.2)

I M. Tech – I Semester **L T P C**
Course Code: B2PS102PE **3 0 0 3**

Prerequisite: Power Systems and Electrical Machines

COURSE OBJECTIVES
1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources
3. To understand Power Electronics Interface with the Grid.

COURSE OUTCOMES
After completion of the course, students will be able to:
1. Gain knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid connected modes

UNIT I SOLAR ENERGY SYSTEMS
Introduction to 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 AND FUEL CELLS
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.

TEXTBOOKS
1. D.P.Kothari, K.C.Singal, R.Ranjan, "Renewable Energy Resources and emerging technologies", PHI 2nd Edition, 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. Rakosh das Begamudre, "Energy conversion systems", New Age International publishers, New Delhi, 2000.
5. John Twidell and Tony Weir, "Renewable Energy Resources", 2nd Edition, Fspon & Co.

REFERENCES:

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

WEB REFERENCES:

1. https://www.nrdc.org/stories/renewable-energy-clean-facts
2. https://www.eia.gov/energyexplained/renewable-sources/
3. https://www.tandfonline.com/doi/full/10.1080/23311916.2016.1167990

E-TEXT BOOKS:

1. https://www.amazon.in/Textbook-Renewable-Energy-Bhatia-Gupta/dp/8193644603
2. https://www.amazon.in/Renewable-Energy-Resources-John-Twidell/dp/0415584388

MOOCS COURSES:

1. https://www.coursera.org/courses?query=renewable%20energyV
2. https://www.edx.org/learn/renewable-energy
3. https://www.classcentral.com/subject/renewable-energy

SMART GRID TECHNOLOGIES
(Professional Elective-I.3)

I M. Tech – I Semester **L T P C**
Course Code: B2PS103PE **3 0 0 3**

Prerequisite: Power Systems

COURSE OBJECTIVES:
1. To understand concept of smart grid and its advantages over conventional grid.
2. To know smart metering techniques.
3. To learn wide area measurement techniques.
4. To understand the problems associated with integration of distributed generation & its solution through smart grid.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Appreciate the difference between smart grid & conventional grid.
2. Apply smart metering concepts to industrial and commercial installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Come up with smart grid solutions using modern communication technologies.

UNIT-I INTRODUCTION
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 METERING, PHEV-HOME AND SUBSTATION AUTOMATION
Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

UNIT III MONITORING, PROTECTION AND STORAGE SYSTEMS IN SMART GRID
Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT IV MICROGRID AND ITS INTERCONNECTING SYSTEMS
Concept of micro-grid, Need& applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, Fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT V POWER QUALITY IN SMART GRID
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. Advanced Metering Infrastructure (AMI) and Various Communication means and IP based Protocols.

TEXTBOOKS:
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. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid: Technology and Applications”, Wiley, 2012.
2. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions”, CRC Press.
3. A.G.Phadke, “Synchronized Phasor Measurement and their Applications”, Springer.

WEB REFERENCES:

1. https://policyreview.info/concepts/smart-technologies
2. https://dl.acm.org/doi/10.1145/2078316.2078321
3. https://www.igi-global.com/dictionary/smart-interactive-game-based-system-for-preschools-in-tanzania/38186

E-TEXT BOOKS:

1. https://www.springer.com/gp/book/9789811371387
2. https://www.worldscientific.com/worldscibooks/10.1142/4832
3. https://www.collins.in/product/collins-smart-tech/

MOOCS COURSES:

1. https://www.mooc-list.com/tags/smart-technologies
2. https://www.my-mooc.com/en/mooc/smart-device-mobile-emerging-technologies/
3. http://www.scitepress.org/Papers/2018/68097/68097.pdf

MODERN CONTROL THEORY
(Professional Elective-I.4)

I M. Tech – I Semester **L T P C**
Course Code: B2PS104PE **3 0 0 3**

Prerequisite: Control Systems

COURSE OBJECTIVES:
1. To explain the concepts of basics and modern control system for the real time analysis and design of control systems.
2. To explain the concepts of state variables analysis.
3. To study and analyze nonlinear systems.
4. To analyze the concept of stability for nonlinear systems and their categorization.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Know various terms of basic and modern control system for the real time analysis and design of control systems.
2. Perform state variables analysis for any real time system.
3. Examine a system for its stability, controllability and observability.
4. Implement basic principles and techniques in designing linear control systems.
5. Apply knowledge of control theory for practical implementations in engineering and network analysis.

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-Time Invariant Systems, General concept of Observability, Observability tests for Continuous-Time Invariant Systems, Observability of different State transformation forms.

UNIT III STATE FEEDBACK CONTROLLERS AND OBSERVERS
State feedback controller design through Pole Assignment, using Ackkermans formula. State observers: Full order and Reduced order observers.

UNIT IV NON-LINEAR SYSTEMS
Introduction to Non-Linear Systems, Types of Non-Linearities, Saturation, Dead-Zone, Backlash, Jump Phenomenon etc., Linearization of nonlinear systems, Singular Points and its types, describing function, 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 V STABILITY ANALYSIS
Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems, Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method, Generation of Lyapunov functions, Variable gradient method, Krasooviski's method.

TEXTBOOKS:

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, 1stEdition.

WEB REFERENCES:

1. https://www.sciencedirect.com/topics/engineering/modern-control-theory
2. https://en.wikipedia.org/wiki/Control_theory
3. https://link.springer.com/chapter/10.1007/978-1-4615-0553-2_2

E-TEXT BOOKS:

1. https://www.amazon.in/Modern-Control-Theory-William-Brogan/dp/8131761673
2. https://www.amazon.in/Modern-Control-Theory-K-R-Verma-ebook/dp/B07FCBZ1NV
3. https://www.quora.com/Which-is-the-best-book-for-modern-control-theory

MOOCS COURSES:

1. https://www.quora.com/What-course-do-you-take-to-learn-control-theory
2. https://www.ou.edu/dreamcourse/past-courses/spring-2017/control-theory-and-apps
3. https://www.mooc-list.com/tags/modern-control

HVDC TRANSMISSION
(Professional Elective-II.1)

I M. Tech – I Semester **L T P C**
Course Code: B2PS105PE **3 0 0 3**

Prerequisite: Power Systems and Power Electronics

COURSE OBJECTIVES:
1) To understand the state-of-the-art HVDC technology.
2) To learn the methods to carry out modelling and analysis of HVDC system frontier-area power flow regulation.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Expose to the basics of HVDC technology.
2. Gain Knowledge of modelling and analysis of HVDC system for inter-area power flow regulation.
3. Analyze the converter and dc grid faults and methods to mitigate them.
4. Understand the HVDC converter reactive power requirements and identifying the necessary means to address those issues.

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 for HVDC 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 & AC-DC POWER FLOW ANALYSIS
Smoothing reactor and DC Lines, Reactive power requirements, Harmonic analysis, Filter design. Power flow Analysis in AC/DC systems, Modelling of DC links, Solutions of AC-DC Power flow.

TEXTBOOKS:
1. J. Arrillaga, “High Voltage Direct Transmission”, Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, “HVDC Power Transmission Systems”, Wiley Eastern Ltd., 1990.

REFERENCES:
1. E. W. Kimbark, “Direct Current Transmission”, Vol. I, Wiley Interscience, 1971.
2. Erich Uhlmann, “Power Transmission by Direct Current”, B.S. Publications, 2004.
3. SN.Singh, “Electric Power Generation, Transmission and Distribution, PHI, New Delhi, 2nd Edition, 2008.
4. V. Kamaraju, “HVDC Transmission”, Tata McGraw-Hill Education Pvt Ltd, New Delhi, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/104/108104013/
2. http://large.stanford.edu/courses/2010/ph240/hamerly1/docs/energyweek00.pdf
3. https://en.wikipedia.org/wiki/High-voltage_direct_current

E-TEXT BOOKS:

1. https://easyengineering.net/hvdc-power-transmission-systems-by-padiyar/
2. https://www.amazon.in/HVDC-Transmission-S-Kamakshaiah/dp/0071072535
3. https://www.amazon.in/HVDC-Power-Transmission-Systems-Padiyar/dp/1781831076

MOOCS COURSES:

1. https://www.coursebuffet.com/sub/electrical-engineering/488/high-voltage-dc-transmission
2. https://www.edx.org/course/multilevel-converters-for-mediumhigh-power-applica
3. https://www.flipkart.com/hvdc-transmission-b-tech-iv-year-ii-sem-eee-r15-mooc-3-jntu-anantapur-latest-2020/p/itma99e194323a61

ELECTRICAL POWER DISTRIBUTION SYSTEM
(Professional Elective-II.2)

I M. Tech – I Semester **L T P C**
Course Code: B2PS106PE **3 0 0 3**

Prerequisite: Power Systems

COURSE OBJECTIVES:
1. To learn about power distribution system
2. To learn of SCADA system
3. To understand distribution automation

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Gain knowledge of power distribution system
2. Study the distribution automation and its application in practice
3. Learn SCADA system

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

UNIT II DISTRIBUTION MANAGEMENT SYSTEM AND AUTOMATION
Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction.

UNIT III DISTRIBUTION SYSTEM CONTROL AND SCADA
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 OPTIMAL PLACEMENT OF SWITHING DEVICES AND CAPACITORS
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 MAINTANANCE OF AUTOMATED DISSTRIBUTION SYSTEM
Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution, Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

TEXTBOOKS:
1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., 4th Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical Power Distribution Automation", University Science Press, New Delhi.

REFERENCES:
1. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press.
2. James Momoh, "Electric Power Distribution automation protection & control", CRC Press.

WEB REFERENCES:
1. https://www.eolss.net/sample-chapters/c05/E6-39A-06-01.pdf
2. https://en.wikipedia.org/wiki/Electric_power_distribution
3. http://onlinelibrary.wiley.com/doi/10.1002/9781118950289.refs/pdf

E-TEXT BOOKS:

1. https://www.amazon.in/ELECTRICAL-POWER-DISTRIBUTION-SYSTEM-KAMARAJU/dp/B01GYR5EMG
2. https://www.amazon.in/Electric-Power-Distribution-7th-Pabla/dp/9389538394
3. https://www.routledge.com/Electric-Power-Distribution-Engineering/Gonen/p/book/9781482207002

MOOCS COURSES:

1. https://www.classcentral.com/course/swayam-electrical-distribution-system-analysis-14029
2. https://www.mooc-list.com/course/electric-power-systems-coursera
3. https://www.coursera.org/learn/electric-power-systems

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REACTIVE POWER COMPENSATION AND MANAGEMENT
(Professional Elective-II.3)

I M. Tech – I Semester **L T P C**
Course Code: B2PS107PE **3 0 0 3**

Prerequisite: Power Systems

COURSE OBJECTIVES:
1. To identify the necessity of reactive power compensation
2. To describe load compensation
3. To select various types of reactive power compensation in transmission systems
4. To illustrate reactive power coordination system
5. To characterize distribution side and utility side reactive power management.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads
2. Work out on various compensation methods in transmission lines
3. Construct models for reactive power coordination
4. Distinguish demand side reactive power management & user side reactive power management

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 REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS
Uncompensated line, Types of compensation, Passive shunt and series and dynamic shunt compensation, Examples.

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS
Characteristic time periods, Passive shunt compensation, Static compensation, Series capacitor compensation, Compensation using synchronous condenser, Examples.

UNIT III REACTIVE POWER COORDINATION
Objective, Mathematical modeling, Operation planning, Transmission benefits, Basic concepts of quality of power supply, Disturbances, Steady–state variations, Effect of under-voltages, Frequency, Harmonics, Radio frequency and electromagnetic interference.

UNIT IV DEMAND SIDE MANAGEMENT
Load patterns, Basic methods load shaping, Power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT
System losses, Loss reduction methods, Examples, Reactive power planning, Objectives, 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 operation, Furnaces transformer, Filter requirements, Remedial measures, Power factor of an arc furnace.

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

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, “Reactive Power Compensation: A Practical Guide”, Wiley Publication, April2012.

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WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119967286
2. https://www.slideshare.net/NaveenKssvs/reactive-power-compensation-33009860
3. https://www.accessscience.com/content/reactive-power-compensation-technologies/YB084380

E-TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119967286
2. https://www.amazon.in/Reactive-Compensation-Hidaia-Mahmood-Alassouli-ebook/dp/B0798H9Y6J
3. https://www.amazon.in/Reactive-Power-Compensation-Practical-Guide/dp/0470977183

MOOCS COURSES:

1. https://www.iare.ac.in/?q=courses/mtech-electrical-power-systems/reactive-power-compensation-and-management
2. https://www.iare.ac.in/?q=pages/mtech-course-descriptions-r18-0
3. https://www.inspirenignite.com/jntuh/jntuh-m-tech-2017-2018-r17-detailed-syllabus-reactive-power-compensation-and-management-2/

ELECTRIC VEHICLES AND DESIGN
(Professional Elective-II.4)

I M. Tech – I Semester **L T P C**
Course Code: B2PS108PE **3 0 0 3**

Prerequisite: Power Semiconductor Drives, Electrical Drives and Control, Utilization of Electric Energy

COURSE OBJECTIVES:
1. To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To know the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used energy storage devices, etc.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Understand the different strategies related to energy storage systems.

UNIT I INTRODUCTION
Conventional Vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance.

UNIT II INTRODUCTION TO HYBRID ELECTRIC VEHICLES
History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies.
Hybrid Electric Drive-Trains: 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 ELECTRIC TRAINS
Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis.
Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency.

UNIT IV ENERGY STORAGE
Energy Storage: Introduction to Energy Storage, Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.
Sizing the drive system: 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 STRATEGIES
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energy management strategies.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TEXTBOOKS:
1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

REFERENCES:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

WEB REFERENCES:

1. https://www.nap.edu/read/12826/chapter/8
2. https://www.hindawi.com/journals/ijvt/2011/571683/
3. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118970553

E-TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118970553
2. https://www.intechopen.com/books/hybrid-electric-vehicles
3. https://www.amazon.in/Electric-Hybrid-Vehicles-Tom-Denton/dp/1138842370

MOOCS COURSES:

1. https://onlinecourses.nptel.ac.in/noc20_ee18/preview
2. https://www.classcentral.com/tag/electric-cars

RESEARCH METHODOLOGY & IPR

I M. Tech – I Semester **L T P C**
Course Code: B2PS101MC **2 0 0 2**

Prerequisite: None

COURSE OBJECTIVES:

1. To understand the research problem
2. To know the literature studies, plagiarism and ethics
3. To get the knowledge about technical writing
4. To analyze the nature of intellectual property rights and new developments
5. To know about the patent rights

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept and creativity.
5. Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. 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.

UNIT I SELECTION OF RESEARCH PROBLEM AND APPROACHES OF INVESTIGATION

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

UNIT II LITERATURE SURVEY PLAGIARISM AND RESEARCH ETHICS

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

UNIT III EFFECTIVE TECHNICAL WRITING

How to write a report, paper in developing a research proposal, Format of research proposal, presentation and assessment by a review committee.

UNIT IV INTELLECTUAL PROPERTY AND PATENTING

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 grant of patents, Patenting under PCT.

UNIT V PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR

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

TEXTBOOKS:

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.

POWER SYSTEMS COMPUTATION LAB-I

I M. Tech – I Semester **L T P C**
Course Code: B2PS104PC **0 0 4 2**

Prerequisite: Power systems

COURSE OBJECTIVES:

1. To construct Y-bus, Z-bus for a n-bus system.
2. To analyze various Load flow studies.
3. To know steady state, transient stability analysis.
4. To understand economic load dispatch problem.
5. To understand unit commitment problem.
6. To understand state estimation of power system.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Construct Y-bus and Z-bus
2. Compare the different load flow methods
3. Analyze the different stability analysis of variety of power systems
4. Understand Economic load dispatch and Unit commitment problems.
5. Understand State estimation of power system.

LIST OF EXPERIMENTS:

1. Develop Program for YBUS formation by direct inspection method.
2. Develop Program for YBUS 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 ZBUS Building Algorithm.
8. Develop Program for Short Circuit Analysis using ZBUS 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.

Note: From the above list, minimum of 10 experiments are to be conducted using suitable software

TEXT BOOK:

1. https://jntuhcej.ac.in/web/syllabus/30_R19M.Tech_ELECTRICALPOWERSYSTEMSSyllabus.pdf
2. https://www.silicon.ac.in/M.%20Tech_EEE-Syllabus-Autonomy.pdf
3. https://www.bitswgl.ac.in/ece/B.Tech%20Lab%20manuals/Electrical-Power-systems-Lab-manual-3-2.pdf
4. http://www.gvpce.ac.in/7%20M.TECH-PSCA-19-10-2011-FINAL.pdf

REFERENCE BOOKS:

1. https://www.researchgate.net/publication/306094450_power_system_lab_manual
2. http://www.eee.griet.ac.in/document/labmanuals/IV-I%20PSS%20Lab%20Manual.pdf
3. https://www.bitswgl.ac.in/ece/B.Tech%20Lab%20manuals/Electrical-Power-systems-Lab-manual-3-2.pdf
4. https://jntuhcej.ac.in/web/syllabus/30_R19M.Tech_ELECTRICALPOWERSYSTEMSSyllabus.pdf

ADVANCED POWER SYSTEMS LAB

I M. Tech – I Semester **L T P C**
Course Code: B2PS105PC **0 0 4 2**

Prerequisite: Power systems and FACTS

COURSE OBJECTIVES:

1. To determine transmission line parameters
2. To determine transmission line regulation and efficiency
3. To determine various fault calculations
4. To perform load and line compensation

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Calculate transmission line parameters
2. Calculate transmission line regulation and efficiency
3. Calculate various fault parameters
4. Compare system parameters with and without compensation

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 ABCD parameters of a given Transmission Line Network.
5. Fault Analysis:
   i. Single Line to Ground fault (L-G).
   ii. Line to Line fault (L-L).
   iii. Double Line to Ground fault (L-L-G).
   iv. 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.

Note: From the above list, minimum of 10 experiments are to be conducted.

TEXT BOOKS:

1. https://www.silicon.ac.in/M.%20Tech_EEE-Syllabus-Autonomy.pdf
2. https://makautwb.ac.in/syllabus/MTech_EE_Power_Common_Syllabus_10.04.14_2.pdf
3. http://www.gvpce.ac.in/7%20M.TECH-PSCA-19-10-2011-FINAL.pdf
4. https://avanthienggcollege.ac.in/syllabus/PS.pdf

REFERENCE BOOKS:

1. https://www.researchgate.net/publication/271461897_Advanced_power_system_laboratory
2. https://www.mtu.edu/research/about/centers-institutes/apsrc/
3. https://www.mtu.edu/mechanical/research/thrusts/aps/
4. https://www.mtu.edu/research/about/centers-institutes/apsrc/

ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course I .1)

I M. Tech – I Semester **L T P C**
Course Code: B2PS101AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first- time submission

COURSE OUTCOMES:
1. Students should be familiar with representative literary and cultural texts within a significant number of historical, geographical, and cultural contexts.
2. Students should be able to apply critical and theoretical approaches to the reading and analysis of literary and cultural texts in multiple genres.

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

UNIT V
Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills 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:
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

REFERENCES BOOKS:
1. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
2. Adrian Wallwork, English for Writing Research Papers, Springer New York DordrechtHeidelber London, 2011

DISASTER MANAGEMENT
(Audit Course I .2)

I M. Tech – I Semester **L T P C**
Course Code: B2PS102AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. To evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. To understand the strengths and weaknesses of disaster management approaches,
5. To plan and program in different countries, particularly their home country or the countries they work.

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

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 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 IV 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 V 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 VI 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.

TEXTBOOKS/ REFERENCES:
1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.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.

SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course I .3)

I M. Tech – I Semester **L T P C**
Course Code: B2PS103AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To learn of Sanskrit to improve brain functioning
3. To Learn of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
4. To equip engineering scholars with Sanskrit will be able to explore the huge knowledge from ancient literature

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Understand basic Sanskrit language
2. Know ancient Sanskrit literature about science & technology can be understood
3. Get 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

TEXTBOOKS/ REFERENCES:
1. “Abhyaspustakam”, Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

VALUE EDUCATION
(Audit Course I .4)

I M. Tech – I Semester **L T P C**
Course Code: B2PS104AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To understand value of education and self- development.
2. To imbibe good values in students.
3. To know about the importance of character.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Get Knowledge of self-development.
2. Learn the importance of Human values.
3. Develop 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 -Avoid fault Thinking. Free from anger, Dignity of labor- 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 IV CHARACTER AND COMPETENCE
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

TEXTBOOKS/ REFERENCES:
1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

I-YEAR (II-SEMESTER)

DIGITAL PROTECTION OF POWER SYSTEM

I M. Tech – II Semester **L T P C**
Course Code: B2PS206PC **3 0 0 3**

Prerequisite: Power System Protection

COURSE OBJECTIVES:

1. To study numerical relays.
2. To develop mathematical approach towards protection.
3. To study algorithms for numerical protection.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Learn the importance of Digital Relays.
2. Apply Mathematical approach towards protection.
3. Develop various Protection algorithms.

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, and 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, and Flux-restrained current differential relay.
Digital Line differential protection: Current-based differential schemes, Composite voltage- and current based scheme.

TEXTBOOKS:

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.

WEB REFERENCES:

1. https://www.ee.iitb.ac.in/web/academics/courses/EE651
2. http://www.rose.pwr.wroc.pl/PC_DER/An%20Introduction%20to%20the%20Digital%20Protection%20of%20Power%20Systems.pdf
3. https://www.researchgate.net/publication/316561483_Digital_Protection

E-TEXT BOOKS:

1. https://www.amazon.in/Digital-Power-System-Protection-Bhide/dp/8120349792
2. https://www.kopykitab.com/Digital-Power-System-Protection-by-Bhide-S-R
3. https://digital-library.theiet.org/content/books/po/pbpo015e

MOOCS COURSES:

1. https://www.classcentral.com/course/swayam-power-system-protection-19974
2. https://onlinecourses.nptel.ac.in/noc20_ee80/preview

POWER SYSTEM DYNAMICS

I M. Tech – II Semester **L T P C**
Course Code: B2PS207PC **3 0 0 3**

Prerequisite: Power Systems and Electrical Machines

COURSE OBJECTIVES:

1. To develop mathematical models for synchronous machine, Exciter, Governor and Prime mover.
2. To study power system dynamic phenomena and the effects of exciter and governor control.
3. To improve dynamic stability of a system.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Understand the modelling of synchronous machine in details
2. Understand the modelling of Exciter and Governor control
3. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
4. Carry out stability analysis with and without power system stabilizer

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 Multimachine System, Shortcomings of the Classical Model, Block Diagram of One Machine.

System Response to Small Disturbances: Types of Problems Studied the Unregulated Synchronous Machine, Modes of Oscillation of an Unregulated Multimachine 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 buildup, 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-signal stability problems.

TEXTBOOKS:

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.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc21_ee16/preview
2. https://ieeexplore.ieee.org/book/8006404
3. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118516072

E-TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118516072
2. https://www.amazon.in/Power-System-Dynamics-Stability-Control-ebook/dp/B005UQLKIU
3. https://www.phindia.com/Books/BookDetail/9788120335257/power-system-dynamics-ramanujam

MOOCS COURSES:

1. https://www.classcentral.com/course/swayam-power-system-dynamics-control-and-monitoring-12955
2. https://www.classcentral.com/tag/power-systems
3. https://www.coursera.org/learn/electric-power-systems
4. https://www.mooc-list.com/tags/system-dynamics

RESTRUCTURED POWER SYSTEMS
(Professional Elective-III.1)

I M. Tech – II Semester **L T P C**
Course Code: B2PS209PE **3 0 0 3**

Prerequisite: Power Systems and Electrical Machines

COURSE OBJECTIVES:
1. To understand what is meant by restructuring of the electricity market
2. To understand the need behind requirement for deregulation of the electricity market
3. To understand the money, power & information flow in a deregulated power system

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and summarize the role of various entities in the market.

UNIT I INTRODUCTION
Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization.

UNIT II OPF AND CONGESTION MANAGEMENT
OPF: Role in vertically integrated systems and in restructured markets, Congestion management.

UNIT III OPTIMAL BIDDING
Optimal bidding- Risk assessment, Hedging, Transmission pricing, Tracing of power.

UNIT IV DISTRIBUTED GENERATION IN RESTRUCTURED MARKETS
Ancillary services, Standard market design, Distributed generation in restructured markets.

UNIT V RESTRUCTURED SYSTEM DEVELOPMENTS IN INDIA
Developments in India, IT applications in restructured markets, working of restructured power systems**,** PJM, Recent trends in Restructuring.

TEXTBOOKS:
1. Lorrin Philipson, 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.

WEB REFERENCES:
1. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470608555
2. https://nptel.ac.in/courses/108/101/108101005/

E-TEXT BOOKS:
1. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470608555
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118558300
3. https://www.amazon.in/Restructuring-Electric-Power-Systems-Gupta/dp/9386768054

MOOCS COURSES:

1. https://www.iare.ac.in/?q=pages/mtech-course-descriptions-r18-0
2. https://nptel.ac.in/courses/108/101/108101005/
3. https://nptel.ac.in/content/syllabus_pdf/108101005.pdf

POWER QUALITY IMPROVEMENT TECHNIQUES
(Professional Elective-III.2)

I M. Tech – II Semester **L T P C**
Course Code: B2PS210PE **3 0 0 3**

Prerequisite: Power Systems and Power Electronics

COURSE OBJECTIVES:
1. To know different terms of power quality.
2. To illustrate power quality issues for short and long interruptions.
3. To study of characterization of voltage sag magnitude and three-phase unbalanced voltage sag.
4. To know the behaviour of power electronics loads, induction motors, synchronous motor etc. By the power quality issues.
5. To know mitigation of power quality problems by using VSI converters.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Know the severity of power quality problems in distribution system.
2. Understand the concept of voltage sag transformation from up-stream (higher voltages) to downstream (lower voltage).
3. Compute the power quality improvement by using various mitigating custom power devices.

UNIT I INTRODUCTION AND POWER QUALITY STANDARDS
Introduction, Classification of Power Quality Problems, Causes, Effects and Mitigation Techniques of Power Quality Problems, Power Quality Terminology, Standards, Definitions, Monitoring and Numerical Problems.

UNIT II CAUSES OF POWER QUALITY PROBLEMS
Introduction to Non-Linear Loads, Power Quality Problems caused by Non-Linear Loads, Analysis of Non-Linear Loads, Numerical Problems.

UNIT III PASSIVE SHUNT AND SERIES COMPENSATION
Introduction, Classification and Principle of operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three Wire System and Three-Phase Four Wire System.

UNIT IV ACTIVE SHUNT AND SERIES COMPENSATION
Introduction to Shunt compensators: Classification of DSTATCOM's, Principle of Operation of DSTATCOM.
Different Control Algorithms of DSTATCOM: PI Controller, I-Cosφ Control Algorithm, Synchronous Reference Frame Theory, Single-Phase PQ theory and DQ Theory Based Control Algorithms, Analysis and Design of Shunt Compensators, Numerical Problems.
Introduction to Series Compensators: Classification of Series Compensators, Principle of Operation of DVR.
Different Control Algorithms of DVR: Synchronous Reference Frame Theory-Based Control of DVR, Analysis and Design of Active Series Compensators, Numerical Problems.

UNIT V UNIFIED POWER QUALITY COMPENSATORS
Introduction to Unified Power Quality Compensators (UPQC), Classification of UPQCs, Principle of Operation of UPQC.
Control of UPQCs: Synchronous Reference Frame Theory-Based UPQC, Analysis and Design of UPQCs, Numerical Problems.

TEXTBOOKS:
1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems and Mitigation Techniques", Wiley Publications, 2015.
2. Math H J Bollen, "Understanding Power Quality Problems", IEEE Press, 2000.

REFERENCES:

1. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, "Electric Power Systems Quality", New York, McGraw-Hill, 1996.
2. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007.
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000.
4. G.T. Heydt," Electric Power Quality", 2ndEdition, West Lafayette, IN, Stars in Circle Publications, 1994.
5. R. SastryVedamMulukutlaS.Sarma, "Power Quality VAR Compensation in Power Systems", CRC Press.
6. A Ghosh, G. Ledwich," Power Quality Enhancement Using Custom Power Devices", Kluwer Academic, 2002.

WEB REFERENCES:

1. https://www.researchgate.net/publication/224365867_Development_of_Web_based_power_quality_monitoring_system_for_handling_user_custom_power_quality_query_and_auto_power_quality_monitoring_report_notification_via_email
2. https://www.pge.com/includes/docs/pdfs/mybusiness/customerservice/energystatus/powerquality/pqreferences-web-8-10-07.pdf
3. http://rericjournal.ait.ac.th/index.php/reric/article/download/107/80
4. https://openpowerquality.org/docs/intro-bibliography.html

E-TEXT BOOKS:

1. https://www.accessengineeringlibrary.com/content/book/9780071470759
2. https://www.amazon.in/Power-Quality-Electric-Engineering/dp/0849310407
3. https://www.amazon.in/Power-Quality-Electric-Engineering-ebook/dp/B00UV99Q5K

MOOCS COURSES:

1. http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_systems_quality.pdf
2. https://easyengineering.net/ee6005powerquality/

EHV AC TRANSMISSION
(Professional Elective-III.3)

I M. Tech – II Semester **L T P C**
Course Code: B2PS211PE **3 0 0 3**

Prerequisite: Power Systems

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Understand the importance of EHV AC transmission
2. Estimate choice of voltage for transmission, line losses and power handling capability of EHV Transmission.
3. Analyze by applying the statistical procedures for line designs, scientific and engineering principles in power systems.

UNIT I E.H.V.A.C. TRANSMISSION LINE TRENDS AND PRELIMINARY ASPECTS

E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages, Estimation at line and ground parameters, Bundled conductor systems, Inductance and Capacitance of E.H.V. lines, Positive, negative and zero sequence impedance, Line Parameters for Modes of Propagation.

UNIT II ELECTROSTATIC FIELD AND VOLTAGE GRADIENTS

Electrostatic field and voltage gradients, Calculation 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 MEASUREMENT OF FIELD AND VOLTAGE GRADIENT

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 over-voltages in EHV lines: No load voltage, charging currents at power frequency, Voltage control, Shunt and series compensation, Static VAR compensation.

UNIT IV CORONA AND RADIO INTERFERENCE

Corona in E.H.V. lines, Corona loss formulae, Attention of traveling waves due to Corona, Audio noise due to Corona and its generation, Characteristic and limits.

Measurement of audio noise radio interference due to Corona, Properties of radio noise, Frequency spectrum of RI fields, Measurement of RI and RIV.

UNIT V DESIGN OF EHV LINES AND CABLES

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

TEXTBOOKS:

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.

WEB REFERENCES:

1. https://app.knovel.com/web/toc.v/cid:kpEHVACTE1/viewerType:toc/
2. https://www.ijert.org/a-survey-paper-on-extra-high-voltage-ac-transmission-lines
3. https://www.ijert.org/ehvac-hvdc-transmission-system-for-power-upgrading-of-transmission-2

E-TEXT BOOKS:

1. https://www.amazon.in/Extra-High-Voltage-Transmission-Engineering/dp/8122417922
2. https://www.amazon.in/Transmission-B-Tech-IV-Year-II-Sem-JNTU/dp/B079NZY6GB
3. http://files.hostgator.co.in/hostgator253199/file/extrahighvoltageactransmissionbybegamudre.pdf
4. https://www.kopykitab.com/EHV-AC-HVDC-Transmission-And-Distribution-Engineering-Third-Edition-by-S-Rao

MOOCS COURSES:

1. https://iare.ac.in/?q=electrical-and-electronics-engineering/elective-iv
2. https://3ee2108sdg.wordpress.com/course-learning-outcome/
3. https://onlinecourses.nptel.ac.in/noc20_ee67/preview

SWARM INTELLIGENCE TECHNIQUES IN POWER SYSTEMS
(Professional Elective-III.4)

I M. Tech – II Semester **L T P C**
Course Code: B2PS212PE **3 0 0 3**

Prerequisite: Artificial Intelligence Techniques in Electrical Engineering

COURSE OBJECTIVES:
1. To understand Evolutionary algorithms like GA, PSO, ANT COLONY and BEE COLONY etc.
2. To apply these Evolutionary algorithms to solve power systems problems
3. To also able to understand solution of multi-Objective optimization using these algorithms

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Discriminate the capabilities of bio-inspired system and conventional methods in solving optimization
2. problems.
3. Examine the importance of exploration and exploitation of swarm intelligent system to attain near global optimal solution.
4. Distinguish the functioning of various swarm intelligent systems.
5. Employ various bio-inspired algorithms for power systems engineering applications.

UNIT I FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES
Definition, Classification of optimization problems, Unconstrained and constrained optimization optimality condition, 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 & 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 & 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 & BAT OPTIMIZATION ALGORITHM
Bat algorithm, Echolocation of bats, Behavior 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.

TEXTBOOKS:

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

AI TECHNIQUES IN POWER SYSTEMS
(Professional Elective-IV.1)

I M. Tech – II Semester **L T P C**
Course Code: B2PS213PE **3 0 0 3**

Prerequisite: Artificial Intelligence Techniques in Electrical Engineering

COURSE OBJECTIVES:
1. To understand fuzzy logic, Artificial Neural Networks.
2. To understanding Genetic Algorithms & Evolutionary Programming.

OURSE OUTCOMES:
After completion of the course, students will be able to:
1. Learn the concepts of biological foundations of artificial neural networks.
2. Learn Feedback networks and radial basis function networks and fuzzy logics.
3. Identify fuzzy and neural network.
4. Acquire the knowledge of Genetic Algorithms.

UNIT I ARTIFICIAL NEURAL NETWORKS
Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.

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

UNIT III FUZZY AND NEURAL NETWORK
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
Applications of above-mentioned techniques to practical problems.

TEXTBOOKS:
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 Com.

ELECTRIC VEHICLE CHARGING TECHNIQUES
(Professional Elective-IV.2)

I M. Tech – II Semester **L T P C**
Course Code: B2PS214PE **3 0 0 3**

Prerequisite: Electric and Hybrid Vehicles, Power Electronics, Smart Grid Technologies

COURSE OBJECTIVES:
1. To understand the charging infrastructure for EV's
2. To explore the working of grid connected with EV's.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Understand the planning and operational issues related to EV's charging.
2. Acquire knowledge about EV's charging implementation models.

UNIT-I: AN OVERVIEW OF EV CHARGING INFRASTRUCTURE
Orients the reader to EV charging infrastructure, providing a brief introduction to technical concepts of electric vehicle supply equipment, AC and DC charging, power ratings, and charging standards.

UNIT-II: LOCATION PLANNING AND LAND ALLOCATION
Covers the location and site planning aspects for EV charging, by framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, and identifies enabling processes and policies to integrate public charging in urban planning.

UNIT-III: CONNECTING EVs TO THE ELECTRICITY GRID
Focuses on supply of electricity for charging infrastructure, familiarizing readers with the regulations that govern electricity supply for EV charging, the role of DISCOMs in provision of EV charging connections, and the three methods of arranging for power supply for charging infrastructure.

UNIT-IV: ACHIEVING EFFECTIVE EV-GRID INTEGRATION
Zooms out from site-level considerations for supply of electricity to assess grid-level impacts, and then highlights the need for smart charging to minimize adverse impacts of EV charging loads on the grid.

UNIT-V: MODELS OF EV CHARGING IMPLEMENTATION
Defines the typical roles within an implementation model for EV charging infrastructure and identifies three models in India – the government-driven model, the consumer-driven model and the charge point operator-driven model –for charging infrastructure implementation.

TEXTBOOKS:
1. Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb, "Smart Charging Solutions for Hybrid and Electric Vehicles",Wiley Publications, March 2022.
2. Handbook of Electric Vehicle Charging Infrastructure Implementation Version-1

REFERENCES:
1. Vahid Vahidinasab, Behnam Mohammadi-Ivatloo, "Electric Vehicle Integration via Smart Charging, Springer, 2022.
2. Alam, Mohammad Saad, Pillai, Reji Kumar, Murugesan, N, "Developing Charging Infrastructure and Technologies for Electric Vehicles", IGI Global

POWER SYSTEM RELIABILITY AND PLANNING
(Professional Elective-IV.3)

I M. Tech – II Semester **L T P C**
Course Code: B2PS215PE **3 0 0 3**

Prerequisite: Reliability Engineering

COURSE OBJECTIVES:
1. To describe the generation system model and recursive relation for capacitive model building
2. To explain the equivalent transitional rates, cumulative probability and cumulative frequency
3. To develop the understanding of risk, system and load point reliability indices
4. To explain the basic and performance reliability indices

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Understand the importance of maintaining reliability of power system components.
2. Apply the probabilistic methods for evaluating the reliability of generation and transmission systems.
3. Assess the different models of system components in reliability studies.
4. Assess the reliability of single area and multi area systems.

UNIT I BASIC RELIABILITY CONCEPTS
The general reliability function, the 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.

TEXTBOOKS:
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.

WEB REFERENCES:
1. https://www.intechopen.com/books/system-reliability/power-system-reliability-mathematical-models-and-applications
2. https://www.researchgate.net/publication/37881951_The_economics_of_power_system_reliability_and_planning_theory_and_case_study
3. https://www.researchgate.net/publication/223412624_Power_system_planning_-_a_reliability_perspective

E-TEXT BOOKS:

1. https://www.researchgate.net/publication/37881951_The_economics_of_power_system_reliability_and_planning_theory_and_case_study
2. https://www.osti.gov/biblio/5024455-power-system-planning
3. https://stupidsid.com/popular-books/power-system-planning-and-reliability-337

MOOCS COURSES:

1. https://www.coursera.org/learn/electric-power-systems
2. https://www.dnv.sg/training/training-course-power-system-reliability-9331
3. https://www.iare.ac.in/?q=pages/mtech-course-descriptions-r18-0
4. https://zoetalentsolutions.com/course/electric-power-system-planning-and-reliability-calculation/

INDUSTRIAL LOAD MODELLING AND CONTROL
(Professional Elective-IV.4)

I M. Tech – II Semester **L T P C**
Course Code: B2PS216PE **3 0 0 3**

Prerequisite: Power Systems

COURSE OBJECTIVES:
1. To understand the energy demand scenario.
2. To understand the modelling of load and its ease to study load demand industrially.
3. To know electricity pricing models.
4. To study reactive power management in Industries.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Acquire knowledge about load control techniques in industries and its application.
2. Understand different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3. Apply load management to reduce demand of electricity during peak time.
4. Apply different energy saving opportunities in industries.

UNIT I
Electric Energy Scenario, Demand Side Management, Industrial Load Management. Load Curve, Load Shaping Objective, Methodologies.
Barriers: Classification of Industrial Loads, Continuous and Batch processes, Load Modeling.

UNIT II
Direct load control, Interruptible load control. Bottom- u p approach, Scheduling, Formulation of load models, Optimization and control algorithms, Case studies. Reactive power management in industry, Controls, Power quality impacts, Application of filters, Energy saving in industries.

UNIT III
Cooling and heating loads, Load profiling, Modeling. Cool storage, Types, Control strategies.
Optimal operation, Problem formulation, Case studies.

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

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

TEXTBOOKS:
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 Inter science 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- e f f ect i v e planning in Industrial facilities”, IEEE Inc, USA.

WEB REFERENCES:

1. https://www.osti.gov/pages/servlets/purl/1435710
2. https://www.nerc.com/comm/PC/LoadModelingTaskForceDL/Dynamic%20Load%20Modeling%20Tech%20Ref%202016-11-14%20-%20FINAL.PDF
3. https://ieeexplore.ieee.org/document/7981072

E-TEXT BOOKS:

1. https://www.osti.gov/pages/servlets/purl/1435710
2. https://www.amazon.in/Industrial-Load-Management-Practice-Simulations/dp/0444873651
3. https://www.elsevier.com/books/industrial-load-management/bjork/978-0-444-87365-1
4. https://www.springer.com/gp/book/9783642178740

MOOCS COURSES:

1. https://www.iare.ac.in/?q=pages/mtech-course-descriptions-r18-0
2. https://www.gitam.edu/departments_cms/assets/uploads/syllabus/1564571382_M__Tech__(PS_A)_w__e__f__2019-20_admitted_batch_.pdf
3. http://www.gcekarad.ac.in/uploaded_files/M_Tech_EPS_Structure_&_Curriculum.pdf

POWER SYSTEMS COMPUTATION LAB-II

I M. Tech – II Semester **L T P C**
Course Code: B2PS209PC **0 0 4 2**

Prerequisite: Power Systems and Artificial Neural Networks

COURSE OBJECTIVES:

1. To know Neural network tool box
2. To know the various Evolutionary Algorithms
3. To apply various Evolutionary Algorithms to power system problems

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Understood Neural network and fuzzy logic tool box
2. Understood various Evolutionary Algorithms
3. Solve power system problems by applying various Evolutionary Algorithms

LIST OF EXPERIMENTS:

1. Load Flow analysis using Neural Network
2. State Estimation 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.

TEXT BOOKS:

1. https://jntuhcej.ac.in/web/syllabus/30_R19M.Tech_ELECTRICALPOWERSYSTEMSSyllabus.pdf
2. https://makautwb.ac.in/syllabus/MTech_EE_Power_Common_Syllabus_10.04.14_2.pdf
3. https://www.silicon.ac.in/M.%20Tech_EEE-Syllabus-Autonomy.pdf
4. https://www.nitw.ac.in/media/uploads/2019/03/15/mtech-pse-revised-syllabus-02-08-2016-0535pm.pdf

REFERENCE BOOKS:

1. https://www.researchgate.net/publication/306094450_power_system_lab_manual
2. https://www.bitswgl.ac.in/ece/B.Tech%20Lab%20manuals/Electrical-Power-systems-Lab-manual-3-2.pdf
3. https://www.slideshare.net/mathupuji/power-system-simulation-lab-electrical-engineering-power-systems
4. http://www.eee.griet.ac.in/document/labmanuals/IV-I%20PSS%20Lab%20Manual.pdf

POWER SYSTEM PROTECTION LAB

I M. Tech – II Semester **L T P C**
Course Code: B2PS210PC **0 0 4 2**

Prerequisite: Power System Protection

COURSE OBJECTIVES:

1. To understand practically different types of Faults occurring in power systems
2. To study the characteristics of different types of relays
3. To apply different protection schemes and understand the principle of operation

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Calculate various faults
2. Analyze the various time-current characteristics of protective relays.
3. Know the Performance and Testing of various electrical models and systems

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.

TEXT BOOKS:

1. http://eie.sliet.ac.in/files/2021/03/Power-System-Lab-Manual.pdf
2. https://jcboseust.ac.in/electrical/images/lab/ps_lab_manual.pdf
3. https://www.scribd.com/doc/59926214/Power-System-Protection-Lab-Manual

REFERENCE BOOKS:

1. https://www.academia.edu/44789446/Lab_Manual_Electrical_Power_System_Protection_PTUK
2. https://baixardoc.com/documents/59926214-power-system-protection-lab-manual-5c7d8ae6eb1c4
3. https://www.textroad.com/pdf/JAEBS/J.%20Appl.%20Environ.%20Biol.%20Sci.,%207(3)252-257,%202017.pdf

CONSTITUTION OF INDIA
(Audit Course-II .1)

I M. Tech – II Semester **L T P C**
Course Code: B2PS205AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History Drafting Committee, (Composition& Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES:
Fundamental Rights Right to Equality, Right to Freedom, right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT V LOCAL ADMINISTRATION
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

TEXTBOOKS/ REFERENCES:
1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn. Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES
(Audit Course-II.2)

I M. Tech –II Semester **L T P C**
Course Code: B2PS206AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. To identify critical evidence gaps to guide the development.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Understand what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. Understand what is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. Understand 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 EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school 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
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 design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXTBOOKS/ 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.

STRESS MANGEMENT BY YOGA
(Audit Course-II.3)

I M. Tech – II Semester **L T P C**
Course Code: B2PS207AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To achieve overall health of body and mind
2. To overcome stress

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Develop healthy mind in a healthy body thus improving social health also
2. 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 yoga poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXTBOOKS/ REFERENCES:
1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining" Part-I, Nagpur
2. Swami Vivekananda, AdvaitaAshrama, "Rajayoga or conquering the Internal Nature", Publication Department, Kolkata.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course-II.4)

I M. Tech – II Semester **L T P C**
Course Code: B2PS208AC **2 0 0 0**

Prerequisite: None

COURSE OBJECTIVES:
1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awake wisdom in students.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
3. 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 BhagwadGeeta : 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 BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. Shrimad BhagwadGeeta:

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

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

II-YEAR (I-SEMESTER)

POWER SYSTEM TRANSIENTS
(Program Elective-V.1)

II M. Tech – I Semester **L T P C**
Course Code: B2PS317PE **3 0 0 3**

Prerequisite: Power Systems

COURSE OBJECTIVES:
1. To learn the reasons for occurrence of transients in a power system.
2. To understand the change in parameters like voltage & frequency during transients.
3. To know about the lightning phenomenon and its effect on power system.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Get knowledge of various transients that could occur in power system and their mathematical formulation.
2. Design various protective devices in power system for protecting equipment and Personnel.
3. Coordinate the insulation of various equipment in power system.
4. Model the power system for transient analysis.

UNIT I
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
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
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
Switching HVDC line, travelling waves on transmission line, Circuits with distributed Parameters, Wave Equation, Reflection, Refraction, Behavior 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 earthling.

TEXTBOOKS:
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.

WEB REFERENCES:

1. http://ieeexplore.ieee.org/document/1458910/
2. https://www.mdpi.com/journal/energies/special_issues/PST_P
3. http://www.powerqualityworld.com/2011/10/emtp-rv-power-system-transients.html

E-TEXT BOOKS:

1. https://www.amazon.in/Power-System-Transients-Theory-Applications-ebook/dp/B00I60MF68
2. https://www.amazon.in/Power-System-Transients-Dr-J-Bhaskaran/dp/B071KXHS1G
3. https://www.routledge.com/Power-System-Transients-Theory-and-Applications-Second-Edition/Ametani-Nagaoka-Baba-Ohno-Yamabuki/p/book/9780367736675

MOOCS COURSES:

1. https://www.iare.ac.in/?q=courseslist/75
2. https://www.classcentral.com/course/swayam-power-system-engineering-10052
3. https://www.ntnu.edu/studies/courses/TET4130

FACTS AND CUSTOM POWER DEVICES
(Program Elective-V.2)

II M. Tech – I Semester **L T P C**
Course Code: B2PS318PE **3 0 0 3**

Prerequisite: Power Electronics and Power Systems

COURSE OBJECTIVES:
1. To understand uncompensated lines and their behavior under heavy loading conditions.
2. To understand the concept and importance of controllable parameters of FACTS controllers.
3. To emphasize the objectives of Shunt compensation and basic operation of SVC and STATCOM.
4. To analyze the functioning of series controllers like GCSC, TSSC and TCSC

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Choose proper controller for the specific application based on system requirements
2. Understand various systems thoroughly and their requirements
3. Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
4. Detect the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

UNIT I FACTS CONCEPTS
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 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, 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 SVC AND STATCOM
The regulation and slope transfer function and dynamic performance, Transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT V STATIC SERIES COMPENSATORS
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). Control schemes for GSC, TSSC and TCSC.

TEXTBOOKS:
1. Hingorani H G and Gyugyi. L, “Un d e r s t a n d i n g 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. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash, “Flexible AC Transmission Systems: Modeling and Control”, Springer, 2012.
2. Yong-Hua Song, Allan Johns, “Flexible AC Transmission Systems”, IET, 1999.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Flexible_AC_transmission_system
2. https://www.sciencedirect.com/topics/engineering/flexible-ac-transmission-systems
3. https://www.siemens-energy.com/global/en/offerings/power-transmission/portfolio/flexible-ac-transmission-systems.html

E-TEXT BOOKS:

1. https://www.flipkart.com/flexible-ac-transmission-systems-facts/p/itmewhz5ewqzk3hh
2. https://www.springer.com/gp/book/9783030353858
3. https://www.amazon.in/Flexible-AC-Transmission-Systems-Modelling/dp/3642282407

MOOCS COURSES:

1. https://npti.gov.in/flexible-ac-transmission-system
2. https://www.veltech.edu.in/syllabi/SoEC/EEE/PROGRAMMEELECTIVE/1152EE112FLEXIBLEACTRANSMISSIONSYSTEMS.pdf
3. https://www.tandfonline.com/doi/abs/10.1080/01587919.2014.919710

GAS INSULATED SYSTEMS
(Program Elective-V.3)

II M. Tech – I Semester **L T P C**
Course Code: B2PS319PE **3 0 0 3**

Prerequisite: Switch Gear and Protection

COURSE OBJECTIVES:
1. To know the GIS concepts and principles
2. To distinguish Air Insulated and Gas insulated Substations
3. To demonstrate the design and constructional aspects of GIS
4. To analyze transient phenomenon, problems and diagnostic methods in GIS

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Know the advantages of GIS systems over air insulated systems
2. Observe constructional design features of GIS design
3. Discriminate the problems and design diagnostic methods of GIS

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.

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

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

SCADA SYSTEMS AND APPLICATIONS
(Program Elective-V.4)

II M. Tech – I Semester **L T P C**
Course Code: B2PS320PE **3 0 0 3**

Prerequisite: -

COURSE OBJECTIVES:
1. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical Applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Acquire knowledge about single unified standard architecture IEC 61850.
4. Learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

UNIT I INTRODUCTION TO SCADA
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 SYSTEM 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
SCADA Architecture**,** Various SCADA architectures, Advantages and disadvantages of each System, Single unified standard architecture -IEC 61850.

UNIT IV SCADA COMMUNICATION
SCADA Communication, Various industrial communication technologies, Wired and wireless methods and fiber optics, Open standard communication protocols.

UNIT V SCADA APPLICATIONS
SCADA Applications: Utility applications**,** Transmission and Distribution sector operations, Monitoring, analysis and improvement**.** Oil, gas and water industries case studies: Implementation, Simulation exercises.

TEXTBOOKS:
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, “Cyber Security 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”, Penn Well, 1999.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/SCADA
2. https://www.researchgate.net/publication/269984924_Efficient_Web-Based_SCADA_System
3. https://www.researchgate.net/publication/274738731_Using_WEB_Services_in_SCADA_Applications

E-TEXT BOOKS:

1. https://www.amazon.in/Designing-SCADA-Application-Software-Practical-ebook/dp/B00EDL4VV6
2. https://www.amazon.in/Power-System-SCADA-Smart-Grids/dp/148222674X
3. https://www.elsevier.com/books/designing-scada-application-software/mccrady/978-0-12-417000-1

MOOCS COURSES:

1. https://sppumoodle.unipune.ac.in/course/view.php?id=220
2. https://instrumentationtools.com/applications-of-scada/
3. https://en.wikipedia.org/wiki/SCADA

BUSINESS ANALYTICS
(Open Elective.1)

II M. Tech – I Semester **L T P C**
Course Code: B2PS301OE **3 0 0 3**

Prerequisite: None

COURSE OBJECTIVES:
1. To understand the role of business analytics within an organization.
2. To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. To use decision-making tools/Operations research techniques.
6. To Mange business process using analytical and management tools.
7. To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Demonstrate knowledge of data analytics.
2. Demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Demonstrate the ability to translate data into clear, actionable insights.

UNIT I INTRODUCTION
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics. Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II TRENDINESS AND REGRESSION ANALYSIS
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV FORECASTING TECHNIQUES
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V DECISION ANALYSIS
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making. Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. “Business analytics Principles, Concepts, and Applications” by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. “Business Analytics by James Evans”, persons Education.

INDUSTRIAL SAFETY
(Open Elective.2)

II M. Tech – I Semester **L T P C**
Course Code: B2PS302OE **3 0 0 3**

Prerequisite: None

UNIT I INTRODUCTION
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING
Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricantstypes and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TEXTBOOKS/ REFERENCES:
1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

E- BOOKS
1. http://cms.sinhgad.edu/media/357263/book%20by%20dr.%20kale.pdf
2. http://kalasalingam.ac.in/site/wp-content/uploads/2015/10/M.Tech-Industrial-Safety-Engineering.pdf

OPERATIONS RESEARCH
(Open Elective.3)

II M. Tech – I Semester **L T P C**
Course Code: B2PS303OE **3 0 0 3**

Prerequisite: None

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Apply the concept of non-linear programming
3. Carry out sensitivity analysis
4. Model the real-world problem and simulate it.

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXT BOOKS

1. H.A.Taha,OperationsResearch,AnIntroduction,PHI,2008
2. H.M.Wagner,PrinciplesofOperationsResearch,PHI,Delhi,1982.

REFERENCEBOOKS:

1. J.C.Pant,IntroductiontoOptimization:OperationsResearch,JainBrothers,Delhi,2008
2. HitlerLibermannOperationsResearch:McGrawHillPub.2009
3. Pannerselvam,OperationsResearch: PrenticeHallof India2010
4. HarveyMWagner,PrinciplesofOperationsResearch:PrenticeHallofIndia2010

COST MANAGEMENT OF ENGINEERING PROJECTS
(Open Elective.4)

II M. Tech – I Semester **L T P C**
Course Code: B2PS304OE **3 0 0 3**

Prerequisite: None

UNIT I INTRODUCTION AND OVERVIEW OF THE STRATEGIC COST MANAGEMENT PROCESS

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II PROJECT AND ITS EXECUTION

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT III COST BEHAVIOR AND PROFIT PLANNING MARGINAL COSTING

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT IV ACTIVITY-BASED COST MANAGEMENT, BENCH MARKING

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXTBOOKS/ REFERENCES:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS
(Open Elective.5)

II M. Tech – I Semester **L T P C**
Course Code: B2PS305OE **3 0 0 3**

Prerequisite: None

UNIT I INTRODUCTION
Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS:
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III MANUFACTURING OF METAL MATRIX COMPOSITES:
Casting – Solid State diffusion technique,
Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V STRENGTH
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXTBOOKS/ REFERENCES:
1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

PHOTOVOLTAIC SYSTEMS
(Open Elective.6)

II M. Tech – I Semester **L T P C**
Course Code: B2PS306OE **3 0 0 3**

Prerequisite: None

COURSE OBJECTIVES:
1. To introduce photovoltaic systems
2. To deal with various technologies of solar PV cells
3. To understand details about manufacture, sizing and operating techniques
4. To have knowledge of design considerations.

COURSE OUTCOMES:
After completion of the course, students will be able to:
1. Identify photovoltaic system components and system types
2. Calculate electrical energy and power
3. Correctly size system components, design considerations of solar equipment
4. Design a basic grid-tie PV system.

UNIT I SOLAR ENERGY
Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation, Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT II SOLAR CELLS
Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, Encapsulation systems, Manufacture, Power rating, Hotspot effect, Design qualifications.

UNIT III PROTECTION AND MEASUREMENTS
Flat plate arrays, Support structures, Module interconnection and cabling, Lightning protection, Performance measurement using natural sun light and simulator, Determination of temperature coefficients, Internal series resistance, Curve correction factor.

UNIT IV PHOTOVOLTAIC SYSTEMS
Photovoltaic systems, Types, General design considerations, System sizing, Battery sizing, Inverter sizing, Design examples, Balance of PV systems.

UNIT V MAXIMUM POWER POINT TRACKERS
Maximum power point trackers, Perturb and observe, Incremental conductance method, Hill climbing method, Hybrid and complex methods, Data based and other approximate methods, Instrument design, Other MPP techniques, Grid interactive PV system.

TEXTBOOKS:
1. F.C.Treble, “Generating electricity from Sun”, Pergamon Press.
2. A.K.Mukherjee, Nivedita Thakur,”Photovoltaic systems: Analysis and design”, PHI, 2011.

REFERENCES:
1. C.S.Solanki,” Solar Photovoltaic’s: Fundamentals, Technologies and applications”, PHI, 2009.