ACADEMIC REGULATIONS, COURSE STRUCTURE and DETAILED SYLLABUS

R22

M.Tech – Power Electronics

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

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

(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 – Power Electronics

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
B2PE101PC	Advanced Power Electronic Converters-I	PC	3	-	-	3	40	60	100
B2PE102PC	Electrical drives	PC	3	-	-	3	40	60	100
	Professional elective-I	PE	3	-	-	3	40	60	100
	Professional elective-II	PE	3	-	-	3	40	60	100
B2PE103PC	Research methodology and IPR	PC	2	-	-	2	40	60	100
B2PE104PC	Advanced Power Electronic Converters Lab-I	PC	-	-	4	2	40	60	100
B2PE105PC	Electrical drives Lab	PC	-	-	4	2	40	60	100
	Audit course-I	AC	2	-	-	-	100	-	100
TOTAL			**16**	**-**	**8**	**18**	**380**	**420**	**800**

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
B2PE206PC	Advanced Power Electronic Converters-II	PC	3	-	-	3	40	60	100
B2PE207PC	Power electronics application to power systems	PC	3	-	-	3	40	60	100
	Professional elective-III	PE	3	-	-	3	40	60	100
	Professional elective-IV	PE	3	-	-	3	40	60	100
B2PE208PC	Mini project with seminar	PC	-	-	4	2	100	-	100
B2PE209PC	Advanced Power Electronic Converters Lab-II	PC	-	-	4	2	40	60	100
B2PE210PC	Power electronics application to power systems lab	PC	-	-	4	2	40	60	100
	Audit course-II	AC	2	-	-	-	100	-	100
TOTAL			**14**	**-**	**12**	**18**	**440**	**360**	**800**

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
	Professional elective-V	PE	3	-	-	3	40	60	100
	OPEN ELECTIVE	OE	3	-	-	3	40	60	100
B2PE301PW	Dissertation work review -I	PWC	0	-	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
B2PE401PW	Dissertation work review-II	PWC	-	-	12	6	100	-	200
B2PE402PW	Dissertation viva voice		-	-	28	14	-	100	100
TOTAL			**-**	**-**	**40**	**20**	**100**	**100**	**200**

Total Credits = 68

PROFESSIONAL ELECTIVES			
PE- I		**PE- II**	
B2PE101PE	Machine Modelling and Analysis	B2PE105PE	Power Semiconductor Devices and Modelling
B2PE102PE	Micro controller applications to power electronics	B2PE106PE	Reactive power compensation and management
B2PE103PE	Smart grid technologies	B2PE107PE	High Frequency Magnetic Components
B2PE104PE	Modern Control Theory	B2PE108PE	Electric vehicle and design
PE- III		**PE- IV**	
B2PE209PE	Industrial Load Modelling and Control	B2PE213PE	Dsp based drive control
B2PE210PE	Advanced digital signal processing	B2PE214PE	Distributed Generation
B2PE211PE	Power quality improvement techniques	B2PE215PE	Electric vehicle charging techniques
B2PE212PE	Power electronics for renewable energy systems	B2PE216PE	Electromagnetic interference and compatibility
PE- V			
B2PE317PE	Reliability Engineering		
B2PE318PE	Dynamics of electric machines		
B2PE319PE	Energy storage technologies		
B2PE320PE	scada systems and applications		

OPEN ELECTIVES	
B2PE301OE	Business analytics (offered by CSE dept)
B2PE302OE	Industrial Safety (offered by chemical engineering department)
B2PE303OE	Operations Research (offered by mechanical department)
B2PE304OE	Cost Management of Engineering Projects (offered by civil engineering department)
B2PE305OE	Composite materials (offered by metallurgical engineering department)
B2PE306OE	Photo voltaic systems (offered by EEE department)

AUDIT COURSE I		AUDIT COURSE II	
B2PE101AC	English for Research Paper Writing	B2PE205AC	Constitution of india
B2PE102AC	Disaster Management	B2PE206AC	Pedagogy studies
B2PE103AC	Sanskrit for technical knowledge	B2PE207AC	Stress management by yoga
B2PE104AC	Value education	B2PE208AC	Personality Development Through Life Enlightenment Skills

DETAILED SYLLABUS

ADVANCED POWER ELECTRONIC CONVERTERS-I

I M.Tech-I Semester **L T P C**
Course Code: B2PE101PC **3 - - 3**

COURSE OBJECTIVES:

To learn

1. To understand various advanced power electronic devices.
2. To comprehend the design of rectifiers and inverters
3. To understand the operation of multi-level inverters with switching strategies for high power applications.

COURSE OUTCOMES:

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

1. Develop and analyze various converter topologies..
2. Use power electronic simulation packages for analyzing and designing power converters

UNIT I MODERN POWER SEMICONDUCTOR DEVICES

Modern power semiconductor devices: Symbol, Structure and equivalent circuit of 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). Comparison of their features.

UNIT II SINGLE PHASE & THREE PHASE CONVERTERS

Single phase converters: Half controlled and Fully controlled converters, Evaluation of input power factor and harmonic factor, continuous and Discontinuous load current, Single phase dual converters, Power factor Improvements Techniques, Extinction angle control, Symmetrical angle control, Singlephase sinusoidal PWM, Single phase series converters, Overlap analysis, Applications & Problems. Three phase converters: Half controlled and fully controlled converters, Evaluation of input powerfactor and harmonic factor, Continuous and Discontinuous load current, Three phase dual converters,Power factor Improvements Techniques, Three phase PWM, Twelve pulse converters, Applications & Problems.

UNIT III PULSE WIDTH MODULATED INVERTERS

Principle of operation, Performance parameters, Single phase bridge inverter, Evaluation of output voltage and current with resistive, inductive and capacitive loads, Voltage control of single phase inverters, Single PWM, Multiple PWM, Sinusoidal PWM, Modified PWM, Phase displacement Control, Advanced modulation techniques for improved performance, Trapezoidal, Staircase, Stepped, Harmonic injection and Delta modulation, Advantages, Applications & Problems

UNIT IV THREE PHASE INVERTERS

Introduction to Three phase inverter, Analysis of 180 degree conduction for output voltage And current with resistive, inductive loads, Analysis of 120 degree Conduction, Voltage control of three phase inverters, Sinusoidal PWM, Third Harmonic PWM, 60 degree PWM, Space vector modulation, Comparison of PWM techniques, Harmonic reductions, Problems.

UNIT V MULTILEVEL INVERTERS

Multilevel concept, Classification of multilevel inverters, Principle of operation, main features and comparison of Diode clamped, Improved diode Clamped, Flying capacitors, Cascaded multilevel inverters, Multilevel inverter applications, Reactive power compensation, Back to back intertie system,Adjustable drives, Switching device currents, DC link capacitor voltage balancing

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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/

ELECTRICAL DRIVES

I M.Tech-I Semester **L T P C**
Course Code: B2PE102PC **3 - - 3**

COURSE OBJECTIVES:

To prepare the students to

1. To understand principle of operation of scalar control of AC motor and corresponding speedtorque
2. Characteristics
3. To comprehend the vector control for AC motor drive (IM and SM).
4. To explain the static resistance control and Slip power recovery drive
5. To explain synchronous motor drive characteristics and its control strategies
6. To comprehend the principle of operation of brushless DC motor.

COURSE OUTCOMES:

At the end of the course, the student is able to:

1. Develop induction motor for variable speed operations using scalar and vector control techniques.
2. Identify the difference between the rotor resistance control and static rotor resistance control
3. method and significance of slip power recovery drives.
4. Develop controllers for synchronous motor and variable reluctance motor

UNIT I RECTIFIER CONTROLLED DC MOTOR

Separately excited DC motors and DC series motors with single phase semi converter and single phase full converter, Three-phase controlled converter, control circuit, control modeling of three phase converter, Steady state analysis of three phase converter control DC motor drive, Two quadrant, Three phase converter controlled DC motor drive, DC motor, load and converter.

CLOSED LOOP CONTROL OF DC DRIVE

Current and speed controllers, Current and speed feedback, Design of controllers, Current and speed controllers, Motor equations, Filter in the speed feedback loop speed controller, Current reference generator, Current controller and flowchart for simulation, Harmonics and associated problems, Sixth harmonics torque.

UNIT II CHOPPER CONTROLLED DC MOTOR DRIVES

Principle of operation of the chopper, Chopper with other power devices, Model of the chopper, Input to the chopper, Steady state analysis of chopper-controlled DC motor drives.

Closed loop operation: Speed controlled drive system, Current control loop, Pulse width modulated current controller, Hysteresis current controller, Modeling of current controller, Design of current controller.

UNIT III CONTROL OF INDUCTION MOTOR

Introduction to motor drive, Torque production, Equivalent circuit analysis, Speed – Torque characteristics with Variable voltage, Variable frequency, Constant v/f, Variable stator current operation, Induction motor characteristics in constant torque and field weakening regions.

STATOR SIDE CONTROL

Scalar control, Voltage fed inverter control, Open loop v/f control, Speed control slip regulation, Speed control with torque and flux control, Current controlled voltage fed inverter drive.

ROTOR SIDE CONTROL OF INDUCTION MOTOR DRIVES

Slip power recovery drives, Static Kramer Drive, Phasor diagram, Torque expression, Speed control of Kramer Drive, Static Scheribus Drive, and Modes of operation

UNIT IV VECTOR CONTROL OF INDUCTION MOTOR DRIVES

Principles of Vector control, Direct and Indirect methods of vector control, Adaptive control principles, Self tuning regulator Model referencing control, Direct torque control of AC motors.

UNIT V CONTROL OF PERMENANT MAGNET SYNCHRONOUS MOTOR DRIVES

Synchronous motor and its characteristic, Control strategies, Constant torque angle control, Unity power factor control, Constant mutual flux linkage control, Closed loop operation

TEXT BOOKS:

1. R. Krishnan, “Electric Motor Drives Pearson Modeling, Analysis and control”, 1st Edition, 2002
2. B K Bose, “Modern Power Electronics and AC Drives”, Pearson Publications, 1st Edition.

REFERENCE BOOKS:

1. MD Murthy and FG Turn, “Power Electronics and Control of AC Motors”, Bull Pergman Press
2. 1st Edition
3. BK Bose, “Power Electronics and AC Drives”, Prentice Hall Eagle wood diffs New Jersey, 1st
4. Edition.
5. M H Rashid, “Power Electronic circuits Deices and Applications”, PHI, 1995.
6. G. K. Dubey, “Fundamentals of Electrical Drives”, Narosa publications, 1995.

WEB REFERENCES:

1. https://www.sanfoundry.com/best-reference-books- -electrical-machines/
2. https://books.google.com/books/about/ELECTRICAL_DRIVES.html?id=u3SADAAAQBAJ

E -TEXT BOOKS:

1. https://books.google.com/books/about/ELECTRICAL_DRIVES.html?id=u3SADAAAQBAJ
2. https://www.ikbooks.com/books/book/engineering-computer-science/electrical-engineering/modeling-analysis-electrical-machine/9789384588267/

MOOCS COURSE:

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

MACHINE MODELLING AND ANALYSIS

(Professional Elective- I)

I M.Tech-I Semester **L T P C**

Course Code: B2PE101PE **3 - - 3**

COURSE OBJECTIVES

To prepare the students to

1. To identify the methods and assumptions in modeling of machines.
2. To recognize the different frames for modeling of AC machines.
3. To write voltage and torque equations in state space form for different machines.

COURSE OUTCOMES

At the end of the course, the student is able to:

1. Develop the mathematical models of various machines like, induction motor and Synchronous
2. machines, permanent magnet synchronous motor, brushless DC motor using modeling equations.
3. Analyze the developed models in various reference frames

UNIT I

Basic Two-pole DC machine, Primitive 2-axis machine, Voltage and Current relationship, Torque equation. Mathematical model of separately excited DC motor and DC Series motor in state variable form, Transfer function of the motor, Numerical problems. Mathematical model of D.C. shunt motor, D.C. Compound motor in state variable form, Transfer function of the motor, Numerical Problems.

UNIT II

Linear transformation, Phase transformation (a, b, c to α, β, o), Active transformation (α. β, o to d, q), Circuit model of a 3-phase Induction motor, Linear transformation, Phase Transformation, Transformation to a Reference frame, Two axis models for induction motor, “d-q” model based DOL starting of induction motors.

UNIT III

Voltage and current Equations in stator reference frame, Equation in Rotor reference frame, Equations in a synchronously rotating frame, Torque equation, Equations in state – space form.

UNIT IV

Circuit model of a 3-phase Synchronous motor, two- axis representation of Synchronous Motor. Voltage and current Equations in state – space variable form, Torque equation, and “dq” model based short circuit fault analysis, Emphasis on voltage, Frequency and recovery time

UNIT V

Modeling of Permanent Magnet Synchronous motor, Modeling of Brushless DC Motor

TEXT BOOKS:

1. P.S. Bimbhra, “Generalized Machine theory”, Khanna Publishers.
2. Paul C. Krause, Oleg wasynezuk, Scott D. Sudhoff, “Analysis of electric machinery and Drives systems”.

REFERENCE BOOKS:

1. Vedam Subranmanyam, “Thyristor control of Electric Drives”.
2. Prabha Kundur, “Power System Stability and Control”, EPRI.
3. Article in IEEE Transactions on Energy Conversion, “Performance optimization of induction motors during Voltage-controlled soft starting”, July, 2004.

4. Nithin K.S, Dr.Bos Mathew Jos, Muhammed Rafeek, Dr.Babu Paul, "A Novel Method for
5. Starting of Induction Motor with Improved Transient Torque Pulsations", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 8, February 2013

WEB REFERENCES:

1. https://www.sanfoundry.com/best-reference-books-modeling-analysis-electrical-machines/
2. https://books.google.com/books/about/ELECTRICAL_MACHINES_MODELLING_AND_ANALYS.html?id=u3SADAAAQBAJ

E -TEXT BOOKS:

1. https://books.google.com/books/about/ELECTRICAL_MACHINES_MODELLING_AND_ANALYS.html?id=u3SADAAAQBAJ
2. https://www.ikbooks.com/books/book/engineering-computer-science/electrical-engineering/modeling-analysis-electrical-machine/9789384588267/

MOOCS COURSE:

1. https://www.coursera.org/specializations/power-electronics

MICROCONTROLLER APPLICATIONS TO POWER ELECTRONICS

(Professional Elective- I)

I M.Tech-I Semester **L T P C**

Course Code: B2PE102PE **3 - - 3**

COURSE OBJECTIVES

To learn

1. To study the internal structure and operation of PIC 16F876 microcontroller and 8051 Micro controllers.
2. To know assembly language program for the generation of firing and control signals employing these microcontrollers

COURSE OUTCOMES

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

1. Understand the architecture of 8051 and 16F876 microcontrollers.
2. Develop assembly language programs employing 8051 & 16F876 microcontrollers
3. Analyze the microcontroller programming using MPLAB and develop typical programs for power converter applications

UNIT I

8051 microcontrollers: Architecture, Addressing modes, I/O ports, Instruction sets, Simple assembly language programming.

UNIT II

Use of microcontrollers for pulse generation in power converters, Overview of Zero-Crossing Detectors, Typical firing/gate-drive circuits, Firing/gate pulses for typical single-phase and three-phase power Converters

UNIT III

PIC16F876 Micro-controller: Device overview, Pin diagrams, Memory organization, Special Function Registers, I/O ports, Timers, Capture/ Compare/ PWM modules (CCP).

UNIT IV

Analog to Digital Converter module, Instruction set, Instruction description, Introduction to PIC microcontroller programming, Oscillator selection, Reset, Interrupts, Watch dog timer.

UNIT V

Introduction to MPLAB IDE and PICSTART plus, Device Programming using MPLAB and PICSTART plus, Generation of firing / gating pulses for typical power converters.

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan, “Non-conventional Energy sources”, Tata McGraw-hill Publishing Company,, 2009

REFERENCE BOOKS:

1. Rashid .M. H, “Power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006
3. Rai. G.D, “Non-conventional energy sources”, Khanna Publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, Prentice Hall linc, 1995

WEB REFERENCES:

1. http://www.ecerg.com/iesres/micro controller_08_04_2016_r1.pdf
2. https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages%281%29.pdf
3. https://intra.ece.ucr.edu/~hamed/microcontroller.pdf

E -TEXT BOOKS:

1. https://www.engineeringbookspdf.com/microcontroller-momoh/
2. https://www.springer.com/gp/book/9783662609293
3. https://www.ieee-pes.org/images/files/pdf/2012-pe-smart-grid-compendium.pdf

MOOCS COURSES:

1. https://www.coursera.org/lecture/controller/5-2-power electronics-YUPgW
2. https://www.mooc-list.com/tags/power electronics
3. https://online.stanford.edu/courses/xeiet137-power electronics-data-analytics-and-control
4. https://onlinecourses.nptel.ac.in/noc19_ee64/preview

SMART GRID TECHNOLOGIES

(Professional Elective- I)

I M.Tech-I Semester **L T P C**
Course Code: B2PE103PE **3 - - 3**

COURSE OBJECTIVES

To prepare the students to
To understand concept of smart grid and its advantages over conventional grid

1. To know smart metering techniques
2. To learn wide area measurement techniques
3. To understand the problems associated with integration of distributed generation & its solution through smart grid

COURSE OUTCOMES

After taking this course, the student 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
4. measurements
5. Come up with smart grid solutions using modern communication technologies

UNIT I

Electromechanical Analogy – Magnetic Saturation – Rotating field theory – Operation of Inductor motor– equivalent circuit – Steady state equations of DC machines – operations of synchronous motor – Power angle characteristics.

UNIT II

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 III

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

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 & 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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://link.springer.com/content/pdf/bfm%3A978-1-349-01615-0%2F1.pdf
2. https://www.intechopen.com/books/matlab-a-fundamental-tool-for-scientific-computing-and-engineering applications-volume-1/dynamic-simulation-of-electrical-machines-and-drive-systems-using-matlab-gui

E -TEXT BOOKS:

1. https://www.scribd.com/document/350510697/D-P-Sen-Gupta-J-W-Lynn-Auth-Electrical-Machine-Dynamics-Macmillan-Education-UK-1980
2. https://link.springer.com/book/10.1007/978-1-349-01615-0

MOOCS COURSE:

1. https://nptel.ac.in/courses/108/106/108106023/
2. https://www.engineeringonline.ncsu.edu/course/ece-732-dynamics-and-control-of-electric-machines/

MODERN CONTROL THEORY

(Professional Elective- I)

I M.Tech-I Semester **L T P C**

Course Code: B2PE104PE **3 - - 3**

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.
5. To apply the comprehensive knowledge of optimal theory for Control Systems.

COURSE OUTCOMES

Upon completion of this course, students should be able to

1. Various terms of basic and modern control system for the real time analysis and design of control systems.
2. To perform state variables analysis for any real time system.
3. Apply the concept of optimal control to any system.
4. Able to examine a system for its stability, controllability and observability.
5. Implement basic principles and techniques in designing linear control systems.

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 – 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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://civildatas.com/download/modern-control-theory-by-bakshi
2. https://www.engineeringbookspdf.com/modern-control-theory/
3. https://www.technicalbookspdf.com/modern-control-theory-pdf/

E -TEXT BOOKS:

1. http://docs.znu.ac.ir/members/pirmohamadi_ali/Control/Brogan(BookZZ.org).pdf

MOOCS COURSE:

1. https://www.coursera.org/lecture/bioengineering/introduction-to-the-control-theory-ni2VN
2. https://www.coursera.org/courses?query=control%20systems&page=1
3. https://nptel.ac.in/courses/107/106/107106081/
4. https://onlinecourses.nptel.ac.in/noc20_ee90/preview

POWER SEMICONDUCTOR DEVICES AND MODELLING

(Professional Elective- II)

I M.Tech-I Semester **L T P C**

Course Code: B2PE105PE **3 - - 3**

COURSE OBJECTIVES

To prepare the students to

1. Improve power semiconductor device structures for adjustable speed motor control applications.
2. Understand the static and dynamic characteristics of current controlled power semiconductor devices
3. Understand the static and dynamic characteristics of voltage controlled power semiconductor devices
4. Enable the students for the selection of devices for different power electronics applications
5. Understand the control and firing circuit for different devices.

COURSE OUTCOMES

Upon completion of this course, students should be able to:

1. Know the operating charactertics of various basic semiconductor devices and switches
2. Understand the advanced power semiconductor devices operation.
3. Know the modeling of basic and advanced semiconductor devices and switches through simulation
4. Analyze the applications of various power semiconductor switches

UNIT I POWER DIODES

Basic structure and V-I characteristics, breakdown voltages and control, on-state losses, switching characteristics- turn-on transient, turn off transient and reverse recovery transient, Schottky diodes, snubber requirements for diodes, diode snubber, modeling and simulation of Power diodes. 5 Hrs. Power BJT'S: Basic structure and V-I characteristics, breakdown voltages and control, secondary breakdown and it's control- FBSOA and RBSOA curves - on state losses, switching characteristics, resistive switching specifications, clamped inductive switching specifications, turn-on transient, turn-off transient, storage time, base drive requirements, switching losses

UNIT II POWER BJT'S, SCR, TRIACS

Device protection- snubber requirements for BJT'S and snubber design switching aids, modeling and simulation of power BJT'S Basic structure, V-I characteristics, turn-on process, on-state operation, turn -off process, switching characteristics, turn-on transient and di/dt limitations, turn-off transient, turnoff time and reapplied dv/dt limitations, gate drive requirements, ratings of thyristors, snubber requirements and snubber design, modelling and simulation of thyristor Basic structure and operation-I characteristics, ratings, snubber requirements, modeling and simulation of triacs.

UNIT III GATE TURNOFF THYRISTOR & POWER MOSFET

Basic structure and operation, GTO switching characteristics, TO turn-on transient, GTO turn -off transient, minimum on and off state times, gate drive requirements, maximum controllable anode current, over current protection of GTO'S, modeling and simulation of GTO'S.

Basic structure, V-I characteristics, turn-on process, on state operation, turnoff process, switching Characteristics, resistive switching specifications, clamped inductive switching specifications - turn-on transient and di/dt limitations, turn-off transient, turn off time, switching losses, effect of reverse recovery transients on switching stresses and losses - dv/dt limitations, gating requirements, gate charge - ratings of MOSFET'S, FBSOA and RBSOA curves, device protection - snubber requirements, modeling and simulation of Power MOSFET'S.

UNIT IV INSULATED GATE BIPOLAR TRANSISTORS (IGBT'S)

Basic structure and operation, latch up IGBT, switching characteristics, resistive switching specifications, clamped inductive switching specification –IGBT turn-on transient, IGBT turn off transient- current tailing - gating requirements ,ratings of IGBT'S,FBSOA and RBSOA curves, switching losses – minimum on and off state times, switching frequency capability – overcurrent protection of IGBT'S, short circuit protection, snubber requirements and snubber design.

UNIT V ADVANCED POWER SEMICONDUCTOR DEVICES

MOS gated thyristors, MOS controlled thyristors or MOS GTO'S, base resistance controlled thyristors, emitter switched thyristor, thermal design of power electronic equipment, modelling and simulation, heat transfer by conduction, transient thermal impedance, heat sinks, heat transfer by radiation and convection - heat sinks election for power semiconductor devices.

TEXT BOOKS:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition. Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, "Semiconductor Device Modeling with Spice", McGrawHill, 2nd Edition, 2010.

REFERENCE BOOKS:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition. Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, "Semiconductor Device Modeling with Spice", McGrawHill, 2nd Edition, 2010.

WEB REFERENCES:

1. http://www.cluster2.hostgator.co.in/files/writeable/uploads/hostgator58966/file/powerelectronicssemoconductordevices.pdf
2. http://www.ime.cas.cn/icac/learning/learning_3/201907/P020190717354934353602.pdf
3. https://onlinelibrary.wiley.com/doi/pdf/10.1002/9780470611494.fmatter

E -TEXT BOOKS:

1. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1043&context=elecengtheses

MOOCS COURSE:

2. https://www.coursera.org/lecture/converter-circuits/sect-4-2-0-introduction-to-power-semiconductors-b5VYY
3. https://www.coursera.org/specializations/power-electronics
4. https://nptel.ac.in/courses/108/102/108102145/
5. https://online.stanford.edu/courses/ee216-principles-and-models-semiconductor-devices

REACTIVE POWER COMPENSATION AND MANAGEMENT

(Professional Elective- II)

I M.Tech-I Semester **L T P C**

Course Code: B2PE106PE **3 - - 3**

COURSE OBJECTIVES

To identify the necessity of reactive power compensation

1. To describe load compensation
2. To select various types of reactive power compensation in transmission systems
3. To illustrate reactive power coordination system
4. To characterize distribution side and utility side reactive power management

COURSE OUTCOMES

Upon completion of this course, students should be able to:

Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads

1. Work out on various compensation methods in transmission lines
2. Construct models for reactive power coordination
3. 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.

TEXT BOOKS:

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.

REFERENCE BOOKS:

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

WEB REFERENCES:

1. https://core.ac.uk/download/pdf/41785444.pdf
2. http://www.ieahev.org/assets/1/7/2009_annual_report.pdf
3. http://www.ieahev.org/assets/1/7/Report2015_WEB.pdf

E -TEXT BOOKS:

1. http://www.ae.pwr.wroc.pl/filez/20110606092353_HEV.pdf
2. https://www.routledge.com/rsc/downloads/CRC_Hybrid_Vehicles_Freebook.pdf

MOOCS COURSE:

1. https://nptel.ac.in/courses/108/103/108103009/

HIGH FREQUENCY MAGNETIC COMPONENTS

(Professional Elective- II)

I M.Tech-I Semester **L T P C**

Course Code: B2PE107PE **3 - - 3**

COURSE OBJECTIVES

To prepare the students to

1. To have a knowledge on magnetic circuits
2. To know the skin effect and proximity effect

COURSE OUTCOMES

Upon completion of this course, students should be able to:

1. Design of magnetic components (i.e., inductor and transformer) in a converter.
2. Perform steady-state analysis of switched mode power supply.
3. Understand core loss in an electromagnetic device, recognize& describe its effect.
4. Describe the engineering uses of electromagnetic waves, by frequency band, and the respective
5. hazards associated with them.

UNIT I FUNDAMENTALS OF MAGNETIC DEVICES

Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

MAGNETIC CORES

Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nanocrystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

UNIT II SKIN EFFECT & PROXIMITY EFFECT

Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

WINDING RESISTANCE AT HIGH FREQUENCIES

Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

UNIT III TRANSFORMERS

Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

DESIGN OF TRANSFORMERS

Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

UNIT IV

Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

DESIGN OF INDUCTORS

Introduction, Restrictions on Inductors, Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converter in CCM, Inductor Design for Buck Converter in DCM method.

UNIT V SELF-CAPACITANCE

Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel- Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

TEXT BOOKS:

1. Umanand L, Bhat, S.R, “Design of Magnetic Components for Switched Mode Power
2. Converters”, ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.
3. Marian K. Kazimierczuk, “High-Frequency Magnetic Components”, ISBN: 978-0-470-71453-9,
4. John Wiley& Sons, Inc.

REFERENCE BOOKS:

1. B. Jayant Baliga, “Power Semiconductor Devices”, 1st Edition, International Thompson Computer
2. Press, 1995.
3. V. Benda, J. Gowar, and D. A. Grant, “Discrete and Integrated Power Semiconductor Devices:
4. Theory and Applications”, John Wiley & Sons, 1999.

WEB REFERENCES:

1. G.C. Chryssis, “High frequency switching power supplies”, McGraw Hill, 1989 (2nd Edition.)
2. Eric Lowdon, “Practical Transformer Design Handbook”, Howard W. Sams & Co., Inc., 1980
3. Thompson, “Electrodynamic Magnetic Suspension.pdf”
4. Witulski, “Introduction to modeling of transformers and coupled inductors”
5. Beattie,“Inductance 101.pdf”
6. P. L. Dowell, “Effects of eddy currents in transformer windings.pdf”
7. Dixon, “Eddy current losses in transformer windings.pdf”
8. J J Ding, J S Buckkeridge, “Design Considerations for A Sustainable Hybrid Energy System” IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
9. Texas Instruments, “Windings.pdf”
10. Texas Instruments, “Magnetic core characteristics.pdf”.
11. Ferroxcube, “3f3 ferrite datasheet.pdf”.

E -TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118717806
2. https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118717806.fmatter
3. https://sites.google.com/a/sturgisrapid.web.app/328ro4/high-frequency-magnetic-components-by-marian-k-kazimierczuk-b00gyxpbkq

MOOCS COURSE:

1. https://www.coursera.org/learn/magnetics-for-power-electronic-converters-v2

ELECTRIC VEHICLES AND DESIGN

(Professional Elective- II)

I M.Tech-I Semester **L T P C**

Course Code: B2PE108PE **3 - - 3**

COURSE OBJECTIVES

To prepare the students to

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

Upon completion of this course, students should 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).

TEXT BOOKS:

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

REFERENCE BOOKS:

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

WEB REFERENCES:

1. https://www.buecher.de/shop/leistungselektronik/high-frequency-magnetic-components-ebook-pdf/kazimierczuk-marian-k- /products_products/detail/prod_id/39935460/
2. http://convocation.smu.edu.in/7lun/05-deshaun-huel/OtRAUnxK.pdf

E -TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118717806
2. https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118717806.fmatter
3. https://sites.google.com/a/sturgisrapid.web.app/328ro4/high-frequency-magnetic-components-by-marian-k-kazimierczuk-b00gyxpbkq

MOOCS COURSE:

1. https://www.coursera.org/learn/magnetics-for-power-electronic-converters-v2

RESEARCH METHODOLOGY AND IPR

I M.Tech-I Semester **L T P C**
Course Code: B2PE103PC **2 - - 2**

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 the patent rights

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics

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

UNIT II
Effective literature studies approaches, analysis, Plagiarism, Research ethics

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

UNIT IV
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent 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.

TEXT BOOKS:
1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”.

REFERENCE BOOKS:
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.

ADVANCED POWER ELECTRONIC CONVERTERS LAB-I

I M.Tech-I Semester **L T P C**
Course Code: B2PE104PC **- - 4 2**

COURSE OBJECTIVES

To prepare the students to

1. To simulate various AC-AC, AC-DC, DC-AC converter topologies

COURSE OUTCOMES

At the end of the course, the student is able to:

1. Design controlled rectifiers
2. Design conventional multi-level inverters for industrial applications.

LIST OF EXPERIMENTS

Characteristics of IGBT, MTO, ETO, IGCT, MCT

1. Single phase and three-phase fully controlled converter.
2. Single phase and three-phase Half controlled converter.
3. Single phase Extinction angle control.
4. Single phase symmetrical angle control.
5. Single phase PWM controlled full converter.
6. Sinusoidal pulse width modulated single phase inverter.
7. Sinusoidal pulse width modulated three phase inverter.
8. Space vector modulated three phase inverter.
9. Single phase diode clamped Multi-level inverter.
10. Single phase flying capacitor Multi-level inverter.
11. Single phase cascaded Multi-level inverter.

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

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi, 2009

REFERENCE BOOKS:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non-conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, ‘Introduction to Modern Power Electronics’, 2nd edition, wiley
6. India Pvt. Ltd, 2012.

WEB REFERENCES:

1. http://www.msec.ac.in/files/mech/lab/6_2.pdf
2. http://www.darshan.ac.in/DIET/EE/SubjectDetail/2720715

E -TEXT BOOKS:

1. https://www.vlab.co.in/broad-area-electrical-engineering

MOOCS COURSE:

1. https://www.coursera.org/lecture/modeling-simulation-natural-processes/modeling-and-simulation-F7vas

ELECTRICAL DRIVES LAB

I M.Tech-I Semester **L T P C**
Course Code: B2PE105PC **- - 4 2**

COURSE OBJECTIVES:

To prepare the students to

To understand principle of operation of scalar control of AC motor and corresponding speed torque characteristics

1. To comprehend the vector control for AC motor drive (IM and SM)
2. To explain the static resistance control and Slip power recovery drive
3. To explain synchronous motor drive characteristics and its control strategies
4. To comprehend the principle of operation of brushless DC motor

COURSE OUTCOMES:

At the end of the course, the student is able to:

1. Develop induction motor for variable speed operations using scalar and vector control techniques.
2. Identify the difference between the rotor resistance control and static rotor resistance control
3. Method and significance of slip power recovery drives.
4. Develop controllers for synchronous motor and variable reluctance motor.

LIST OF EXPERIMENTS

1. Speed control of separately excited DC Motor Drive with 1 quadrant chopper
2. Speed control of separately excited DC Motor Drive with 4 quadrant chopper.
3. Speed control of BLDC Motor Drive.
4. Multi-level inverter-based AC Induction Motor Drive control equipment.
5. Speed control of 3-phase wound rotor Induction Motor Drive.
6. Speed control of 3-phase doubly fed Induction Motor Drive.
7. Speed control of 5-phase Induction Motor Drive.
8. Speed control of 3-phase Induction Motor Drive using V/F control.
9. Speed control of 3-phase Induction Motor Drive using Vector Control technique.
10. Speed Measurement and closed loop control using PMDC Motor Drive.
11. Speed measurement and closed loop control of PMDC Motor Drive with thyristor circuit. Matrix Converter
12. Speed measurement and closed loop control of IGBT used single 4 quadrant chopper for PMDC Motor Drive.
13. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.

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

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009

REFERENCE BOOKS:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non-conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, ‘Introduction to Modern Power Electronics’, Second edition, wiley India Pvt. Ltd, 2012.

WEB REFERENCES:

1. https://www.scribd.com/document/284782110/Power-Converters-Lab-Manual
2. http://publish.illinois.edu/powerandenergy/files/2016/09/ECE469V32_Aug2016f.pdf

E -TEXT BOOKS:

1. https://www.springer.com/gp/book/9781447154778
2. https://www.freebookcentre.net/Electronics/Power-Electronics-Books.html

MOOCS COURSE:

1. https://www.coursera.org/specializations/power-electronics
2. https://engineering.purdue.edu/online/courses/power-electronic-converters-systems

ENGLISH FOR RESEARCH PAPER WRITING

(Audit Course – I.1)

I M.Tech-I Semester **L T P C**
Course Code: B2PE101AC **2 - - -**

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

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

UNIT III

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

UNIT IV

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

UNIT V

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

TEXT BOOKS:

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 Dordrecht Heidelber London, 2011

DISASTER MANAGEMENT
(Audit Course I.2)

I M.Tech-II Semester **L T P C**
Course Code: B2PE102AC **2 - - -**

COURSE OBJECTIVES:
Students will be able to
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate Disaster risk reduction and humanitarian response policy and practice From multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches,

COURSE OUTCOMES:
1. Understanding Disasters, man-made Hazards and Vulnerabilities
2. Understanding disaster management mechanism
3. Understanding capacity building concepts and planning of disaster managements

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches,

Man-made Disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and\ Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT III DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT IV RISK ASSESSMENT DISASTER RISK
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT V DISASTER MITIGATION
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

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

REFERENCES BOOKS:
1. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
2. 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: B2PE103AC **2 - - -**

COURSE OBJECTIVES:

Students will be able to:

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:

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

TEXT BOOKS:

1. “Abhyaspustakam”, Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit
3. Sansthanam, New Delhi Publication

REFERENCES BOOKS:

1. “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: B2PE104AC **2 - - -**

COURSE OBJECTIVES:
Students will be able to:
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:
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 –Holy books vs. Blind faith - Self-management and good health - Science of reincarnation - Equality, Nonviolence, Humility, Role of Women - All religions and same message – Mind your Mind, Self-control - Honesty, Studying effectively

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

I-YEAR (II-SEMESTER)

ADVANCED POWER ELECTRONIC CONVERTERS II

I M.Tech-II Semester **L T P C**
Course Code: B2PE206PC **3 - - 3**

COURSE OBJECTIVES

Understand various advanced power electronics devices.

1. To comprehend the concepts of different power converters and their applications
2. To analyze and design switched mode regulators for various industrial applications.
3. To develop resonant power converters with better performance

COURSE OUTCOMES

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

1. Select an appropriate power semiconductor device and design a power converter for the required application
2. Model existing and modified power converters based on real time applications
3. Analyze and design power converters and feedback loops.

UNIT I NON-ISOLATED D.C. TO D.C. CONVERTERS

Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-Inductive loads, Switched mode regulators, Analysis of Buck Regulators, Boost regulators, Buck and boost regulators, Cuk regulators, Condition for continuous inductor current and capacitor voltage, Comparison of regulators, Multi output boost converters, Advantages, Applications, Problems, State space analysis of regulators.

UNIT II ISOLATED D.C. TO D.C. CONVERTERS

Classification, switched mode dc power supplies, Fly back Converter, Forward converter, Push-pull converter, Half bridge converter, Full bridge converter, Control circuits, Magnetic design considerations, Applications.

UNIT III 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, Parallel resonant, Series loaded, Parallel loaded, Series and Parallel loaded inverters, Voltage control of resonant inverters, Class-E resonant inverter, Class-E resonant rectifier, Evaluation of values of ‘C’ and ‘L’ for Class-E inverter and Class-E rectifier, Numerical problems..

UNIT IV ZCS & ZVS RESONANT CONVERTERS

Resonant converters, zero current switching resonant converters, L-type and M-type ZCS resonant converter, zero voltage switching resonant converters, Comparison between ZCS and ZVS resonantconverters, Two quadrant ZVS resonant converters, Resonant dc-link inverters, Evaluation of ‘L’ and ‘C’ for a zero current switching inverter, Numerical problems..

UNIT V POWER CONDITIONERS

Power line disturbances, Power conditioners, Uninterruptible Power supplies, Applications

ADVANCED CONVERTERS

Principle of operation of SEPIC converter, Matrix Converter, Luo Converter, Interleaved Converter.

TEXT BOOKS:

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

REFERENCE BOOKS:

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, FredeBlabjerg Edition:" Control in power electronics" illustrated Published by Academic Press, 2002
4. NPTEL online course, Power Electronics, by Prof. B. G. Fernandez.

WEB REFERENCES:

1. https://sites.google.com/site/eeenotes2u/courses/advanced-power-electronics
2. https://www.routledge.com/Power-Electronics-Drives-and-Advanced-Applications/Kumar-Behera-Joshi-Bansal/p/book/9781138062399

E-TEXT BOOKS:

1. https://www.wiley.com/en-in/Advanced+Power+Electronics +Converters%3A+PWM+Converters +Processing+AC+Voltages-p-9781118880944
2. https://www.electronicbo.com/2019/06/Advanced-Power-Electronics-Converters.html

MOOCS COURSE:

1. https://www.classcentral.com/course/swayam-advance-power-electronics-and-control-12956
2. https://nptel.ac.in/courses/108/107/108107128/
3. https://onlinecourses.nptel.ac.in/noc20_ee28/preview

POWER ELECTRONICS APPLICATION TO POWER SYSTEMS

I M.Tech-II Semester **L T P C**
Course Code: B2PE207PC **3 - - 3**

COURSE OBJECTIVES:

1. Understand the basics of formation of bus admittance matrix, modeling of transmission line, and analyze the load flow.
2. Teach the analysis of sensitivity and the basics of power system security.
3. Explain the voltage stability, proximity indicators and participation factors.
4. Familiarize with FACT systems for controlling the power and configuration of various FACT devices.
5. Introduce the thyristor-controlled series capacitor, its analysis, different modes of operation and various models.

COURSE OUTCOMES:

1. Create the bus admittance matrix, describe the reactive power of transmission line, model the transmission line, define the model of OLTC and analyze the load flow of lines.
2. Analyze the sensitivity of different distribution factors, explain the power system security, and select and evaluate the contingency.
3. Determine the voltage stability, proximity indicators and participation factor based on model analysis.
4. Describe the FACT's controllers for power system and configure various FACT devices.

UNIT I

Power System components models formation of bus admittance matrix, algorithm for formation of bus impedance matrix, Reactive power capability of an alternator, transmission line model and loadability, Reactive power transmission and associated difficulties, regulated shunt compensation, Models of OLTC and Phase shifting transformer, load flow study.

UNIT II

Sensitivity analysis: Generation shift distribution factors, line outage distribution factors, Compensated shift factors.Power system security levels, contingency selection and evaluation, security constrained economic dispatch. Pre contingency corrective rescheduling..

UNIT III

Voltage stability: Proximity indicators e.g., slope of PV-curve, Minimum Eigen value of reduced load flow Jacobian, participation factors based on modal analysis and application.

UNIT IV

Flexible ac transmission systems, Reactive power control, Brief description and definition of FACT's controllers,Shunt compensators, Configuration and operating characteristics of TCR, FC-TCR, TSC, Comparison of SVCs.

UNIT V

The Thyristor-controlled series capacitor (TCSC), Advantages of the TCSC, Basic principle and different mode of operation, Analysis, Variable-reactance model and transient stability model of TCSC.

TEXT BOOKS:

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill 2011.
2. A. J. Wood and B. F. Wollenberg, "Power generation, operation and control", second edition John Wiley and Sons 1996.
3. N. G. Hingorani and L. Gyugyi, "Understanding facts: Concepts and Technology of flexible AC transmission systems", Wiley Press 2000.

REFERENCE BOOKS:

1. P. Kundur, “Power System Stability and control”, McGraw-Hill edition 2008.
2. R. M. Mathur and R. K. Varma, “Thyristor Based FACTS Controllers for electrical Transmission systems”,John Wiley and sons 2002

WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118622735
2. https://books.google.co.in/books/about/Fundamentals_of_power system.html?id=2NsGKpLolsQC
3. https://www.freebookcentre.net/power electronics-Books.html

E-TEXT BOOKS:

1. https://easyengineering.net/a-first-course-on-power system-by-pillai/
2. http://www.freeengineeringbooks.com/power electronics-books.php
3. https://www.sanfoundry.com/best-reference-books-electrical-drives-control/

MOOCS COURSE:

1. https://www.classcentral.com/course/swayam-fundamentals-of-power electronics-14073
2. https://onlinecourses.nptel.ac.in/noc19_ee65/preview
3. https://freevideolectures.com/course/3114/advanced-power system
4. https://ocw.tudelft.nl/courses/power system/

INDUSTRIAL LOAD MODELLING AND CONTROL

(Professional Elective-III)

I M.Tech-II Semester **L T P C**

Course Code: B2PE209PE **3 - - 3**

COURSE OBJECTIVES

To understand the energy demand scenario

1. To understand the modeling of load and its ease to study load demand industrially
2. To know electricity pricing models
3. To study reactive power management in Industries

COURSE OUTCOMES

Upon the completion of this course, the student will be able to

1. Acquire knowledge about load control techniques in industries and its application.
2. Understand different type 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 strategiesOptimal 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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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 fe ct i v e planning in Industrial facilities”, IEEE Inc, USA.

WEB REFERENCES:

1. https://www.engineeringbookspdf.com/ Physically based Industrial load -practical-guide-wolfgang-hofmann-jurgen-schlabbach-wolfgang-justauth/
2. https://www.scribd.com/document/352347061/ Physically based Industrial load - -pdf

E-TEXT BOOKS:

1. https://thebookee.net/re/cooling and heating-textbook-free-download

MOOCS COURSE:

1. https://onlinecourses.nptel.ac.in/noc20_ee08/preview
2. https://www.coursera.org/lecture/linear-cooling and heating-gdKA2
3. https://www.coursera.org/specializations/modeling-and-control-of-power-electronics
4. https://nptel.ac.in/courses/108/106/108106159/

ADVANCED DIGITAL SIGNAL PROCESSING

(Professional Elective-III)

I M.Tech-II Semester **L T P C**

Course Code: B2PE210PE **3 - - 3**

COURSE OBJECTIVES

1. To understand the difference between discrete-time and continuous-time signals
2. To understand and apply Discrete Fourier Transforms (DFT)

COURSE OUTCOMES

1. Acquire knowledge about the time domain and frequency domain representations as well analysis of discrete-time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Gain knowledge about the various linear signal models and estimation of power spectrum of stationary Random signals
5. Design of optimum FIR and IIR filters

UNIT I

Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signal, Discrete time Fourier transforms, Discrete Fourier series, Discrete Fourier transform, Z-transforms,bProperties of different transforms.

UNIT II

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bi-linear transformation method.

UNIT III

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations, Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

UNIT IV

A/D conversion noise, Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models.

UNIT V

All pole, All zero and Pole-zero models, Power spectrum estimation, Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals, Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

TEXT BOOKS:

1. Sanjit K Mitra, “Digital Signal Processing: A computer-based approach “, TMH Edition, 1998.
2. Dimitris G.Manolakis, Vinay K. Ingle and Stephen M. Kogon, “Statistical and Adaptive Signal Processing”, TMH International Editions, 2000.

REFERENCE BOOKS:

1. S Salivahanan. A. Vallavaraj C. Gnanapriya, “Digital Signal Processing”, TMH, 2nd reprint 2001.
2. Lourens R Rebinarand Bernold, “Theory and Applications of Digital Signal Processing”. Auntoniam, “Digital Filter Analysis and Design”, TMH..

WEB REFERENCES:

1. https://www.nerc.com/comm/PC/digital signal processing Tech%20Ref%202016-11-14%20-%20FINAL.PDF
2. https://www.intechopen.com/books/energy-efficiency-the-innovative-ways-for-smart-energy-the-future-towards-modern-utilities/load-management-system-using-intelligent-monitoring-and-control-system-for-commercial-and-industrial
3. https://ieeexplore.ieee.org/document/9067735

E -TEXT BOOKS:

1. https://www.researchgate.net/publication/271272882_Overview_of_digital signal processingr_Applications

MOOCS COURSE:

1. https://www.giet.edu/wp-content/uploads/2020/02/M.Tech-Power-ElectronicsEE2018.pdf
2. https://www.aicte-india.org/downloads/MHRD%20moocs%20guidelines%20updated.pdf

POWER QUALITY IMPROVEMENT TECHNIQUES

(Professional Elective- III)

I M.Tech-II Semester **L T P C**

Course Code: B2PE211PE **3 - - 3**

COURSE OBJECTIVES

To know different terms of power quality.

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

COURSE OUTCOMES

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, Analysisband Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three Wire System andvThree-Phase Four Wire System

UNIT IV ACTIVE SHUNT AND SERIES COMPENSATION

Introduction to Shunt compensators: Classification of DSTATCOM's, Principle of Operation ofvDSTATCOM.
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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

.WEB REFERENCES:

1. https://en.wikipedia.org/wiki/power quality improvement
2. https://www.mdpi.com/2227-7080/5/2/12/pdf

E -TEXT BOOKS:

1. https://www.mdpi.com/2227-7080/5/2/12/pdf
2. https://www.cedengineering.com/userfiles/power quality%20Systems.pdf

MOOCS COURSE:

1. https://www.google.com/aclk?sa=L&ai=DChcSEwjl5cyK7ZPwAhVHDCsKHW7zC9cYABADGgJzZg&ae=2&sig=AOD64_3FqgLYEwx3gOpL1Arf9V2UdLiipQ&q&adurl&ved=2ahUKEwi0-sKK7ZPwAhXZXisKHWBMAaAQ0Qx6BAgCEAE
2. https://www.google.com/aclk?sa=L&ai=DChcSEwjl5cyK7ZPwAhVHDCsKHW7zC9cYABAAGgJzZg&ae=2&sig=AOD64_3G4ZYccw_0nPDy8WNMmosc9LBf_w&q&adurl&ved=2ahUKEwi0-sKK7ZPwAhXZXisKHWBMAaAQ0Qx6BAgEEAE
3. https://sppumoodle.unipune.ac.in/course/view.php?id=220

POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

(Professional Elective- III)

I M.Tech-II Semester **L T P C**

Course Code: B2PE212PE **3 - - 3**

COURSE OBJECTIVES

1. To impart knowledge on different types of renewable energy systems.
2. To analyze the operation of electrical generators used for the wind energy conversion Systems.
3. To know the operation of AC-DC, DC-DC and AC-AC power converters used in renewable energy systems.
4. To know the principles of standalone, grid connected and hybrid operation in renewable energy systems.

COURSE OUTCOMES

1. Demonstrate the various types of renewable energy technologies that are used to harness electrical power.
2. Demonstrate the operating principle and analysis of various types of Wind generators.
3. Identify a suitable converter such as AC-DC, DC-DC and AC-AC converters for renewable energy systems.
4. Demonstrate and analyze the various types of wind and PV systems.
5. Interpret the stand alone, grid connected and hybrid renewable energy systems

UNIT I

Solar cell characteristics and their measurement, PV Module, PV array, Partial shading of a solar cell and a module, The diode, Power conditioning unit, maximum power point tracker, Implementation of Perturb and Observe Method, Incremental Conductance Method, Battery charger/discharge controller.

UNIT II

Centralized Inverters, String Inverters, Multi-string Inverters, Module Integrated Inverter/Micro-inverters, Inverter Topology, Model of Inverter, Sizing Batteries and Inverters for a Solar PV System. Types of PV Systems: Grid-Connected Solar PV System, Stand-Alone Solar PV System.

UNIT III

Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators.

UNIT IV

Modeling of Permanent Magnet Synchronous Generators, Doubly Fed Induction Generators, Squirrel cage Induction Generators wind turbine, Control of Power converters for WECS.

UNIT V

Hybrid Energy Systems, Need for Hybrid Energy Systems, Range and types of Hybrid systems, Hybrid Solar PV/Wind Energy System, Architecture of Solar-Wind Hybrid System and Grid connected issues.

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005

REFERENCE BOOKS:

1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009.
2. Rashid .M. H, “Power Electronics Hand book”, Academic Press, 2001.
3. Rai. G.D, “Non-conventional energy sources”, Khanna Publishers, 1993.
4. Rai. G.D,” Solar energy utilization”, Khanna Publishes, 1993.
5. Gray, L. Johnson, “Wind energy system”, Prentice Hall of India, 1995.
6. B.H.Khan "Non-conventional Energy sources", Mc Graw-hill, 2nd Edition, 2009.

WEB REFERENCES:

1. https://www.kuk.ac.in/userfiles/file/Year2018/LeftLinks/MiscNotices/2246-3418(1).pdf
2. https://ieeexplore.ieee.org/document/658748
3. https://www.wiley.com/eus/Power+Electronic+Converters%3A+PWM+Strategies+and+Current+Control+Techniques-p-9781118622841

E -TEXT BOOKS:

1. https://books.google.com/books/about/Advanced_Power_Electronics_Converters.html?id=GO_sBQAAQBAJ
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118886953
3. https://web.iitd.ac.in/~anandarup/ell302_2017/ell302_2017.html

MOOCS COURSE:

1. https://nptel.ac.in/content/syllabus_pdf/108108035.pdf
2. https://freevideolectures.com/course/3345/pulse-width-modulation-for-power-electronic-converters

DSP BASED DRIVE CONTROL

(Professional Elective- IV)

I M.Tech-II Semester **L T P C**

Course Code: B2PE213PE **3 - - 3**

COURSE OBJECTIVES

1. To enrich the learner with digital controller concepts and its application in the field of Power
2. Electronic drives

COURSE OUTCOMES

1. Understand the architecture of DSP core and its functionalities.
2. Acquire knowledge on operation of interrupts and peripherals
3. Explore the possibilities of hardware implementation using PLDs and FPGAs.
4. Design controllers for power electronic drives

UNIT I

Introduction to the C2xx DSP core and code generation, the components of the C2xx DSP core, mapping external devices to the C2xx core, Peripherals and Peripheral Interface, System configuration registers, Memory, Types of Physical Memory, Memory addressing Modes, Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT II

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT III

ADC Overview, Operation of the ADC in the DSP, Overview of the Event manager (EV), Event Manager Interrupts, General Purpose (GP) Timers, Compare Units, Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry, General Event Manager Information.

UNIT IV

Introduction to Field Programmable Gate Arrays (FPGA), CPLD Vs FPGA, Types of FPGA, Xilinx XC3000 series, Configurable logic Blocks (CLB), Input/output Block (IOB), Programmable Interconnect Point (PIP), Xilinx 4000 series, HDL programming, Overview of Spartan 3E and Virtex II pro FPGA boards case study.

UNIT V

Control of DC motor, Permanent magnet Brushless DC motor, Permanent magnet synchronous motor

TEXT BOOKS:

1. John.F.Wakerly, “Microcomputer Architecture and Programming”, John Wiley and Sons, 1981.
2. Ramesh S.Gaonker, “Microprocessor Architecture, Programming and Applications with the8085”,
3. Penram International Publishing (India), 1994.

REFERENCE BOOKS:

1. Hamid.A.Toliyat and Steven G.Campbell, “DSP Based Electro Mechanical Motion Control”, CRC Press New York, 2004.
2. XC 3000 series datasheets (version 3.1). Xilinx, Inc., USA, 1998.
3. XC 4000 series datasheets (version 1.6). Xilinx, Inc., USA, 1999.
4. Wayne Wolf, “FPGA based system design, Prentice Hall, 2004..

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Distributed_generation
2. https://www.tandfonline.com/toc/ucgn21/current
3. https://www.tandfonline.com/loi/ucgn20

E -TEXT BOOKS:

1. https://www.tandfonline.com/toc/drive control
2. https://www.researchgate.net/publication/228838433_dsp based control_An_Overview_and_Key_Issues
3. https://www.sciencedirect.com/book/9780128042083/distributed-generation-systems

MOOCS COURSE:

1. https://www.aicte-india.org/downloads/dsp based control.pdf

DISTRIBUTED GENERATION

(Professional Elective- IV)

I M.Tech-II Semester **L T P C**
Course Code: B2PE214PE **3 - - 3**

COURSE OBJECTIVES

1. To understand renewable energy sources.
2. To explore the working of off-grid and grid-connected renewable energy generation schemes

COURSE OUTCOMES

1. Understand the planning and operational issues related to Distributed Generation.
2. Acquire knowledge about Distributed Generation Learn Micro-Grids

UNIT I

Need for Distributed generation, Renewable sources in distributed generation and current scenario in Distributed Generation.

UNIT II

Planning of DGs, Sitting and sizing of DGs optimal placement of DG sources in distribution systems, Grid integration of DG's, Different types of interfaces, Inverter based DG's and rotating machine- b a s e d interfaces, Aggregation of multiple DG units..

UNIT III

Technical impacts of DG' on Transmission systems and Distribution Systems, De-regulation, Impact of DGs upon protective relaying, Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis

UNIT IV

Economic and control aspects of DG's Market facts, Issues and challenges, Limitations of DG's, Voltage control techniques, Reactive power control, Harmonics, Power quality issues, Reliability of DG based systems.

UNIT V

Introduction to micro-grids, Types of micro-grids, Autonomous and non-autonomous grids, Sizing of microgrids, Modeling & analysis of Micro-grids with multiple DG's, Micro-grids with power electronic interfacing units, Transients in micro-grids, Protection of micro-grids, Case studies, Advanced topics.

TEXT BOOKS:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation-Planning and Evaluation", Marcel Decker Press.
2. M.Godoy Simoes, Felix A.Farret, "Renewable Energy Systems-Design and Analysis with Induction Generators", CRC press

REFERENCE BOOKS:

1. Stuart Borlase, "Smart Grid: Infrastructure Technology Solutions", CRC Press

WEB REFERENCES:

1. https://www.pge.com/includes/docs/pdfs/mybusiness/customerservice/energystatus/distrribution/pqreferences-web-8-10-07.pdf
2. 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
3. http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_systems_quality.pdf

E -TEXT BOOKS:

1. Http://Www.Gcebargur.Ac.In/Sites/Gcebargur.Ac.In/Files/Lectures_Desk/Electrical_Power_Systems_Quality.Pdf
2. Https://Www.Cet.Edu.In/Noticefiles/227_Electrical_Power_Quality-Peel5403-8th_Sem-Electrical.Pdf
3. Https://Www.Sciencedirect.Com/Book/9780128007822/Power-Quality-In-Power-Systems-And-Electrical-Machines

MOOCS COURSE:

1. https://files.eric.ed.gov/fulltext/EJ1120306.pdf
2. https://www.researchgate.net/publication/331327802_Quality_Reference_Framework_QRF_for_the_Quality_of_MOOCs

ELECTRIC VEHICLE CHARGING TECHNIQUES

(Professional Elective- IV)

I M.Tech-II Semester **L T P C**
Course Code: B2PE215PE **3 - - 3**

COURSE OBJECTIVES

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

COURSE OUTCOMES

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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 Publisher, December 2021,

WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/0471755621
2. https://www.wiley.com/en-gb/Integration+of+Alternative+Sources+of+Energy-p-x000285368
3. https://www.researchgate.net/publication/315669268_charging_methods

E -TEXT BOOKS:

1. https://www.sciencedirect.com/science/article/pii/0301421591901003
2. https://www.researchgate.net/publication/262264959_Integration_of_Renewable_Energy_Sources_in_Future_Power_Systems_The_Role_of_Storage

MOOCS COURSE:

1. https://www.mooc-list.com/tags/renewable-energy
2. https://www.aicte-india.org/downloads/grid%20moocs%20guidelines%20updated.pdf

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

(Professional Elective- IV)

I M.Tech-II Semester **L T P C**
Course Code: B2PE216PE **3 - - 3**

COURSE OBJECTIVES

1. To enumerate sources of Electromagnetic interferences
2. To design EMI Filter for insertion loss and for switch mode power supplies
3. To understand concept of Faraday screens for EMI Prevention.

COURSE OUTCOMES

1. Recognize the sources of Conducted and radiated EMI in Power Electronic Converters and consumer appliances and suggest remedial measures to mitigate the problems.
2. Assess the insertion loss and design EMI filters to reduce the loss
3. Design EMI filters, common-mode chokes and RC-snubber circuits measures to keep the interference within tolerable limits

UNIT I INTRODUCTION:

Sources of conducted and radiated EMI, EMC standardization and description, measuring instruments, conducted EMI references, EMI in power electronic equipment: EMI from power semiconductors circuits.

UNIT II NOISE SUPPRESSION IN RELAY SYSTEMS

AC switching relays, shielded transformers, capacitor filters, EMI generation and reduction at source, influence of layout and control of parasites.

UNIT III EMI FILTER ELEMENTS

Capacitors, choke coils, resistors, EMI filter circuits. Ferrite breeds, feed through filters, bifilar wound choke filter, EMI filters at source, EMI filter at output...

UNIT IV EMI IN SWITCH MODE POWER SUPPLIES

EMI propagation modes, power line conducted-mode inference, safety regulations (ground return currents), Power line filters, suppressing EMI at sources, Line impedance stabilization network (LISN), line filter design, commonmode line filter inductors- design& example, series –mode inductors and problems, EMI measurements.

UNIT V FARADAY SCREENS FOR EMI PREVENTION:

Faraday Screens for EMI prevention in switching devices, transformers, safety screens, faraday screens on output components, reducing radiated EMI on gapped transformer cores, metal screens, electrostatic screens in transformers..

TEXT BOOKS:

1. Electromagnetic Compatibility in Power Electronics, Laszlo Tihanyi, IEEE Press
2. EMI Filter Design, Pullen Timotty. M. Ozenbaugh, N. Richard Lee, CRC Press, Taylor & Francis
3. Practical Design for Electromagnetic Compatibility, R. F. Ficchi Hayden Book Co.

REFERENCE BOOKS:

1. Stuart Borlase, “Smart Grid: Infrastructure Technology Solutions”, CRC Press.
2. Handbook on Switch-Mode Power Supplies, Keith H. Billings, McGraw-Hill Publisher, 1989
3. https://www.ee.iitb.ac.in/web/academics/courses/EE785

E -TEXT BOOKS:

1. https://www.sciencedirect.com/science/article/pii/0301421591901003
2. https://www.researchgate.net/publication/262264959_electromagnetic interference_in_Future_Power_Systems_The_Role_of_Storage

MOOCS COURSE:

1. https://www.mooc-list.com/tags/emi
2. https://www.aicte-india.org/downloads/MHRD%20moocs%20guidelines%20updated.pdf

ADVANCED POWER ELECTRONIC CONVERTERS LAB-II

I M.Tech-II Semester **L T P C**
Course Code: B2PE209PC **- - 4 2**

COURSE OBJECTIVES

1. To know gate drive circuit configurations for converter circuits
2. To analyze advanced converter topologies

COURSE OUTCOMES

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

1. Design the gate driver circuits for converter topologies.
2. Design concern topologies based on industrial applications

LIST OF EXPERIMENTS

1. Buck Converter
2. Boost Converter
3. Cuk converter
4. Push pull converter
5. Fly back converter
6. Forward converter
7. Series resonant converter
8. Parallel resonant converter
9. ZVS
10. ZCS
11. UPS
12. SEPIC Converter

Note: From the above list, minimum of 10 experiments are to be conducted using any simulation tool

REFERENCE BOOKS:

1. https://www.kettering.edu/research/advanced-power-electronics-laboratory
2. https://www.gcek.ac.in/eee_advanced_powerelectronics_lab.php
3. https://ceme.ece.illinois.edu/files/2014/07/ECE469V25.pdf

WEB REFERENCES:

1. https://www.nielit.gov.in/aurangabad/content/power-electronics-lab
2. https://web.ecs.baylor.edu/faculty/grady/Grady_UT_Austin_EE462L_Fall_2010.pdf
3. https://www.bits-pilani.ac.in/hyderabad/EEE/PowerElectronicsLab

POWER ELECTRONICS APPLICATION TO POWER SYSTEMS LAB

I M.Tech-II Semester **L T P C**

Course Code: B2PE210PC **- - 4 2**

COURSE OBJECTIVES

1. To understand the various power electronic devices simulation used in power systems
2. To analyze advanced converter topologies for power system applications

COURSE OUTCOMES

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

1. Model the different power converters for power system applications.
2. Simulate and test the various designs of converter topologies based on needs of power and energy requirements.

LIST OF EXPERIMENTS

1. Simulation of Thyristor Controlled Series Capacitor (TCSC) (Phasor Model)
2. Simulation of Steady-state and transient performance of a simple 6-Pulse HVDC Transmission System(Phasor Model)
3. Simulation of Unified Power Flow Controller (UPFC) (Phasor Model)
4. Simulation of Static Synchronous Compensator (STATCOM) used for midpoint voltage regulation on a transmission line (Phasor Model)
5. Simulation of Distribution STATCOM (D-STATCOM) (Average Model)
6. Simulation of Static Synchronous Series Compensator (SSSC) used for power oscillation damping
7. (Phasor Model)
8. Simulation of Steady-state and dynamic performance of the static var compensator model SVC (Phasor Model)
9. Simulation of Shunt active harmonic filter (Three-Phase Active Harmonic Filter) to minimize the harmonic content propagated to the source from a non-linear load
10. Simulation of a typical transformer-less photovoltaic (PV) residential system connected to the electrical utility grid (Grid-Connected PV Array)
11. Simulation of Steady-state and transient performance of a 12-pulse, HVDC transmission system (Thyristor-Based HVDC Transmission System (Detailed Model))
12. Simulation of Thyristor Controlled Series Capacitor (TCSC) (Detailed Model).
13. Simulation of 48-Pulse, GTO-based unified power flow controller UPFC (Detailed Model)
14. Simulation of Static Synchronous Compensator using 22 power modules per phase STATCOM (Detailed MMC Model with 22 Power Modules per Phase)
15. Simulation of VSC-Based HVDC Transmission System (Detailed Model)
16. Simulation of A 48-pulse GTO based STATCOM (Detailed Model)
17. Simulation of Distribution STATCOM. D-STATCOM (Detailed Model)
18. Simulation of Static Var Compensator (SVC) (Detailed Model)
19. Simulation of Transient stability of a two-machine transmission system with Power System Stabilizers(PSS) and Static Var Compensator (SVC) SVC and PSS (Phasor Model).

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

REFERENCE BOOKS:

1. https://www.aryacollege.org/labmanuals/EDTC-LAB.pdf
2. https://www.jiscollege.ac.in/ee/pdf/EE%20791%20DRIVES%20LAB%20MAUAL.pdf
3. https://www.nit.ac.in/pdf/labs/electrical/drives.pdf

WEB REFERENCES:

1. https://www.dbit.ac.in/eee/syllabus/electric-drives-lab.pdf
2. https://tint.edu.in/tict-ee-department-laboratories/tint-ee-electric-drives-lab.html

CONSTITUTION OF INDIA
(Audit Course – II. 1)

I M.Tech-I Semester **L T P C**
Course Code: B2PE205AC **2 - - -**

COURSE OBJECTIVES:
Students will be able to:
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:
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.

TEXT BOOKS/ REFERENCES BOOKS:
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-I Semester **L T P C**
Course Code: B2PE206AC **2 - - -**

COURSE OBJECTIVES:
Students will be able to:
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:
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
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
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.

TEXT BOOKS/ REFERENCES BOOKS:
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. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

STRESS MANGEMENT BY YOGA

(Audit Course – II.3)

I M.Tech-I Semester **L T P C**
Course Code: B2PE207AC **2 - - -**

COURSE OBJECTIVES:

Students will be able to:

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

COURSE OUTCOMES:

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

UNIT I

Definitions of Eight parts of yog. (Ashtanga)

UNIT II

Yam and Niyam..

UNIT III

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

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT IV

Asan and Pranayam

UNIT V

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

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

TEXT BOOKS/ REFERENCES BOOKS:

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

PERSONALITY DEVELOPMENT THROGH LIFE ENLIGHTMENT SKILLS

(Audit Course –II.4)

I M.Tech-II Semester **L T P C**
Course Code: B2PE208AC **2 - - -**

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 awaken wisdom in students

COURSE OUTCOMES:

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

UNIT-IV:

Statements of basic knowledge.

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

UNIT-V:

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

TEXT BOOKS/ REFERENCES:

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

II-YEAR (I-SEMESTER)

RELIABILITY ENGINEERING

(Professional Elective- V)

II M.Tech-I Semester **L T P C**
Course Code: B2PE317PE **3 - - 3**

COURSE OBJECTIVES

1. Comprehend the concept of Reliability and Unreliability
2. Derive the expressions for probability of failure, Expected value and standard deviation of
3. Binominal distribution, Poisson distribution, normal distribution and weibull distributions.
4. Formulate expressions for Reliability analysis of series-parallel and Non-series parallel systems
5. Derive expressions for Time dependent and Limiting State Probabilities using Markov models

COURSE OUTCOMES

1. Apply fundamental knowledge of Reliability to modelling and analysis of series parallel and Non-series parallel systems.
2. Solve some practical problems related Understand or become aware of various failures, causes of failures and remedies for failures in practical systems

UNIT I RELIABILITY AND PROBABILITY

Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in The definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, exponential distribution Wei bull distribution.

UNIT II HAZARD RATE

Derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures(Early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

UNIT III CLASSIFICATION OF ENGINEERING SYSTEMS

Series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations. Reliability evaluation of Non-series-parallel configurations: Decomposition, Path based and cutest based methods, Deduction of the Paths and cut sets from Event tree.

UNIT IV DISCRETE MARKOV CHAINS

General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of limiting state probabilities of two component repairable model.

UNIT V FREQUENCY AND DURATION TECHNIQUES

Frequency and duration concepts, application to multi state problems, Frequency balance approach. Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. “Reliability evaluation of Engineering systems”, Roy Billinton and Ronald N Allan, BS Publications.
2. “Reliability Engineering”, Elsayed A. Elsayed, Prentice Hall Publications.

REFERENCE BOOKS:

1. "Reliability Engineering: Theory and Practice", By Alessandro Birolini, Springer Publications.
2. "An Introduction to Reliability and Maintainability Engineering", Charles Ebeling, TMH Publications.
3. "Reliability Engineering", E. Balaguruswamy, TMH Publications.

WEB REFERENCES:

1. https://dl.acm.org/citation.cfm?id=3006357
2. https://en.wikipedia.org/wiki/Site_reliability_engineering
3. https://www.linkedin.com/pulse/understanding-site-reliability-engineering-through-movies-laughlin

E -TEXT BOOKS:

1. https://reliabilityanalyticstoolkit.appspot.com/static/books.htm
2. https://www.springer.com/gp/book/9783642395345
3. https://www.weibull.com/knowledge/books.htm

MOOCS COURSE:

1. https://www.google.com/aclk?sa=L&ai=DChcSEwiOrZnz5pPwAhWCBXIKHcShDwUYABAAGgJzZg&ae=2&sig=AOD64_08QIytdxSq4RY0AWfPXFUCcODr8Q&q&adurl&ved=2ahUKEwjTtpLz5pPwAhWhW3wKHRPUCaoQ0Qx6BAgDEAE
2. https://www.coursera.org/learn/site-reliability-engineering-slos
3. https://dl.acm.org/doi/10.1145/3286606.3286834

DYNAMICS OF ELECTRICAL MACHINES

(Professional Elective- V)

II M.Tech-I Semester **L T P C**
Course Code: B2PE318PE **3 - - 3**

COURSE OBJECTIVES

1. To introduce generalized modeling of electrical machines
2. To analyze different electrical machines with dynamic modeling

COURSE OUTCOMES

1. Understand the basic mathematical analysis of electrical machines and its characteristics.
2. Understand behavior of electrical machines under steady state and transient state.
3. Understand dynamic modeling of electrical machines

UNIT I BASIC MACHINE THEORY

Electromechanical Analogy, Magnetic Saturation, Rotating field theory, Operation of Inductor motor, Equivalent circuit, Steady state equation of DC machines, Operation of synchronous motor, Power angle characteristics.

UNIT II ELECTRODYNAMICAL EQUATION & THEIR SOLUTIONS

Spring and Plunger system, Rotational motion, mutually coupled coils, Lagrange's equation, Application of Lagrange's equation, and Solution of Electro dynamical equations.

UNIT III DYNAMICS OF DC MACHINES

Separately excited DC generator and motors, Steady-state and Transient analysis, Interconnection ofmachines, Ward Leonard system of speed control.

UNIT IV INDUCTION MACHINE DYNAMICS

Induction machine dynamics during starting and braking, Accelerating time, Induction machine dynamicduring normal operation, Equation for dynamical response of the induction motor.

UNIT V SYNCHRONOUS MACHINE DYNAMICS

Electromechanical equation, Motor operation, Generator operation, small oscillations, General equations for small oscillations, Representation of the oscillation equations in state variable form.

TEXT BOOKS:

1. Sen GuptaD.P. and J.W, "Electrical Machine Dynamics ", Macmillan Press Ltd., 1980.
2. Bimbhra P.S., "Generalized Theory of Electrical Machines", Khanna Publishers, 2002.

REFERENCE BOOKS:

1. Vedam Subranmanyam, "Thyristor control of Electric Drives".
2. Article in IEEE Transactions on Energy Conversion, "Performance Optimization of Induction
3. motors during Voltage-controlled soft starting", July 2004.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Flexible_AC_transmission_system
2. https://www.siemens-energy.com/global/en/offerings/power-transmission/portfolio/flexible-ac-transmission-systems.html
3. https://link.springer.com/referencework/10.1007/978-3-319-71926-9

E -TEXT BOOKS:

1. https://books.google.co.in/books/about/dynamics of electrical machines .html?id=AqPr4JyDWg0C
2. https://digital-library.theiet.org/content/books/po/pbpo030e
3. https://www.researchgate.net/publication/236623112_electrical machines_and_Control

MOOCS COURSE:

1. https://en.wikipedia.org/wiki/electrical drives
2. https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1208&context=ecetr
3. https://www.hindustanuniv.ac.in/assets/pdf/pg/dynamics pof electrical drives-2018.pdf

ENERGY STORAGE TECHNOLOGIES

(Professional Elective- V)

II M.Tech-I Semester **L T P C**
Course Code: B2PE319PE **3 - - 3**

COURSE OBJECTIVES

1. To introduce generalized storage techniques
2. To analyze the different features of energy storage systems
3. To know the management and application of energy storage technologies
4. To have an idea about electrical energy storage market potential by different forecasting methods

COURSE OUTCOMES

1. Understand the role of electrical energy storage technologies in electricity usage
2. Know the behavior and features of electrical energy storage systems
3. Analyze the applications of energy storage system
4. Understand the hierarchy, demand for energy storage and valuation techniques.
5. Get knowledge about energy storage forecasting methods

UNIT I THE ROLES OF ELECTRICAL ENERGY STORAGE TECHNOLOGIES IN ELECTRICITY USE

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable, Emerging needs for EES, More renewable energy, Less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT II TYPES AND FEATURES OF ENERGY STORAGE SYSTEMS

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Lead-Acid Batteries, Lithium-Ion Batteries, Flow batteries, Other Batteries in Development, Chemical energy storage, Hydrogen (H2), Synthetic Natural Gas (SNG), Electrical storage systems, Double- Layer Capacitors (DLC), Superconducting Magnetic Energy Storage (SMES),Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT III APPLICATIONS OF EES

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), EES installed capacity worldwide, new trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles.

UNIT IV MANAGEMENT AND CONTROL HIERARCHY OF EES

Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems and distributed generation (Virtual Power Plant), “Battery SCADA” aggregation of many dispersed batteries.

DEMAND FOR ENERGY STORAGE

Growth in Variable Energy Resources, Relationship between balancing services and variable energyresources, Energy Storage Alternatives, Variable Generator Control, Demand Management, Market Mechanisms, Longer Term Outlook.

VALUATION TECHNIQUES

Overview, Energy Storage Operational Optimization, Market Price Method, Power System Dispatch Model Method, Ancillary Service Representation, Energy Storage Representation, Survey of Valuation Results.

UNIT V FORECAST OF EES MARKET POTENTIAL BY 2030

EES market potential for overall applications, EES market estimation by Sandia National Laboratory (SNL), EES market estimation by the Boston Consulting Group (BCG), EES market estimation for Li-ion batteries by the Panasonic Group, EES market potential estimation for broad introduction of renewable energies, EES market potential estimation for Germany by Fraunhofer, Storage of large amounts of energy in gas grids, EES market potential estimation for Europe by Siemens, EES market potential estimation by the IEA, Vehicle to grid concept, EES market potential in the future.

Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration. Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

TEXT BOOKS:

1. Paul Breeze, “Power System Energy Storage Technologies”, 1st Edition, Academic Press.
2. Alfred Rufer, “Energy Storage: Systems and Components”, CRC Press, 2017..

REFERENCE BOOKS:

1. Huggins and Robert, “Energy Storage Fundamentals, Materials and Applications”, Springer.
2. andreasoberhofer@gmx.de
3. www.ecofys.com/com/publications
4. www.iec.ch.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/eneryg stroage technologies
2. https://ieeexplore.ieee.org/document/8740460

E -TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119566632
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470822975

MOOCS COURSE:

1. https://nptel.ac.in/courses/108/104/108104013/

SCADA SYSTEMS AND APPLICATIONS

(Professional Elective- V)

II M.Tech-I Semester **L T P C**

Course Code: B2PE320PE **3 - - 3**

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

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, Data acquisition systems, Evolution of SCADA, Communication technologies. Monitoring and supervisory functions, SCADA applications in utility Automation, Industries SCADA.

UNIT II

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

UNIT III

SCADA Architecture, Various SCADA architectures, Advantages and disadvantages of each System, Single unified standard architecture -IEC 61850.

UNIT IV

SCADA Communication, Various industrial communication technologies, Wired and wireless methods andfiber optics, Open standard communication protocols.

UNIT V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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
4. power”, Penn Well, 1999.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/scada
2. https://ieeexplore.ieee.org/document/8740460

E -TEXT BOOKS:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119566632
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470822975

MOOCS COURSE:

1. https://nptel.ac.in/courses/108/104/108104013/

BUSINESS ANALYTICS

(Open Elective)

II M.Tech-I Semester **L T P C**
Course Code: B2PE301OE **3 - - 3**

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:

At the end of the course, student 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

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: 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, 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: 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: 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.
2. Schniederjans, Christopher M. Starkey, Pearson FT Press.
3. "Business Analytics by James Evans", persons Education

REFERENCE BOOKS:

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

INDUSTRIAL SAFETY

(Open Elective)

II M.Tech-I Semester **L T P C**
Course Code: B2PE302OE **3 - - 3**

COURSE OBJECTIVES:

1. To provide information regarding different elements of industrial water pollution and Methodsof treatment.
2. To expose to the various industrial applications, maintenance, preventive measures takenagainst wear and tear.

COURSE OUTCOMES:

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

1. Know how to take safety measures in executing works
2. Identify the need for maintenance (or) replacement of equipment
3. Understand the need for periodic and preventive maintenance

UNIT I

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: Definition and aim of maintenance engineering, Primaryand 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- types, causes, effects, wear reduction methods,lubricants-types and applications, Lubrication methods, general sketch, working and applications, Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication Side feed lubrication ,Ring lubrication ,Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion preventionmethods.

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 ,Any one machine tool, Pump Air compressor Internal combustion engine ,Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

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, stepsand advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps Air compressors ,Diesel generating (DG) sets,Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance

TEXT 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

REFERENCE BOOKS:

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

OPERATIONS RESEARCH

(Open Elective)

II M.Tech-I Semester **L T P C**
Course Code: B2PE303OE **3 - - 3**

COURSE OBJECTIVES:

1. To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems

COURSE OUTCOMES:

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

1. Apply the dynamic programming to solve problems of discreet andcontinuous variables.
2. Apply the concept of non-linear programming
3. Carry out sensitivity analysis
4. Able to 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 - PM/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, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

REFERENCE BOOKS:

1. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3. Pannerselvam, Operations Research: Prentice Hall of India 2010
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

II M.Tech-I Semester **L T P C**
Course Code: B2PE304OE **3 - - 3**

COURSE OBJECTIVES:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting

COURSE OUTCOMES:

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic

UNIT I

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: meaning, Different types, why to manage, cost overruns centres, 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; 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; 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, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting

REFERENCE BOOKS:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS

(Open Elective)

II M.Tech-I Semester **L T P C**

Course Code: B2PE305OE **3 - - 3**

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: 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: 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.

TEXT BOOKS

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.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
4. Hand Book of Composite Materials-ed-Lubin

REFERENCE BOOKS:

1. Composite Materials – K.K.Chawla.
2. Composite Materials Science and Applications – Deborah D.L. Chung.
3. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

PHOTOVOLTAIC SYSTEMS

(Open Elective)

II M.Tech-I Semester **L T P C**

Course Code: B2PE306OE **3 - - 3**

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:

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.

TEXT BOOKS

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

REFERENCE BOOKS:

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