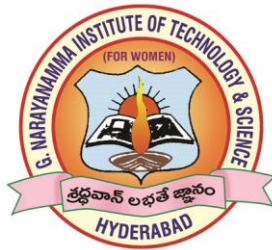


**ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS
M.TECH
POWER ELECTRONICS AND
ELECTRIC DRIVES
(PEED)**

(APPLICABLE FOR THE BATCHES ADMITTED FROM 2018-2019)



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

**G. Narayanamma Institute of Technology & Science (for Women)
(Autonomous)**

Shaikpet, Hyderabad - 500 104, Telangana State

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE

(For Women)

(AUTONOMOUS)

Shaikpet, Hyderabad– 500104

ACADEMIC REGULATIONS 2018

for CBCS Based M.Tech. Degree Course (Regular/Full Time PG Programme)

(Effective for the students admitted into I year from the Academic Year **2018-19** and onwards)

1.0 Post-Graduate Degree Course (PGDC) in Engineering & Technology (E & T)

G. Narayanamma Institute of Technology & Science (GNITS) - for Women, Hyderabad, affiliated to Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, offers 2 Year (4 Semesters) Master of Technology (M. Tech.) Degree Course under Choice Based Credit System (CBCS), with effect from the Academic Year 2018 - 19 onwards in the following Branches of Engineering & Technology with the Specializations as listed below :

<i>S.No</i>	<i>Branch/ Department</i>	<i>Specialization</i>
I.	Computer Science & Engineering	Computer Science & Engineering
II.	Electrical & Electronics Engineering	Power Electronics & Electric Drives
III.	Electronics & Communication Engineering	Digital Electronics & Communication Engineering
IV.	Electronics & Telematics Engineering	Wireless & Mobile Communications
V.	Information Technology	Computer Networks & Information Security

2.0 Eligibility for Admission

2.1 Admission to the **PGDC** shall be made either on the basis of - the Rank/Percentile earned by the candidate in the relevant qualifying GATE Examination, OR the Merit Rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (PGECET) for M.Tech. Programmes, OR an Entrance Test conducted by the Jawaharlal Nehru Technological University Hyderabad, OR on the basis of any other order of merit approved by the University, subject to the reservations as prescribed by the Government from time to time.

2.2 The medium of instruction for all the PG Programmes shall be ENGLISH only.

3.0 M.Tech. Degree Course Structure

3.1 All M.Tech. Programmes at GNITS are of the Semester Pattern with 4 Semesters constituting 2 Academic Years, and each Academic Year has TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations) with a minimum of 90 Instructional Days per Semester.

3.2 UGC/ AICTE specified Definitions/ Descriptions are adopted appropriately for the various terms and abbreviations used in this PGDC - Academic Regulations/Norms.

3.2.1 Semester Scheme:

Each M.Tech Degree Course is of 2 Academic Years (4 Semesters) with each academic year divided into two Semesters of ~ 22 weeks (≥ 90 working days) each, and each semester has - 'Continuous Internal Evaluation' (CIE) and 'End Semester Examination' or 'Semester End Examination' (SEE). Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted and suggested by UGC and AICTE are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab/Practical Course', or 'Design/ Drawing Subject', or 'Elective (Program Specific Elective/ Open Elective)', or 'Mini-Project with Seminar', or 'Project', or 'Audit Course' as the case may be.

3.2.2 Credit Courses:

All the Subjects/Courses are to be registered by a student in a semester to earn Credits. Credits shall be assigned to each Subject/ Course in a **L: T: P: C** (Lecture Periods: Tutorial Periods: Practicals Periods : Credits) Structure, based on the following general pattern:

- One Credit - for One hour/ Week/ Semester for Theory/ Lecture (L) Courses, and Tutorials (T); and,
- One Credit - for Two hours/ Week/ Semester for Laboratory/ Practical (P) Courses.
- Student activity courses like NCC, NSS, NSO, and other Courses identified as Audit Courses shall not carry Credits.

3.2.3 Subject/ Course Classification :

All Subjects/ Courses offered for the PGDC are broadly classified as:

- (a) Core Courses (CoC), and
- (b) Elective Courses (Elc)
 - Core Courses (CoC) and Elective Courses (Elc) are categorized as PS (Professional Subjects), which are further subdivided as –
 - (i) PC (Professional/ Departmental Core) Courses
 - (ii) PE (Program Specific Elective) Courses
 - (iii) OE (Open Elective) Courses; and
 - (iv) Project Works (PW);
 - Specific prescribed Course by AICTE Model Curriculum (on "Research Methodology & IPR").
 - Audit Courses (as listed by AITCTE Model Curriculum).

3.2.4 Course Nomenclature :

The Curriculum Nomenclature and Course Structure grouping for GNITS M.Tech. Degree Programmes are as listed below:

<i>S. No.</i>	<i>Broad Course Classification</i>	<i>Course Group/ Category</i>	<i>Courses Description</i>	<i>Credits</i>
1)	Core Course (CoC)	PC - Professional Core	Includes Core subjects related to the Parent Department/ Branch of Engg.	20
2)	Elective Courses (EtC)	PE – Program Specific Elective	Includes Elective subjects related to the Parent Department/ Branch of Engg.	15
3)		OE - Open Elective	Elective Courses which include subjects from other technical and/or Emerging Areas	3
4)	Project Related Courses	PW - Project Work	M.Tech. Project or PG Project or PG Major Project (Phase-I and Phase-II)	26
		Mini-Project with Seminar (MPS)	Seminar based on core contents related to the Parent Department/ Branch of Engg. in identified specialization	2
5)	Prescribed Course	AICTE Model Curriculum 2018	Research Methodology & IPR	2
6)	Audit Courses	AICTE Model Curriculum 2018	Inclusive of AICTE Suggested List	No Credits
Total Credits for PGDC				68

4.0 Course Work

4.1 A student after securing admission, shall pursue and complete the M.Tech. Degree Course in a minimum period of 2 Academic Years (4 Semesters), and/or within a maximum period of 4 Academic Years (starting from the Date of Commencement of I Year).

4.2 Each student shall register for and secure the specified number of Credits required for the completion of the PG Degree Course and Award of the M.Tech. Degree in the respective Branch of Engineering with the chosen Specialization.

4.3 The I Year is structured to provide typically 18 Credits in each of the I and II Semesters, and II Year comprises of 16 Credits in each of the I and II semesters , totalling to 68 Credits for the entire M.Tech. Programme.

5.0 Course Registration

- 5.1** A 'Faculty Advisor' shall be assigned to each M.Tech. Degree Course student with respective Specialization, and the Faculty Advisor assigned shall advise/counsel the student about the M.Tech. Programme Specialization, its Course Structure and Curriculum, Choice/ Option for Subjects/ Courses, based on the competence, progress, pre-requisites and interest of the student.
- 5.2** The Academic/Examination Section of the College invites 'Registration Forms' from the students apriori (before the beginning of the Semester) through 'ONLINE SUBMISSIONS' ensuring 'DATE and TIME Stamping'. The ONLINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.
- 5.3** A student can apply for ONLINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from her assigned Faculty Advisor, which should be submitted to the College Academic/Examination Section through the Head of the Department (a copy of the same being retained with the Head, Faculty Advisor and the Student).
- 5.4** A student shall Register for Subjects/Courses of 'her CHOICE' with a total of 18 Credits per semester in the I Year as structured in the Course Curriculum, which will be treated as the Minimum Work Load; she may also seek registration for a maximum of 3 additional/extra credits from those specified for the II Year I Semester (Maximum Work Load thus limited to 21 C) based on her interest, competence, progress, and 'pre-requisites' as indicated for various Subjects/ Courses in the Department Course Structure (for the relevant Specialization) and the Syllabus contents for various Subjects/ Courses, as applicable. All the remaining Credits shall be registered in the II Year-I and II Semesters.
- 5.5** The choice for the 'Additional Subjects/ Courses' in the I Year (in any semester, above the typical 18 Credit norm, and within the Maximum Permissible Limit of 21 Credits, as applicable) must be indicated clearly in the ONLINE Registration, which needs the specific approval and the signature of the Faculty Advisor/Counsellor assigned and the Head of the Department on the hard-copy.
- 5.6** If the student submits ambiguous choices or multiple options or erroneous entries during ONLINE Registration for the Subject(s)/Course(s) under a given/specified Course Group/Category as listed in the Course Structure for that particular PGDC Specialization, ONLY the first mentioned Subject/Course in that Category will be taken into consideration, as applicable.
- 5.7** The Subject/Course Options exercised through ONLINE Registration are final and CANNOT be changed, and CANNOT be inter-changed; further, alternate choices shall also not be considered. However, if the Subject/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 may be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements shall be made by the Head of the Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that semester.

5.8 The Dropping of Subjects/ Courses in any semester of the I Year may be permitted, ONLY AFTER obtaining prior approval and signature from the Faculty Advisor (subject to retaining the minimum of specified 18 Credits) 'within 15 Days of Time' from the beginning of the current semester.

6.0 Class Strength

6.1 The typical student strength for each semester shall be 18 (or as per JNTUH / AICTE Approved Intake).

6.2 A Subject/Course may be offered to the students, ONLY IF a minimum of 50% of the students of a PG Specialization opt for the same.

6.3 In case of the options for Subjects/Courses coming from students of other Departments/Branches/Disciplines also, PRIORITY shall be given to the student of the 'Parent Department' first.

7.0 Attendance Requirements

7.1 A student shall be eligible to appear for the Semester End Examination (SEE) of any subject, if she acquires a minimum of 75% of attendance in that Subject for that semester.

7.2 The condoning of shortage of attendance up to 10% in each Subject (for 65% and above, and below 75% attendance cases) of a semester may be granted by the College Academic Committee (CAC) on genuine and valid grounds based on the student's representation with supporting evidence.

7.3 A stipulated fee per Subject/Course shall be payable towards condoning of shortage of attendance.

7.4 The Shortage of Attendance below 65% in any Subject shall in NO case be condoned.

7.5 A student, whose shortage of attendance is not condoned in any Subject(s) in any semester, is considered as 'Detained Student in that Subject(s)', and is not eligible to take End Examination(s) in the Subject(s) detained in that semester; and she has to seek Re-registration for those Subject(s) in subsequent semesters, and attend the same as and when offered.

7.6 Every student shall put in the minimum required attendance (as specified in Clauses 7.1-7.3) in at least 3 theory subjects and 2 lab courses – (i) in I Year I Semester, for promotion to I Year II Semester, and similarly - (ii) in I Year II Semester along with the 'Mini-Project with Seminar', for promotion to II Year I Semester.

7.7 A student shall not be promoted to the next semester unless she satisfies the attendance requirements of the present semester, as applicable. In such cases, she may seek readmission into that semester (and register for all semester subjects), as and when offered. When she fulfils the attendance requirements in the present semester, she shall not be eligible for readmission (or re-register) into the same class/semester again.

8.0 Academic Requirements

The following Academic Requirements have to be satisfied, in addition to the Attendance Requirements mentioned in Clause 7.0:

8.1 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course, if she secures not less than 40% marks

(28 out of 70 marks) in the Semester End Examination (SEE), and a minimum of 50% of marks (50 out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing 'C' Grade or above in that Subject.

- 8.2** A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to - Mini-Project with Seminar (MPS), in I year II semester if she secures not less than 50% of the total marks allocated. The student would be treated as failed, if she - (i) does not execute the Mini-Project (and prepare the report) as specified by the Supervisor, or (ii) does not present the Seminar as required, or (iii) secures less than 50% of Marks (< 50 marks) in evaluation. She may have to reappear for the 'Mini-Project with Seminar' evaluation, when it is re-scheduled again in that semester; if she fails in such 'one reappearance' evaluation also, she has to reappear for the same in the next subsequent semester(s), as and when scheduled, as supplementary candidate.
- 8.3** A student shall register for all Subjects covering 68 Credits as specified and listed in the Course Structure for the chosen M.Tech. Degree Specialization, put up all the Attendance and Academic requirements for securing 68 Credits obtaining a minimum of C Grade or above in each Subject, and 'earn all 68 Credits securing SGPA ≥ 5.0 (in each semester) and final CGPA (i.e., CGPA at the end of PGDC is to be ≥ 5.0), to successfully complete the PGDC.
- 8.4** The Marks and the Letter Grades obtained in all those Subjects covering the specified 68 Credits alone shall be considered for the calculation of final CGPA, which shall be indicated in the Grade Card of the II Year II Semester.
- 8.5** If a student registers for few more 'extra Subjects' (in the parent Department or other Departments/Branches of Engg.) other than those listed Subjects totalling to 68 Credits as specified in the Course Structure, the performances in those 'extra Subjects' (although evaluated and graded using the same procedure as that of the required 68 Credits) shall not be taken into account while calculating the SGPA and CGPA. For such 'extra Subjects' registered, the Letter Grade alone shall be indicated in the Grade Card as a performance measure, subject to the completion of the Attendance and Academic Requirements as stated in Clauses 7.0 and 8.1 – 8.4 above.
- 8.6** A student who fails to earn 68 Credits as per the specified Course Structure, and as indicated in Clauses 8.1- 8.5, within 4 Academic Years from the Date of Commencement of her I Year, shall forfeit her seat in M.Tech. Programme and her admission shall stand cancelled.
- 8.7** When a student is detained due to the shortage of attendance in any Subject(s) in any semester, no Grade Allotment shall be done for such Subject(s), and SGPA/ CGPA calculations of that semester shall not include the performance evaluations of such Subject(s) in which she gets detained. However, she becomes eligible for re-registration of such Subject(s) (in which she gets detained) in the subsequent semester(s), as and when offered next, with the Academic Regulations of the Batch into which she gets readmitted, by paying the stipulated fees per Subject to the College. In all these re-registration cases, the student shall have to secure a fresh set of Internal Marks (CIE) and Semester End Examination Marks

(SEE) for performance evaluation in such Subject(s), and subsequent SGPA/CGPA calculations.

- 8.8** A student eligible to appear for the Semester End Examination (SEE) in any Subject, but is absent at it or failed (failing to secure C Grade or above), may reappear for that Subject at the supplementary examination (Supplementary SEE) as and when conducted. In such cases, her Internal Marks (CIE) assessed earlier for that Subject/ Course shall be retained and added to the marks to be obtained in the supplementary examination (Supplementary SEE) for the evaluation of her performance in that Subject.

9.0 Evaluation - Distribution and Weightage of Marks

- 9.1** The performance of a student in each semester shall be evaluated Subject-wise (irrespective of the Credits assigned) with a maximum of 100 marks for the Theory or Practicals or Mini-Project with Seminar or Drawing/Design etc; further, Phase-I and Phase-II of the M.Tech. Project Work (in II Year I and II semesters) shall also be evaluated for 100 marks each. These evaluations shall be based on 30% CIE and 70% SEE, and a Letter Grade corresponding to the % of marks obtained shall be given.

- 9.2** For all the Subjects/ Courses as mentioned in 9.1, the distribution shall be: 30 marks for CIE (Continuous Internal Evaluation), and 70 marks for the SEE (Semester End Examination).

- 9.3** a) For the Theory Subjects, the CIE marks shall comprise of - Mid-Term Examination marks (for 30 Marks).

b) During the semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 30 marks (with 120 minutes duration), and the question paper shall contain 2 parts, Part-A is for 06 Marks and shall contain 3 short answer questions of 02 marks each and Part-B is for 24 Marks and shall contain 5 questions of 8 Marks each out of which 3 questions are to be answered. The first Mid-Term examination shall be conducted at the middle of the semester for the first 50% of the syllabus and the second Mid-Term examination shall be conducted at the end of the semester, immediately after the completion of the class work, for the remaining 50% of the syllabus; each shall be evaluated for 30 marks.

c) The first mid-term examination marks, shall make the first set of CIE marks, and the second mid-term examination marks shall make the second set of CIE marks; and the AVERAGE of the two sets of mid-term examination marks shall be taken as the final marks secured by the student towards Continuous Internal Evaluation (CIE) in that Theory Subject.

- 9.4** For the Lab./Practical Subjects, there shall be a Continuous Internal Evaluation (CIE) during the semester for 30 marks, and Semester End Examination (SEE) at the end of the semester for 70 marks. Out of the 30 marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 marks; and the performance in an internal Lab./Practical Test shall be evaluated for 10 marks. The Semester End Examination (SEE) for Lab./ Practicals shall be conducted at the end of the semester by the Lab. Teacher concerned and another faculty member of the same Department as assigned by the Head of the Department.

- 9.5** a) There shall be a Mini-Project, preferably in collaboration with an Industry with the relevant specialization to be registered and executed during the I Year II Semester, for about sixteen weeks duration. It shall also carry 100 marks, out of which CIE shall be for 30 marks, and SEE shall be for 70 marks. Marks earned under CIE for the 'Mini-Project with Seminar' shall be awarded by the Mini-Project Guide/Supervisor (based on the continuous evaluation of student's performance during the Mini-Project execution period).
 b) The Mini-Project work shall be submitted in a Technical Report form, and a presentation of the same shall be made before a Committee as a Seminar, and the 'Mini-Project with Seminar' shall be evaluated by the committee for 70 Marks (SEE). The Committee shall consist of the Head of the Department, the Supervisor of Mini-Project, and a Senior Faculty Member of the Department. Performance evaluation of the 'Mini-Project with Seminar' shall be included in the I Year II Semester Grade Card.
- 9.6** **Electives:** 5 Program Specific Elective Courses and 1 Open Elective Course are offered in the 4 Semester PG Degree Course at GNITS, as per AICTE Model Curriculum. Students are to choose each Elective Course from the corresponding Set of Electives given, and the evaluation of the Elective Course shall be the same as that for the Theory Course/Subject.
- 9.7** Every student shall be required to execute her M.Tech. Project under the guidance of the Supervisor assigned to her by the Head of the Department, and shall submit her dissertation on a topic relevant to her PG specialization.
 a) The M.Tech. Project shall start immediately after the completion of the I Year II Semester, and shall be divided and carried out in 2 phases : Phase-I during II Year I Semester, and Phase-II during II Year II Semester. The student shall prepare and submit two independent Project Work Reports - Project Work Report-I shall include the Project Work carried out under Phase-I, and the Project Work Report-II (Final Report) shall include the Project Work carried out under Phase-I and Phase-II put together.
 b) In Phase-I of the Project Work, the student shall carry out the literature survey, select an appropriate topic and submit a Project Proposal within 6 weeks (immediately after her I Year II Semester End Examinations), for approval by the Project Review Committee (PRC). The PRC shall be constituted by the Head of the Department, and shall consist of the Head of the Department, Project Supervisor, and a Senior Faculty Member of the Department. The student shall present her Project Work Proposal to the PRC (PRC-I Presentation), on whose approval she can 'REGISTER for the M.Tech Project'. Every student shall compulsorily register for her M.Tech. Project Work, preferably within the 6 weeks of time-frame as specified.
 c) After the Registration, the student shall carry out the work, and periodically submit 'a periodic progress report' to her Supervisor throughout the Project period. The PRC shall monitor the progress of the Project Work and review, based on the PRC-II and PRC-III presentations and performance evaluations – the first one at the middle of the II Year I Semester, and the second one at the end of the II Year I Semester (before the I Semester End Examinations). The student shall also

submit the Project Work Report-I to the PRC at PRC-III, for the PRC-III considerations and evaluations.

d) 100 marks are allocated for each Phase (Phase-I and Phase-II) of the Project Work, out of which 30 marks shall be for CIE (Continuous Internal Evaluation/CIE), and 70 Marks will be for SEE (Semester End viva-voce Examination).

e) The marks earned under CIE for the Phase-I of the Project shall be awarded by the Project Guide/Supervisor (based on the continuous evaluation of student's performance, all her PRC presentations during the Project Work Phase-I period and Project Work Report-I). For SEE marks of Project Phase-I, the Project Work Report-I shall be examined, and viva-voce shall be conducted at the end of the II Year I Semester (along with PRC-III) by the PRC, and the corresponding SEE marks shall be awarded.

f) The Phase-II of the Project shall be carried out in the II Year II Semester, and the student's progress and performance evaluation shall be carried out through PRC-IV (at the middle of the II semester), and PRC-V (at the end of the II semester) presentations. The student shall submit the Project Work Report-II (Final Project Report or Dissertation Draft Copy) to the PRC at PRC-V, for the PRC-V considerations and evaluations. Marks earned under CIE for Phase-II of the Project shall be awarded by the Project Guide/Supervisor (based on the continuous evaluation of student's performance, all her PRC presentations during the Project Work Phase-II period and Project Work Report-II). Marks earned under SEE for Phase-II Work shall be awarded by the External Examiner, after the evaluation of the M.Tech. dissertation and the final viva-voce examination of the M.Tech. Project work.

g) After the PRC-V presentation, the PRC shall evaluate the entire performance of the student and declare the Project Work as 'Satisfactory' or 'Unsatisfactory'. Every Final Project Work Report (that has been declared 'satisfactory') shall undergo 'Plagiarism Check' as per the University/ College norms to ensure the content plagiarism below a specified level of 30%, and to be acceptable for submission. In case of the unacceptable plagiarism levels, the student shall resubmit the Modified Project Work Report/Dissertation after carrying out the necessary modifications/additions to her Project Work/Report as suggested by the PRC within the specified time.

h) If any student could not be present for any PRC at the scheduled time (after approval and registration of her Project Work at the PRC-I), or her progress is considered as 'not satisfactory' at any scheduled PRC, she will have to reappear (within one month period) for the same PRC presentation and evaluation at a later date/time as suggested by the PRC.

i) A student is allowed to submit her M.Tech. Project Dissertation 'only after the completion of 40 weeks from the date of approval/registration' of her Project, and after obtaining all the approvals from the PRC. The Extension of time, within the total permissible limits of completion of the PGDC may be considered by the PRC on sufficient valid, genuine grounds.

j) The student shall be allowed to submit her M.Tech. Project Dissertation, only on the successful completion of all the prescribed PG Subjects (Theory and Labs.), Mini-Project with Seminar, etc. (securing C Grade or above), and after obtaining all

approvals from PRC. In such cases, the M.Tech. dissertation will be sent to an External Examiner nominated by the Principal of the College, from the panel of 3 names of external faculty members (Professors or Associate Professors, outside the college) suggested by the Head of Department, on whose approval, the student can appear for the M.Tech. Project viva-voce Examination, which shall be conducted by a Board, consisting of the PG Project Supervisor, Head of the Department, and the External Examiner who adjudicated the M.Tech. Project Work and Dissertation. The Board shall jointly declare the Project Work Performance as 'satisfactory', or 'unsatisfactory'; and in successful cases, the External Examiner shall evaluate the Student's Project Work presentation and performance for 70 Marks (SEE).

k) If the adjudication report of the External Examiner is 'not favourable', then the student shall revise and resubmit her M.Tech Dissertation after one semester, or as per the time specified by the External Examiner and/ or the PRC. If the resubmitted report is again evaluated by the External Examiner as 'not favourable', then that Dissertation will be summarily rejected. Subsequent actions for such rejected dissertations may be considered, only on the specific recommendations of the External Examiner and/ or PRC.

l) In cases, where the Board declared the Project Work Performance as 'unsatisfactory', the student is deemed to have failed in the Project viva-voce Examination, and she may reappear for the viva-voce Examination as per the Board's recommendations. If she fails in the second viva-voce Examination also, she shall not be considered eligible for the Award of the Degree, unless she is asked to revise and resubmit her Project Work by the Board within a specified time period (within 4 years from the date of commencement of her I Year I Semester).

10.0 Re-Admission / Re-Registration

10.1 Re-Admission for Discontinued Students :

The student who has discontinued the M.Tech. Degree Programme on account of any reasons whatsoever, may be considered for 'Readmission' into the same Degree Programme (with same specialization) with the Academic Regulations of the Batch into which she get readmitted, with prior permission from the authorities concerned, subject to Clause 4.1.

10.2 Re-Registration for Detained Students :

When any student is detained in a Subject(s) on account of the shortage of attendance in any semester, she may be permitted to re-register for the same Subject(s) in the 'same category' (Core or Elective Group) or equivalent Subject(s) if the same Subject is not available, as suggested by the BoS Chair of that Department, as and when offered in the sub-subsequent semester(s), with the Academic Regulations of the Batch into which she seeks re-registration, with prior permission from the authorities concerned, subject to Clause 4.1.

11.0 Grading Procedure

11.1 The marks shall be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Mini-Project with Seminar, or Project etc., and based on the % of marks obtained in CIE + SEE (Continuous Internal Evaluation +

Semester End Examination, both taken together) as specified in Clause 9.0, a corresponding Letter Grade shall be given.

11.2 A Letter Grade does not imply any specific % of marks.

11.3 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:

<i>% of Marks Secured (Class Intervals)</i>	<i>Letter Grade (UGC Guidelines)</i>	<i>Grade Points (GP)</i>
90% and above ($\geq 90\%$, $\leq 100\%$)	O (Outstanding)	10
Below 90% but not less than 80% ($\geq 80\%$, $< 90\%$)	A⁺ (Excellent)	9
Below 80% but not less than 70% ($\geq 70\%$, $< 80\%$)	A (Very Good)	8
Below 70% but not less than 60% ($\geq 60\%$, $< 70\%$)	B⁺ (Good)	7
Below 60% but not less than 55% ($\geq 55\%$, $< 60\%$)	B (above Average)	6
Below 55% but not less than 50% ($\geq 50\%$, $< 55\%$)	C (Average)	5
Below 50% ($< 50\%$)	F (FAIL)	0

11.4 A student obtaining F Grade in any Subject shall be considered 'failed', and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), in the subsequent semesters, as and when offered. In such cases, her Internal marks (CIE marks) in those Subject(s) will remain same as those she obtained earlier.

11.5 In general, a student shall not be permitted to repeat any Subject(s) with the sole intention of 'Grade Improvement' or 'SGPA/ CGPA Improvement'. However, she has to repeat all those Subject(s), in which she gets 'detained due to lack of required attendance' (as listed in Clauses 8.7 and 10.2), through Re-Registration at a later date.

11.6 A student earns Grade Points (GP) in each Subject on the basis of the Letter Grade obtained by her in that Subject. Then, the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Points with Credits for that particular Subject/Project.

Credit Points (CP) = Grade Points (GP) x Credits

11.7 The student passes the Subject/Project only when she gets $GP \geq 5$ (C Grade or above).

11.8 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL the Subjects/ Seminar/ Comprehensive Viva-voce/Project 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:

$$\text{SGPA} = \{ \sum_{i=1}^N C_i G_i \} / \{ \sum_{i=1}^N C_i \} \dots \text{For each semester,}$$

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester, C_i is the no. of Credits allotted to the ith Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that ith Subject.

- 11.9** 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 Second Semester onwards, at the end of each Semester, as per the formula:

$$\text{CGPA} = \{ \sum_{j=1}^M C_j G_j \} / \{ \sum_{j=1}^M C_j \} \dots \text{For all S Semesters registered}$$

(ie., upto and inclusive of S semesters, $S \geq 2$),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of that PGDC Specialization) the student has 'REGISTERED' from the 1st Semester onwards up to and inclusive of the Semester S (obviously $M > N$), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the jth Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After Registration and completion of the I Year I Semester however, the SGPA of that Semester itself may be taken as CGPA, as there are no cumulative effects.

- 11.10** For the Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs shall be used.
- 11.11** For the calculations listed in Clauses 11.6 – 11.10, performance in the failed Subjects/Courses (securing F Grade) shall also be taken into account, and the Credits of such Subjects/Courses shall also be included in the multiplications and summations.
- 11.12 Passing Standards :**
- A Student shall be declared successful or 'passed' in a semester, only when she gets a $\text{SGPA} \geq 5.00$ (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire PGDC, only when she gets a $\text{CGPA} \geq 5.00$; subject to the condition that she secures a $\text{GP} \geq 5$ (C Grade or above) in every registered Subject/ Course in each semester (during the entire PGDC), for the Award of the Degree, as required.
 - After the completion of each semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the registered students of that semester, indicating the Letter Grades and the Credits earned. The Grade Card/Grade Sheet

shall show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned), Credits earned, SGPA, and CGPA etc.

12.0 Declaration of Results

12.1 The Computation of SGPA and CGPA are done using the procedure listed in Clauses 11.6 – 11.11.

12.2 For the Final % of Marks equivalent to the computed CGPA, the following formula may be used

$$\text{\% of Marks} = \text{CGPA} \times 10$$

13.0 Award of Degree

13.1 A student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes all the examinations prescribed in the entire M.Tech. Programme (PGDC), and secures the required number of 68 Credits (with CGPA ≥ 5.0), within the 4 Academic Years from the Date of Commencement of the First Academic Year, shall be declared to have 'QUALIFIED' for the Award of the M.Tech. Degree in the chosen Branch of Engineering, with the Specialization considered at the time of Admission.

13.2 A student who qualifies for the Award of the M.Tech. Degree (in her chosen Branch/ Specialization) as listed in Clause 13.1, shall be placed in the following Class Divisions:

13.3 a) A student with CGPA (at the end of the PG Degree Course) ≥ 8.00 , and fulfilling the following conditions -

(i) should have passed all the Subjects/Courses in 'FIRST APPEARANCE' within the first 2 Academic Years (or 4 Sequential Semesters) from the Date of Commencement of her First Academic Year,

(ii) should have secured a CGPA ≥ 8.00 , at the end of each of the first 4 sequential semesters, starting from the I Year I Semester onwards,

(iii) should not have been detained or prevented from writing the End Semester Examinations in any Semester due to the shortage of attendance or any other reason **shall be placed in 'FIRST CLASS with DISTINCTION'**.

b) A student with CGPA ≥ 8.00 , but has not fulfilled the conditions under Clause 13.3 (a) shall be placed in 'FIRST CLASS'.

13.4 A student with CGPA (at the end of the PG Degree Course) ≥ 6.50 but < 8.00 , shall be placed in 'FIRST CLASS'.

13.5 A student with CGPA (at the end of the PG Degree Course) ≥ 5.00 but < 6.50 , shall be placed in 'SECOND CLASS'.

13.6 A student with CGPA (at the end of the PG Degree Course) < 5.00 will not be eligible for the Award of the Degree.

13.7 A student fulfilling the conditions listed under Clause 13.3 (a) alone, shall be the eligible candidate for the 'University Rank' and 'Gold Medal' considerations.

14.0 Withholding of Results

14.1 If a student has not paid fees to the University/ College at any stage, or has pending dues against her name on account of any reason whatsoever, or if any case of indiscipline is pending against her, the result of such student may be withheld, and

she shall not be allowed to into the next higher semester. The Award or issue of the Degree may also be withheld in such cases.

15.0 Transitory Regulations

15.1 A student who has discontinued for any reason, or has been detained for want of attendance or lack of required credits as specified, or who has failed in her M.Tech. Degree Course after the PGDC period of 2 years, may be considered eligible for readmission - to the same PGDC with same set of Subjects/ Courses (or equivalent Subjects/ Courses as the case may be), and/or to the same Program Specific Electives (or from same set/category of Electives or equivalents as suggested), as and when they are offered (within the time-frame of 4 years from the Date of Commencement of her I Year I Semester), along with the Academic Regulations of the Batch into which she gets readmitted.

16.0 Student Transfers

16.1 There shall be no Branch/ Specialization transfers after the completion of the Admission Process.

17.0 Scope

- i) Where the words “Subject” or “Subjects”, occur in these regulations, they also imply “Course” or “Courses”.
- ii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.
- iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.
- iv) The College may change or amend the Academic Regulations, Course Structure or Syllabi at any time, and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College Authorities.

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MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	If the student:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which student is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the student is to be cancelled and sent to the university.

3.	Impersonates any other student in connection with the examination.	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.

6.	Refuses to obey the orders of the chief superintendent/assistant superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.

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

M.Tech. 2 Year (4 semesters) Regular Programme in EEE

(Applicable for the Batch admitted from the Academic Year 2018-19 onwards)

Specialization: Power Electronics & Electric Drives**COURSE STRUCTURE for I Year I Semester**

S.No	Group	Subject	L	T	P	Credits
1)	PC	Advanced Electric Drives	3	-	-	3
2)	PC	Modeling and Analysis of Electrical Machines	3	-	-	3
3)	PSE	Program Specific Elective -1	3	-	-	3
4)	PSE	Program Specific Elective -2	3	-	-	3
5)	PC	Electric Drives Laboratory	-	-	4	2
6)	PC	Electrical Systems Simulation Lab	-	-	4	2
7)	PW	Research Methodology and IPR	2	-	-	2
8)	Audit	AUDIT COURSE 1	2	-	-	-
	TOTAL		16	-	8	18

Program Specific Elective -1	Program Specific Elective- 2	Audit Course -1
Advanced Power Electronic Circuits	Static VAR Controllers and Harmonic Filtering	English for Research Paper Writing
Optimal and Adaptive Control	HVDC Transmission	Disaster Management
Dynamics of Electrical Machines	Modelling of Power Semiconductor Devices	Pedagogy Studies
--	--	Personality Development through Life Enlightenment Skills

COURSE STRUCTURE for I Year II Semester

S.No	Group	Subject	L	T	P	Credits
1)	PC	Power Quality	3	-	-	3
2)	PC	Digital Control of Power Electronics and Drive Systems	3	-	-	3
3)	PSE	Program Specific Elective -3	3	-	-	3
4)	PSE	Program Specific Elective -4	3	-	-	3
5)	PC	Power Quality Lab	-	-	4	2
6)	PC	Power Converters Simulation Lab	-	-	4	2
7)	PW	MINI PROJECT with Seminar	-	-	4	2
8)	Audit	AUDIT COURSE 2	2	-	-	-
	TOTAL		14	-	12	18

Program Specific Elective -3	Program Specific Elective- 4	Audit Course -2
Smart Grid	Advanced Microcontroller based Systems	SANSKRIT for Technical Knowledge
Switched Mode and Resonant Converters	Distributed Generation	Value Education
Electric Vehicles	Digital Signal Processors	Constitution of India
--	--	Stress Management by YOGA

COURSE STRUCTURE for II Year I Semester

S.No	Group	Subject	L	T	P	Credits
1)	PSE	Program Specific Elective -5	3	-	-	3
2)	OE	Open Elective - 1	3	-	-	3
3)	PW	Project/ Dissertation phase – 1	-	-	20	10
	TOTAL					16

Program Specific Elective -5
PLCs and FPGAs
FACTS and Custom Power Devices
Design of Power Converters

COURSE STRUCTURE for II Year II Semester

S.No	Group	Subject	L	T	P	Credits
1)	PW	Project/ Dissertation Phase - 2	-	-	32	16
	TOTAL					16

LIST OF OPEN ELECTIVES

1. Business Analytics.
2. Industrial Safety.
3. Operations Research.
4. Cost Management of Engineering Projects.
5. Composite Materials.
6. Energy from Waste.
7. Power from Renewable Energy Sources

ADVANCED ELECTRIC DRIVES

Prerequisites: Electrical Machines, Power Electronics, Control Systems

Course Objectives:

1. To Understand Basic electrical drives and their analysis.
2. To Learn Design of controller for drives.
3. To Understand scalar control, vector control of drives and special motors.

Unit1: (~10 Lecture Hours)

Control Techniques for DC motor drives:

Phase controlled DC motor drives: Transfer function of current and speed controllers, current and speed feedback-design of current and speed controllers-Simulation of DC motor drive - motor equations-filter in the speed feedback loop controller-current reference generator –current controller and flow chart for Simulation.

Chopper controlled DC motor drives: Model of the chopper –closed loop operation of DC motor drives –speed controlled drive system-current control loop - pulse width modulated current controller- Hysteresis current controller-modelling of current controller, design of current controller-dynamic simulation of the speed controlled DC motor drive.

Unit2: (~8 Lecture Hours)

Scalar control of induction motor drives:

Voltage fed inverter control –open loop volts /HZ control – speed control with slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive-current fed inverter control-Independent current and frequency control –speed and flux control in current fed inverter drive-volts/Hz control of current fed inverter drive – efficiency optimization control by flux program.

Unit3: (~10 Lecture Hours)

Vector control of Induction motor drives:

Vector control: Principle of vector control –vector controlled methods- direct method of vector control – indirect method of vector control- Direct torque and flux control (DTC)- Adaptive control – self tuning control – model referencing adaptive control – sliding mode control.

Unit4: (~8 Lecture Hours)

Synchronous motor drives:

Current of permanent magnet synchronous motor drive: Constant torque angle control-unity power factor control - constant mutual flux linkages control-indirect flux weakening – maximum permissible torque speed control scheme – implementation strategy.

Unit5: (~8 Lecture Hours)

Brushless DC motor and switched reluctance motor drives:

Brushless DC motor drive: Difference between mechanical and electronic commutator –Hall effect sensors – optical sensors – multiphase Brushless motor – square wave permanent magnet brushless motor drive. Switched reluctance motor.

Principle of operation –Torque equation – Power Electronic Converter circuit characteristics and control – Torque / speed characteristics current sensing – Rotor position requirement and estimation.

Text Books:

1. R.Krishnan –“Electric Motor Drives”, “Modeling, Analysis and Control” - Pearson Education-low price edition – 1st edition-2002.
2. Bimal K. Bose “Modern Power Electronics and AC Drives” Pearson education –low price edition-4th edition 2004.
3. R.Krishnan, “Switched reluctance motor drives-Modelling, Analysis and Control” Prentice Hall of India Pvt. Ltd., New Delhi,2003.

Reference Books:

1. MD Murphy and FG Turn Bull” Power Electronic control of AC Motors” Pergman Press 1st edition.
2. GK. Dubey “Fundamentals of Electrical Drives”- Narora publications -1995.
3. B.K.Bose “Power Electronics and Variable frequency drives”- IEEE Press - Standard publications – 1st edition-2002.
4. Miller T.J.E “Brushless permanent magnet and reluctance motor drives”, Clarendon press, oxford,1989.

Online Resources:

1. <http://nptel.ac.in/courses/108104011>

Course Outcomes:

Students will be able to:

1. Model and simulate electric drive systems.
2. Design power electronics converters, for drives application.
3. Design appropriate current/voltage regulators for electric drives.
4. Analyze the various speed control methods for drive.
5. Identify the motors for suitable application.
6. Evaluate and differentiate between scalar and vector control techniques of induction motor drives.

MODELING AND ANALYSIS OF ELECTRICAL MACHINES

Prerequisites: All Electrical Machines Courses

Course objectives:

1. To understand the operation of an electrical machine mathematically.
2. To understand how a machine can be represented by its mathematical model.
3. To develop mathematical model of AC & DC machines and perform transient analysis on them.

Unit 1: (~8 Lecture Hours)

Principles of electromagnetic Energy Conversion, General expressions of stored magnetic energy, Co-energy and force/torque, example using a doubly excited system. Basic Concepts of Rotating machines –Calculation of air gap mmf and per phase machine inductance using physical machine data; Voltage and torque equation of the DC machine.

Unit 2: (~8 Lecture Hours)

Basic two pole DC machine – primitive two axis machine – voltage and current equations – torque equations.
Mathematical modeling of separately excited, shunt, series and compound DC motors.

Unit 3: (~12 Lecture Hours)

Symmetrical Induction machines-Introduction, Voltage equations in machine variables, Torque equation in machine variables, Equations of transformation for rotor circuits, Voltage equations in arbitrary reference-frame variables, Torque equation in arbitrary reference-frame variables, Commonly used reference frames.

Unit 4: (~8 Lecture Hours)

Synchronous machines-Introduction, Voltage equations in machine variables, Torque equation in machine variables, Stator voltage equations in arbitrary reference-frame variables, voltage equations in rotor reference-frame variables: Park's equations, Torque equations in substitute variables, Rotor angle and angle between rotors.

Unit 5: (~10 Lecture Hours)

Special Machines – Permanent magnet synchronous machine; Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines; Construction and operating principle; Analysis of Brushless D.C. Motor for space Applications.

Text Books

1. P.C.Krause "Analysis of Electric Machines" Wiley IEEE Press 3rd Edition.
2. P.S. Bimbhra, "Generalized Machine theory" Khanna Publishers.
3. R.Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India.

Reference Books

1. Charles Kingsley, Jr., A.E. Fitzgerald, Stephen D.Umans, "Electric Machinery". Tata McGraw Hill.
2. Miller, T.J.E., "Brushless Permanent Magnet and reluctance Motor Drives", Clarendon Press.

Online Resources:

1. <http://nptel.ac.in/courses/108106023>

Course Outcomes:

Students will be able to:

1. Gain Knowledge about the dynamic behavior rotating machines.
2. Derive & analyze equivalent circuit of synchronous machines.
3. Understand & apply various practical issues of different machines.
4. Identify special machines from the perspective of their salient features.
5. Create dynamic model and analyze 2 ϕ asymmetrical induction machine & 1 ϕ induction machine.
6. Distinguish between abc model & dq models of rotating machines.

ADVANCED POWER ELECTRONIC CIRCUITS (Program Specific Elective 1.1)

Prerequisites: Power Electronics

Course Objectives:

1. To understand the operation of advanced power electronic topologies.
2. To understand the control strategies of various converters.
3. To analyze various power converters and identify their applications.

Unit 1: (~8 Lecture Hours)

High power switching devices

Gate turn-off thyristor (GTO)-Gate Commutated thyristors(GCT)-Insulated gate Bi polar Transistor-Other switching devices-DC to DC converters: Switched mode regulators-Analysis of Buck, Boost, Buck-Boost and Cuk Regulators- Condition for continuous inductor current and capacitor voltage-Multi-output boost converters-Advantages-Applications.

Unit 2: (~8 Lecture Hours)

Two level Voltage source inverter

Sinusoidal PWM-modulation scheme-Harmonic content-overmodulation-third harmonic injection PWM-Space vector modulation-Switching states-space vectors-dwell time calculation-modulation index-switching sequence-spectrum analysis-even-order harmonic Elimination.

Unit 3: (~10 Lecture Hours)

Power Electronic Converters Processing ac Voltage and Power Blocks Geometry

Principles of Power Blocks Geometry, Description of Power Blocks, Application of PBG in multi-level configurations-Neutral point clamped configuration, cascade configuration, Flying capacitor configuration, Other multi-level configurations, Application of PBG in ac-dc-ac configurations-Classification of multilevel inverters.Neutral point Clamped configuration- Three-level configuration, PWM implementation(Half-bridge topology), Full-bridge topologies, three -phase NPC converter, Non-Conventional arrangements by using three-level legs, Unbalanced capacitor voltage, Four-level configuration, PWM implementation(Four-level configuration), Full-bridge and other circuits(Four-level configuration), Five-level configuration.

Unit 4: (~10 Lecture Hours)

Cascade Configuration

Single H-bridge converter, PWM implementation of a single H-bridge converter, three-phase converter-one H-bridge converter per phase, two H-bridge converters, PWM implementation of two cascade H-bridges, Three-phase converter-two cascade H-bridges per phase, two H-bridge converters(seven and nine level topologies), three H-bridge converters, four H-bridge converters and generalization.

Unit 5: (~10 Lecture Hours)

Flying Capacitor Configuration

Three-level configuration, PWM implementation(Half-bridge topology), flying capacitor voltage control, full-bridge topology, three-phase FC converter, Non-conventional FC converters with three-level legs, Four-level configuration, Generalization.

Text Books:

1. Bin Wu-A John Wiley & Sons “High power converters and AC drives” Inc,Publication –IEEE Press.
2. Euzeli Cipriano Dos Santos Jr. and Edison Roberto Cabral Da Silva- A John Wiley & Sons, “Advanced Power Electronics converters” Inc, Publication – IEEE Press.
3. Ned Mohan, Tore M. Undeland and William P. Robbins – John Wiley and sons – “Power Electronics” Second Edition.
4. Mohammed H. Rashid, “Power Electronics” Pearson Education, Third Edition.
5. G.K.Dubey “Thyristorised Power Controllers” Wiley Eastern Ltd. 2005-06.

Reference Books:

1. Cyril W Lander “Power Electronics” McGraw Hill - 2005.
2. Abraham I Pressman “Switching Power Supply Design” McGraw Hill Publishing Company.
3. Robert W. Erickson, Dragan and Maksimovic, “Fundamentals of Power Electronics”–Springer.
4. M.S. Jamil Asghar “Power Electronics”- PHI Private Limited.

Online Resources:

1. <http://nptel.ac.in/courses/108108077>

Course Outcomes:

Subsequent to completion of the course, the student should be able to:

1. Acquire knowledge about analysis and design of various converter topologies
Viz. DC- DC converters etc.,
2. Analyze of two level converters.
3. Analyze of multi level inverters.
4. Apply space vector modulation techniques under different operating conditions.
5. Apply Knowledge acquired to increase the level of converters.
6. Achieve hardware implementation of the different types of converters.

OPTIMAL AND ADAPTIVE CONTROL
(Program Specific Control 1.2)

Prerequisites: Control Systems

Course Objectives:

1. To acquire knowledge in the mathematical area of 'calculus of variations' so as to apply the same for solving the optimal control problems.
2. To acquire knowledge of problem formulation, performance measure and mathematical treatment of optimal control problems so as to apply the same to engineering control problems with the possibility to do further research in this area.
3. To acquire knowledge on solving optimal control design problems by taking into consideration the physical constraints on practical control systems.

Unit1: (~10 Lecture Hours)

Optimal Control Problem – Open loop & Closed loop form of Optimal Control – Measures for Optimal Control Problems – General form of performance measures – Fundamental concepts & theorems of Calculus of variations – Function & Functional – Extremal of functionals with dependant functions – Use of Lagrange multipliers – differential equation constraints – isoperimetric constraints.

Unit 2: (~8 Lecture Hours)

The variational approach to solving optimal control problems – Necessary conditions for optimal control using Hamiltonian – Different boundary conditions for solving the optimal control problem – closed loop control for linear regulator problem – Linear tracking problem.

Unit 3: (~8 Lecture Hours)

Pontryagin's minimum principle – State inequality constraints – Minimum time problem – Minimum control effort Problem. Dynamic Programming – Principle of optimality – application to multistage decision making – application to optimal control problem.

Unit 4: (~7 Lecture Hours)

Need for interpolation – recurrence relation of dynamic programming – curse of dimensionality – discrete linear regulator problem – Hamilton-Jacobi-Bellman equation – continuous linear regulator problem.

Unit 5: (~9 Lecture Hours)

An overview of Adaptive control Systems – Model Reference Adaptive Systems (MRAS) – the need for MRAS - Mathematical description of Model Reference Adaptive Systems (MRAS) – Design Hypothesis –Equivalent representation of MRAS. Introduction to design method based on the use of Liapunov function – design & simulation an adaptive of variable structure model-following control.

Text Books:

1. Donald E. Kirk, Optimal Control Theory, An introduction, Prentice Hall Inc., 2004
2. Yoan D. Landu, Adaptive Control (Model Reference Approach), Marcel Dekker. 1981

Reference Books:

1. HSU and Meyer , Modern Control, Principles and Applications, McGraw Hill, 1968
2. A.P. Sage, Optimum Systems Control, Prentice Hall, 1977
3. K.K.D.Young, Design of Variable Structure Model Following Control Systems., IEEE Transactions on Automatic Control, Vol. 23, pp 1079-1085, 1978.
4. A.S.I. Zinobar, O.M.E. EI-Ghezawi and S.A. Billings, Multivariable variable structure adaptive model following control systems. . Proc. IEE., Vol. 129, Pt.D., No.1, pp 6-12, 1982.

Online Resources:

- 1.<http://nptel.ac.in/courses/108107098>

Course Outcomes:

1. Apply the knowledge in the mathematical area of 'calculus of variations' for solving the optimal control problems.
2. Apply the knowledge of problem formulation, performance measure to engineering control problems with the possibility to do further research in this area.
3. Solve optimal control design problems by taking into consideration the physical constraints on practical control systems.
4. Apply the knowledge of controller design problems to obtain optimal solutions by taking into consideration the limitation on control energy.
5. Apply the knowledge acquired to develop and utilize modern software tools for design and analysis of optimal control problems.
6. Extend the knowledge in model reference adaptive control system design to other areas of model-following control.

DYNAMICS OF ELECTRICAL MACHINES

(Program Specific Elective 1.3)

Prerequisites: Electrical Machines, Circuits Theory

Course objectives:

1. To impart knowledge on the performance characteristics of different machines.
2. To gain understanding of the dynamics of different machines.
3. To determine both steady state and treatment stability of the different machines.

Unit 1: (~8 Lecture Hours)

Dynamics of Separately Excited DC Generator:

Steady state analysis, Transient analysis-Sudden step field excitation at no-load and load-Sudden short circuit of armature terminals-Sudden short circuit of field terminals, Generator operation with displaced brushes.

Unit 2: (~8 Lecture Hours)

Dynamics of DC Motors:

Separately Excited DC Motor-Steady state analysis, Transient analysis-Sudden application of voltage and load torque-Sudden application of inertia load, Transfer function- Dynamic behaviour. DC Series Motor: Steady state analysis-Linearization techniques for small perturbations.

Unit 3: (~10 Lecture Hours)

Transients in Transformers:

Excitation phenomena-Harmonics in single -phase transformers, Over current transients-Qualitative and Analytical approaches.- Estimation of inrush current, External and Internal over voltages -Transformer equivalent circuit with over voltages-Initial voltage distribution for solidly grounded neutral and isolated neutral.

Unit 4: (~10 Lecture Hours)

Induction Machine Dynamics:

Dynamics during starting and braking-Accelerating time- Dynamics during normal operation, Operation on unbalanced supply voltages- Equivalent circuit, Operation on Single phasing- Equivalent circuit.

Unit 5: (~8 Lecture Hours)

Synchronous Machine Dynamics:

Electro-mechanical equation- Motor operation- Generator operation- Linearized analysis, Cyclic variations of shaft torque, Electric braking-Plugging and Dynamic braking.

References Books:

1. Bhimbra P.S. *Generalized Theory of Electrical Machines*, Khanna Publishers, 2002.
2. Nagrath I.J. & Kothari D.P, *Electric Machines*, Tata McGraw Hill Publishers, 2004.
3. I. Boldia & S.A. Nasar, *Electrical Machine Dynamics*, The Macmillan Press Ltd. 1992
4. C.V. Jones, *The Unified Theory of Electrical Machines*, Butterworth, London. 1967

Text Books:

1. D.P. Sengupta & J.B. Lynn, Electrical Machine Dynamics, The Macmillan Press Ltd. 1980
2. R Krishnan “Electric Motor Drives, Modeling, Analysis, and Control”, Pearson Education., 2001
3. P.C. Kraus, Analysis of Electrical Machines, McGraw Hill Book Company, 1987

Course outcomes:

Students will be able to:

1. Formulate of electrodynamic equations of all electric machines and analyze their performance characteristics.
2. Analyze /interpret of transformations for the dynamic analysis of different machines.
3. Determine of stability of the machines under small signal variations and Transient conditions
4. Formulate and solve the problems related to synchronous machines.
5. Analyze the problems related to DC machines by using linearization and other techniques.
6. Carry out the dynamic analysis of AC machines under different operating conditions.

STATIC VAR CONTROLLERS AND HARMONIC FILTERING

(Program Specific Elective 2.1)

Prerequisites: Power Electronics, Power Systems

Course Objectives:

1. To impart knowledge on various static converters used in Transmission & Distribution Systems.
2. To gain Understanding of the static converter control strategies.
3. To Understand the reactive power compensation and its control.
4. To design controllers for Harmonic filtering.

Unit 1: (~10 Lecture Hours)

Fundamental concepts

Fundamentals of Load Compensation and EHV Line Compensation, Introduction of FACTS, Basic types of FACTS Controllers, Definitions of FACTS controllers, Brief description of FACTS Controllers, Summary of main Power Electronic Devices (SCR, IGBT and GTO), Similarities and Differences between them. Power Quality Issues: Sags, Swells, Unbalance, Flicker, Distortion, Current Harmonics, Sources of Harmonics in Power Systems, Need for Harmonic Filtering and Power Quality Monitoring.

Unit 2: (~10 Lecture Hours)

Static Shunt Compensators

Static VAR Compensators (SVC) - FC-TCR, TSC-TCR and their control schemes, Coordination of the power system characteristics and the SVC characteristics for applications, Applications of SVC in power flow control and for enhancing Stability of power systems and enhancing the power carrying capacity in EHV Lines

Static Synchronous Compensator (STATCOM) – Operating Principle of Voltage Source Inverters and STATCOM Control Schemes, Application of STATCOM for Sag/Swell mitigation in distribution systems.

Unit 3: (~10 Lecture Hours)

Static Series Compensators

Thyristor -Controlled Series Capacitor (TCSC): Operating principle of TCSC , Control Schemes and their Protection, Application of TCSC to enhance power carrying capacity of EHV lines and for power system stability improvement.

Static Synchronous Series Compensator (SSSC) :Operating principle of SSSC and their Control schemes. Application of SSSC for improving stability and damping in power systems.

Unit 4: (~8 Lecture Hours)

Harmonic in Static Converters

Quantification of Harmonics produced in different converters employing standard Modulation Strategies (SPWM, SVM), Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type, Multi-level inverters of Cascade Type and their modulation, Current Control of Inverters.

Unit -5 (~8 Lecture Hours)

Harmonic Filtering Techniques

Passive Harmonic Filtering :Single Phase Shunt Current Injection Type Filter and its Control, Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modeling, Three phase four wire shunt active filters, Hybrid Filtering using Shunt Active Filters, Dynamic Voltage Restorer and its control, Power Quality Conditioner.

Active Harmonic Filtering: Series Active Filtering in Harmonic Cancellation Mode, Series Active Filtering in Harmonic Isolation Mode.

Text books:

1. Hingorani, L, Gyugyi, "Concepts and technology of Flexible AC Transmission Systems", IEEE Press New York, 2000 ISBN-0780334588.
2. E Acha, V G Agelidis, O Anaya- Lara, T.J.E. Miller, "Power Electronic Control in Electrical Systems", Elsevier, 2006.
3. Prabha Kundur, "Power System Stability and Control", Tata McGraw Hill, 2006.

Reference books:

1. Ned Mohan et.al, "Power Electronics", John Wiley and Sons, 2006.
2. G. Massobrio, P. Antognet, "Semiconductor Device Modeling with Spice", McGraw-Hill, Inc., 1988.
3. B. J. Baliga, "Power Semiconductor Devices", Thomson, 2004
4. V. Benda, J. Gower, D. A. Grant, "Power Semiconductor Devices. Theory and Applications", John Wiley & Sons, 1994.

Course Outcomes:

After completion of the course students should be able to:

1. Apply various compensation techniques in FACTS devices.
2. Analyze various static converter control strategies
3. Identify the FACTS devices for different applications on system control.
4. Analyze / interpret harmonic filtering and design their controllers.
5. Formulate and solve problem related to static compensator.
6. Identify and reduce Harmonics in static compensator through different Harmonic filtering techniques.

HVDC TRANSMISSION
(Program Specific Elective 2.2)

Prerequisites: Power Systems, Power Electronics

Course Objectives:

1. To classify HVDC systems and their major components
2. To identify and implement suitable control schemes for a given type of system
3. To design suitable converters, filters for a given application
4. To analyze faults in converter stations.

Unit 1: (~8 Lecture Hours)

DC TRANSMISSION TECHNOLOGY: Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC links. Equipment required for HVDC systems. Line Commutated Converter and Voltage Source Converter based systems. Planning & Modern trends in HVDC Technology. Introduction to Relevant national and international standards, digital techniques in HV measurements.

Unit 2: (~10 Lecture Hours)

ANALYSIS OF HVDC CONVERTERS: Choice of converter configurations, Analysis of six pulse converter, Analysis with and without commutation overlap, harmonics. Characteristics of Twelve Pulse Converters. Inverter Operation.

CONTROL OF HVDC CONVERTERS: Principle of DC Link Control, Control Hierarchy, Firing Angle Control: Current and Extinction Angle Control. Starting and Stopping of DC Link, Higher level Controllers : Real and reactive Power control and Frequency Control.

UNIT 3: (~8 Lecture Hours)

CONVERTER FAULTS & PROTECTION : Types of faults- Faults on AC side of Converter Stations-Converter faults – Faults on DC side of the System - Protection against over current and over voltage in converter station - Surge arresters - Smoothing reactors – Transient over voltages in DC line- DC breakers - Corona effects on DC lines - Radio interference.

UNIT4: (~9 Lecture Hours)

HARMONICS : Harmonics in HVDC: Generation of Harmonics - Characteristics harmonics and Non Characteristics harmonics, Adverse effects of harmonics, Calculation of AC current and DC voltage Harmonics , Effect of Pulse number on harmonics. Filter configuration- Types of AC filters-Design of Single tuned, double tuned and high pass filters. Minimum Cost of Tuned AC Filters. Reactive Power Requirements in steady state-Conventional and Alternate control strategies. Sources of reactive power: AC Filters, shunt capacitors and synchronous condensers.

UNIT 5: (~10 Lecture Hours)

AC -DC POWER SYSTEMS AND MTDC SYSTEMS : Interaction between AC -DC systems. Over voltages on AC/DC side of power system. Multi-terminal HVDC systems and their control. Modeling of HVDC systems, per unit system, Representation of power flow solution and stability studies

Text Books:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

Reference Books:

1. S.Kamakshaiah and V.Kamaraju, HVDC Transmission
2. E.Uhlmann, Power Transmission by Direct Current. B.S. Publications.
3. S.Rao, EHVAC and HVDC Transmission Engineering and Practice.

Online Resources:

- 1.<http://nptel.ac.in/courses/108104013>

Course Outcomes:

1. Classify HVDC systems, categorize major components employed and applications of HVDC Transmission system
2. Identify a device and its control scheme for a given application in the HVDC system. viz power control converter control etc.
3. Design a suitable device like converters, filters and their protection schemes in a HVDC system.
4. Analyze various faults in converter stations and interaction between AC-DC systems.
5. Realize the mathematical model of the HVDC system
6. Analyze the control methods of the MTDC systems.

**MODELING OF POWER SEMICONDUCTOR DEVICES
(Program Specific Elective 2.3)****Prerequisites:** Power Electronics**Course Objectives:**

1. To learn the basics of power semiconductor switches.
2. To understand the working of various types of converters and application of them.
3. To understand and design the drive circuits for various Power Semiconductor Switches.
4. To learn to model the converters and semiconductor switches.
5. To learn about the control of various power semiconductor switches.

Unit1: (~10 Lecture Hours)

Power Diodes, Basic Structure and I-V Characteristics - on State Losses, Switching Characteristics, Turn on Transient, Turn off Transient, Reverse Recovery Transient, Schottky Diodes-Thyristors – 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, Turn off time and dv/dt limitations, Ratings of Thyristors. Snubber Requirements and snubber design- Triacs. Basic structure and operation, V-I Characteristics, Ratings, Snubber Requirements- Gate Turnoff Thyristor (GTO). Basic Structure and operation. GTO Switching Characteristics, GTO Turn on Transient, GTO Turn off Transient, Minimum ON and OFF State times.

Unit 2:(~8 Lecture Hours)

Power BJTs, Basic Structure and I-V Characteristics, Breakdown Voltages and Control, Second Breakdown and its Control- FBSOA and RBSOA Curves –On State – Switching Characteristics, Resistive Switching Specifications, Turn on Transient, Turnoff Transient, Storage Time- Base Drive Requirements. Switching Losses. Device Protection- Snubber. Requirements for BJTs and Snubber Design – Switching Aids. Power MOSFETs - Basic Structure. V-I Characteristics. Turn on Process. On state operation. Turn off process. Switching Characteristics. Resistive 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.

Unit3:(~8 Lecture Hours)

Insulated Gate Bipolar Transistor (IGBTs). Basic Structure and Operation. Latch up IGBT Switching Characteristics. Resistive Switching Specifications. Clamped Inductive Switching Specifications – IGBT Turn on Transient- IGBT Turn off Transient – Current Tailing- Ratings of MOSFETs. FBSOA and RBSOA Curves. Switching Losses-Minimum ON and OFF State times-Switching Frequency Capability – Over current protection of IGBTs. Short Circuit Protection. Snubber Requirements and Snubber Design.

Unit 4: (~8 Lecture Hours)

IGCT and ETO power semiconductor devices. Thermal design of power electronics equipment. Modeling of power semiconductors (principles).

Unit 5: (~12 Lecture Hours)

Gating Requirements for Thyristor, Component Temperature Control and Heat Sinks. Control of device temperature. Heat transfer by conduction. Transient thermal impedance- heat sinks heat transfer by radiation and convection – Heat Sink Selection for SCRs and GTOs. Modelling of power diode – Modelling of power MOSFET - Modelling of bipolar transistor - Modelling of IGBT.

Text Books:

1. Ned Mohan et.al, “Power Electronics”, John Wiley and Sons, 2006.
2. G. Massobrio, P. Antognetti, “Semiconductor Device Modeling with Spice”, McGraw-hill, Inc., 1988.

References:

1. B.J. Baliga, “Power Semiconductor Devices”, Thomson, 2004.
2. V. Benda, J. Gowar, D.A. Grant, “Power Semiconductor Devices. Theory and Applications”, John Wiley & Sons 1994-99

Course Outcomes:

At the end of the course the students will be able to:

1. Choose the power semiconductor switches based on their characteristics.
2. Design the drive circuits using power semiconductor devices.
3. Model the converter devices & power Semiconductor switches.
4. Control the target systems through appropriate power semiconductor switches.
5. Design appropriate protective system as per requirement.
6. Design suitable temperature control system for the devices with heat sinks.

ELECTRIC DRIVES LABORATORY**Prerequisites:** Electrical Machines, Power Electronics, Control Systems**Course Objectives:**

1. To gain hands on experience on various types of Electric drives.
2. To become familiar with different speed control methods including V/f control for a 3 phase induction motor.
3. To analyze the braking operations for a DC Motor using MATLAB.

Compulsory Experiments

1. (i) Thyristorised drive for 1 HP DC Motor with closed loop control .
(ii) Thyristorised drive for PMDC Motor with Speed Measurement & Closed loop control.
2. Open Loop and Closed Loop Control of DC motor using IGBT based 4-Quadrant chopper.
3. V/f Control of 3 ϕ Induction motor drive.
4. Study of AC single-phase motor speed control using TRIAC.
5. PLC Based AC/DC Motor Control Operation.
6. Characteristics of solar PV Systems and Maximum Power Point Tracking.
7. VSI fed Induction Motor Drive using MATLAB software.

Optional (Any 2 to be Conducted)

8. Speed control of three Phase Wound Rotor Induction motor using Slip Power Recovery Scheme.
9. PWM Inverter fed 3 ϕ Induction motor control using MATLAB software.
10. 3 ϕ Input IGBT based 4 quadrant Chopper Drive for DC Motor with closed loop Control Equipment

Course Outcomes:

1. Analyze the DC Motor drive with closed loop control.
2. Apply the knowledge of 4-Quadrant operation by using choppers.
3. Use Programmable logic controller for control operations of AC/DC motors.
4. Apply the concept of Maximum power point tracking system for various stems.
5. Analyze the performance of 1 ϕ converters with Inductive Load.
6. Use the software tools like MATLAB to create and control of typical drive models in the lab.

ELECTRICAL SYSTEMS SIMULATION LAB**Prerequisites:** Power Electronics, Electrical Machines, Control Systems**Course Objectives:**

1. To gain hands-on experience on Single Phase & Three Phase fully controlled Converters for different loads.
2. To become familiar with the simulation tools like SIMULINK, Mi-Power and PSIM.
3. To be able to analyze typical control systems by both time domain approach and State Space approach using MATLAB.

Compulsory Experiments

1. Single Phase fully controlled Converter using RL &RLE loads.
2. Single Phase Inverter using PWM controller with RL load.
3. Three phase fully controlled Converter using RL &RLE loads.
4. Three phase Inverter with SPWM Controller.
5. DC-DC Converter (Buck, Boost and Buck-Boost).
6. Modeling and Simulation of Separately Excited D.C Motor to study the Dynamic Behavior of the machine for change in Load Torque.
7. Modelling and Simulation of Three Phase Induction Motor in different Frames.
8. Dynamic Behaviour of Induction Motor using Transfer Function approach and State Space approach.

Optional Experiments(Any 2 to be conducted)

1. Speed control of DC Motor using SIMULINK & PSIM.
2. Load Flow studies using Mi-Power.
3. State Space model for a classical Transfer Function using MATLAB.
4. Simulation and Analysis of 3- ϕ PWM inverter fed Induction Motor.

Course Outcomes:

The students will be able to:

1. Analyze both Single Phase fully controlled Converter and Single Phase Inverter using PWM controller for different loads.
2. Carry out stability analysis of a 3rd order system using MATLAB.
3. Model & simulate a Separately Excited D.C Motor to study the Dynamic Behavior of the machine for change in Load Torque.
4. Assess the Dynamic Behavior of an Induction Motor using Transfer Function approach and State Space approach.
5. Use the software tools like SIMULINK, Mi-Power and PSIM and apply the knowledge acquired to carry out Load Flow studies and control of typical drives.
6. Apply the knowledge acquired in SIMULINK, Mi-Power and PSIM for analyzing continuous time control Systems.

RESEARCH METHODOLOGY AND IPR**Prerequisites:** English**Course Objectives:**

- To develop an understanding of IPR/ research methodology in the process of creation of patents through research.
- To develop further research capabilities.
- To learn better report writing skills and Patenting.

Unit 1: (~8 Lecture Hours)

Research Methodology: Objectives and Motivation of Research, Significance of Literature review, Types of Research, Research Approaches, and Research Methods verses Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research.

Unit 2: (~8 Lecture Hours)

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, ,Data collection methods, Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data.

Unit 3 : (~6 Lecture Hours)

Research Report Writing: Format of the Research report, Synopsis, Dissertation, References/Bibliography/Webliography, Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Unit 4: (~4 Lecture Hours)

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

Unit 5: (~4 Lecture Hours)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. New Developments in IPR: Administration of Patent System.

TEXT BOOKS:

1. C.R Kothari, "Research Methodology, Methods & Technique".New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
4. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.
5. Satarkar, S.V., "Intellectual property rights and copy right". ESS Publications, 2000.

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

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.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
6. Compose and write quality research reports and attain familiarity with intellectual property rights.

ENGLISH FOR RESEARCH PAPER WRITING
(Audit course -Common to all M.Tech courses)

Prerequisites: NIL

Course Objectives:

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To give the practice of writing a Research Paper.
4. To enable the students to evolve original research papers without subjected to plagiarism.

UNIT 1: (~7 Lecture Hours)

Academic Writing

What is Research? - Meaning & Definition of a research paper- Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT 2: (~7 Lecture Hours)

Research Format

Title – Abstract – Introduction – Discussion - Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT 3: (~6 Lecture Hours)

Research Methodology

Methods (Qualitative – Quantitative) – Literature Review – Who did what – Criticizing, Paraphrasing & Plagiarism.

UNIT 4: (~6 Lecture Hours)

Process of Writing a research paper

Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - Typing the final draft

UNIT 5: (~6 Lecture Hours)

How to & where to get published

Reputed Journals – National/International – ISSN No, No. of volumes, Scopes Index/UGC Journals – Freepublications - Paid Journal publications – /Advantages/Benefits

Reference Books:

1. MLA Hand book for writers of Research Papers, East West Press Pvt. Ltd, New Delhi, 7th Edition.
2. C. R Kothari, Gaurav, Garg, Research Methodology Methods and Techniques, New Age International Publishers. 4th Edition.
3. Lauri Rozakis, Schaum's Quick Guide to Writing Great Research Papers, Tata McGraw Hills Pvt. Ltd, New Delhi.
4. N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

Course Outcomes:

After completion of the course the students will be able to

1. Understand the nuances of research writing
2. Write a research paper with required writing skills and be confident to share their writing with others
3. Publish a paper using the requisite standard in a journal
4. Review the research papers and articles in a scientific manner.
5. Work on citations and ably place them in their research paper.
6. Avoid plagiarism and be able to develop their own writing skills in presenting the research work.

DISASTER MANAGEMENT
(Audit course -Common to all M.Tech courses)

Prerequisites: Awareness about Various Planetary & Extra Planetary Hazards, their Impacts & Mitigation measures.

Course Objectives:

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, planning and programming in different countries, particularly their home country or the countries they work in.
5. Students will get the overview on the roles of government and non-government agencies in disaster management.
6. Describe the basic concepts of the emergency management cycle (mitigation, preparedness, response and recovery) and their application on various types of disasters.

UNIT – 1: (~8 Lecture Hours)

Introduction and Repercussions of Disasters and Hazards: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. 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 – 2 : (~ 5 Lecture Hours)

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 – 3: (~ 5 Lecture Hours)

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 – 4: (~5 Lecture Hours)

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 – 5: (~ 5 Lecture Hours)

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.
2. Sahni, PardeepEt.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies”,Deep&Deep Publication Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-2012).
2. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
3. Satapathy S. (2009) Psychosocial care in Disaster management, A training of trainers manual (ToT), NIDM publication.
4. Guerisse P. 2005 Basic Principles of Disaster Medical Management. Act Anaesth. Belg;56:395-401
5. Study Guide prepared by Sharman and Hansen Aim and Scope of Disaster Management.. UW-DMC, University of Washington.

WEB RESOURCES:

1. <https://www.mooc-list.com/tags/earthquake>
2. <https://freevideolectures.com/course/3581/earthquakes-in-your-backyard>
3. <https://summer.uci.edu/online/>
4. <http://www.open.edu/openlearn/free-courses/full-catalogue>
5. <https://www.edx.org>
6. <https://www.disasterready.org/courses>

COURSE OUTCOMES:

After completion of the course students will be able to

1. Learn different disasters and measures to reduce the risk due to these disasters.
2. Learn institutional frame work for disaster management at national as well as global level.
3. Develop the capacity to integrate knowledge and to analyze, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
4. Demonstrate, describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
5. Understand the emergency/disaster management cycle for various types of disasters.
6. Develop a basic understanding of prevention, mitigation, preparedness, response and recovery on various types of disasters.

PEDAGOGY STUDIES
(Audit course -Common to all M.Tech courses)

Prerequisites:- Nil

Course Objectives:

To enable the students

To understand the programme design and policies of pedagogy studies.

1. To develop knowledge, abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
2. Analyze various theories of learning and their connection to teaching practice.
3. To familiarize the student with various research designs and research methods.
4. To create an awareness about the practices followed by DfID, other agencies and other researchers.
5. To identify critical evidence gaps to guide the development.

UNIT 1: (~8 Lecture Hours)

Introduction and Methodology:

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

UNIT 2: (~6 Lecture Hours)

Thematic overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT 3: (~6 Lecture Hours)

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 material 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 4: (~6 Lecture Hours)

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

UNIT 5: (~6 Lecture Hours)

Research gaps and future directions - Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

Reference Books:

1. Ackers J, Hardman F (2001) Classroom Interaction in Kenyan Primary Schools, *Compare*, 31 (2): 245 – 261.
2. Agarwal 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? Multisite 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 R J (2001) Culture and Pedagogy : International Comparisons in Primary Education. Oxford and Boston : Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resources%20working%20paper%202.pdf.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview

Course Outcomes:

After completion of the course the students will be able to

1. The pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. To examine the effectiveness of pedagogical practices.
3. To understand the concept, characteristics and types of educational research and perspectives of research.
4. The role of teacher education, school curriculum and guidance materials for effective pedagogy.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit course -Common to all M.Tech courses)

Prerequisites:-NIL

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.

UNIT 1: (~6 Lecture Hours)

Neetisatakam – Holistic development of personality - Verses 19,20,21,22 (Wisdom) - Verses 29,31,32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT 2: (~ 6 Lecture Hours)

Neetisatakam – Holistic development of personality (cont'd) - Verses 52,53,59 (don't's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT 3: (~ 7 Lecture Hours)

Introduction to Bhagavadgeetha for Personality Development - Shrimad BhagawadGeeta: 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 4: (~ 7 Lecture Hours)

Statements of basic knowledge - Shrimad BhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad BhagawadGeeta.

UNIT 5: (~ 6 Lecture Hours)

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Reference Books:

1. Srimad Bhagavad Gita by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari'sThriSatakam (Niti – Sringer- Vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Online Courses:

1. NPTEL: <http://nptel.ac.in/downloads/109104115/>

Course Outcomes:

After completion of the course the student will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Develop versatile personality.

POWER QUALITY

Prerequisites: Power Systems, Power Electronics

Objectives:

1. To understand and analyze the short and long interruptions in power Systems.
2. To study the voltage sag magnitude and its characteristics.
3. To gain knowledge on various mitigation methods for interruptions and voltage sags.

UNIT 1: (~6 Lecture Hours)

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

PQ Standards: Purpose of standardization - IEC Electromagnetic compatibility standards- European voltage characteristics standards.

UNIT 2: (~10 Lecture Hours)

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

Short interruptions: origin of short interruptions- monitoring of short interruptions- Multiple events - single phase tripping – voltage and current during fault period- voltage and current at post fault period- stochastic prediction of short interruptions.

UNIT 3: (~10 Lecture Hours)

Voltage sag-Characterization: Voltage sag – causes of voltage sag-voltage sag magnitude-voltage sag duration-three phase unbalances- phase angle jumps-magnitude and phase angle jumps for three phase unbalanced sags- other characteristics of voltage sags- load influence on voltage sags-sags due to starting of Induction motors.

Loads that cause Power quality problems: Introduction-classification of non-linear loads- power quality problems caused by non-linear loads

UNIT 4: (~10 Lecture Hours)

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

Harmonics: Individual and total harmonic distortion, RMS value of Harmonic waveform, triplex harmonics. Important harmonic introducing devices, effect of harmonics on power quality.

UNIT 5: (~10 Lecture Hours)

Mitigation of Interruptions and Voltage Sags: Overview of mitigation methods – System equipment interface – Passive shunt and series compensation-principle of

operation- active shunt compensation-DSTATCOM's principle and operation- active series compensation, principle and operation-Unified power quality compensators, principle of operation.

Future directions and opportunities for Power quality enhancement: Power quality sensitivity- utility based vs customer based correction-power quality performance requirements and validation- role of compensators in future energy delivery.

TEXTBOOKS:

1. Math H J Bollen "Understanding Power Quality Problems", IEEE Press, standard publishers distributors, delhi, 2001.
2. Bhimsingh, Ambrish Chandra, kamal AI-Haddad "Power quality problems and mitigation techniques" Wiley Publications, 2015.
3. A Ghosh, G. Ledwich, "Power Quality Enhancement Using Custom Power Devices", KluwerAcademic, 2002.

REFERENCES:

1. R.C. Dugan, M.F. Mc Granaghan and H.W. Beaty, "Electric Power Systems Quality." NewYork: McGraw-Hill. 1996
2. G.T. Heydt, "Electric Power Quality", 2nd Edition. West Lafayette, IN, Stars in aCircle Publications, 1994.
3. R. Sastry,Vedam Mulukutla S. Sarma"Power Quality VAR Compensation in Power Systems", CRC Press.
4. J.Arrillaga,B.C.Smith, N.R.Watson&A.R.Wood, " Power system Harmonic Analysis" Wiley publishers, 1997.

Outcomes:

Students will be able to:

Analyze power quality terms used and EMS standards.

1. Distinguish causes for power quality issues.
2. Interpret the characteristics of voltage sag.
3. Understand the equipment behavior with power quality issues.
4. Understand harmonics and its effects in power system.
5. Compute the mitigation techniques for interruptions and voltage sag.

DIGITAL CONTROL OF POWER ELECTRONICS AND DRIVE SYSTEMS

Prerequisites: Control Systems, Power Electronics, Electric Drives

Course Objectives:

1. To impart digital simulation concept of rectifiers and choppers.
2. To understand state space modeling of different inverters.
3. To perform simulation of different power converters

Unit 1: (~8 Lecture Hours)

Rectifiers

Simulation of Rectifiers

Basic Terms & Definitions - Power Electronic Switches - Uncontrolled rectifiers and Controlled Rectifiers- Half wave rectifiers - Full wave rectifiers- Analysis of rectifiers for various loads-dual converters.

Unit 2: (~10 Lecture Hours)

Choppers

Simulation of Choppers & Cycloconverters Basic chopper - operation & control techniques - step-down & up choppers-buck-Boost chopper - Types of choppers- Chopper commutation techniques- step-up cycloconverter - step down cycloconverter.

Unit 3 : (~8 Lecture Hours)

Inverters

Simulation of single phase & three phase inverters

Single-phase Inverters-Half-wave Inverter - Full-wave Inverter - Full wave Inverter with R-L Load-Current Source Inverter-Three-phase Inverters - Three-phase 180° Conduction mode Inverter - Three phase 120 degrees Conduction Mode Inverter PWM Inverter.

Unit 4: (~10 Lecture Hours)

Simulation DC & AC machines

DC machines - Separately Excited DC Machines - DC Series Motor - DC Shunt Motor - AC Motors- Three - phase Induction Motor - Three-phase Synchronous Motor.

Unit 5: (~9 Lecture Hours)

Simulation of Power Converters

Introduction to Matrix Converter - Basics of Matrix Converter-Bi - directional switches, Commutation problem - Modulation techniques-Programming and simulation of Matrix Converters - Introduction to PWM rectifier - Control Techniques.

Text Books:

1. Ned Mohan et al “ Power Electronics” John Wiley and Sons, 2006
2. P.S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011

Reference Books:

1. MATLAB and Simulink for ENGINEERS, A.K.Tyagi, OXFORD
2. Simulink Reference Manual, Math works, USA

Course Outcomes

Students will be able to:

1. Model and simulate power simulation circuits and systems.
2. simulate power electronic systems
3. Analyse the system response of power electronic systems.
4. Simulate the converter fed DC motor drives
5. Simulate single phase inverters with thyristors and self-commutated devices.
6. Simulate three phase inverters with thyristors and self commutated devices.

SMART GRID

(Program Specific Elective-3.1)

Prerequisites: Power Systems, Power Quality

Course Objectives:

1. To Understand the salient concepts of Smart Grid and its advantages over Conventional Grid.
2. To Study the architecture and operation of Micro-grids including the common distributed energy sources.
3. To Model and analyse Smart Distribution systems including the Advanced Metering and Wireless Communication Technologies
4. To Learn wide area measurement techniques for monitoring and control of Smart Transmission Systems in Modern Energy Management Centers.
5. To Understand the Power Quality issues associated with grid-connected renewable energy sources and the mitigation techniques deployed.

Unit-1 (~8 Lecture Hours)

Introduction to Smart Grid:

Evolution of Smart Grid from Conventional Grid, Concept and need of Smart Grid, Smart Grid Architectures, Interoperability, Communication technologies, National Smart Grid Mission (NSGM) by Govt. of India and International policies in Smart Grids.

Unit-2 (~10 Lecture Hours)

Micro-Grids:

Concept of micro-grid and its Architecture, need and salient features of micro-grid, Formation of micro grid with the main distributed generators like solar PV systems, Fuel cells, small Wind Energy Conversion Systems, Micro-turbines and Energy Storage Devices along with their Power Electronic Interfaces to utility grid. Issues of interconnections, operation of micro-grid including protection and control aspects.

Unit-3 (~10 Lecture Hours)

Smart Distribution Systems:

Substation and Distribution system Automation, Fault location, isolation and service restoration (FLISR), Outage Management Systems (OMS), Automated Meter Reading (AMR), Advanced Metering Infrastructure (AMI), Home and building automation with smart appliances, Demand response, Tariff Design, Time of the Day pricing (TOD), Time of Use (TOU) Pricing, Real time Pricing using web based services.

Unit-4 (~8 Lecture Hours)

Smart Transmission Systems:

Intelligent Electronic Devices (IED), Supervisory Control and Data Acquisition (SCADA), Geographic Information System (GIS), Phasor Measurement Units (PMU), Wide Area Monitoring Systems (WAMS), Coordination of SCADA & WAMS in modern energy management centres.

Unit-5 (~8 Lecture Hours)**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.

Text Books:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012.

Reference Books:

1. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions "CRC Press.
2. A.G.Phadke , "Synchronized Phasor Measurement and their Applications", Springer.
3. James Momoh, "Smart Grid Fundamentals of Design and Analysis". Wiley, IEEE Press, 2016.
4. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.

Course Outcomes:

Upon the completion of the subject, the student will be able to

1. Identify the different technologies for Smart Grid.
2. Analyze the architecture and operation of Micro-grids including the common distributed energy sources
3. Analyze the Smart transmission as well distribution systems
4. Interpret the Power Quality issues associated with grid-connected renewable energy sources and the mitigation techniques deployed.
5. Formulate and analyze the power systems problems from the point of view of reliability.
6. Apply the concepts SCADA and WAMS Technologies towards realizing a better distribution system.

SWITCHED MODE AND RESONANT CONVERTERS (Program Specific Elective 3.2)

Prerequisites: Power Electronics

Course Objectives:

1. To understand different types of converters and their relevant.
2. To understand different switch mode topologies & control methods for industrial applications.
3. To impart knowledge on types of resonant converter topologies.

Unit 1: (~10 Lecture Hours)

The Push-Pull Topology - Basic Operation (With Master/Slave Outputs) - Slave Line-Load Regulation- Slave Output Voltage Tolerance - Master Output Inductor Minimum Current Limitations - Flux Imbalance in the Push-Pull Topology (Staircase Saturation Effects)- Indications of Flux Imbalance - Testing for Flux Imbalance - Coping with Flux Imbalance- Gapping the Core- Adding Primary Resistance- Matching Power Transistors Using MOSFET Power Transistors- Using Current-Mode Topology

Unit 2: (~8 Lecture Hours)

Forward Converter Topology- Basic Operation- Design Relations: Output/Input Voltage, 'ON' Time, Turns Ratios - Slave Output Voltages- Secondary Load, Free-Wheeling Diode, and Inductor Currents - Relations Between Primary Current, Output Power, and Input Voltage- Maximum Off-Voltage Stress in Power Transistor -Practical Input Voltage/Output Power Limits - Forward Converter With Unequal Power and Reset Winding Turns- Forward Converter Magnetics - First-Quadrant Operation Only- Core Gapping in a Forward Converter- Magnetizing Inductance with Gapped Core- Double-Ended Forward Converter Topology - Basic Operation.

Unit 3: (~8 Lecture Hours)

Half- and Full-Bridge Converter Topologies

Half-Bridge Converter Topology- Basic Operation - Half-Bridge Magnetics-Selecting Maximum 'ON' Time, Magnetic Core, and Primary Turns - The Relation Between Input Voltage, Primary Current, and Output Power- Primary Wire Size Selection -Secondary Turns and Wire Size Selection - Output Filter Calculations-Blocking Capacitor to Avoid Flux Imbalance - Half-Bridge Leakage Inductance Problems- Double-Ended Forward Converter vs. Half Bridge -Practical Output Power Limits in Half Bridge-Full-Bridge Converter Topology - Basic Operation - Full-Bridge Magnetics - Maximum 'ON' Time, Core, and Primary Turns Selection-Relation Between Input Voltage, Primary Current, and Output Power-Flyback Converter Topologies - Basic Flyback Converter Schematic Operating Modes-Discontinuous-Mode Operation- Relationship Between Output Voltage, Input Voltage,'ON' Time, and Output Load-Discontinuous-Mode to Continuous-Mode Transition- Continuous-Mode Flyback Basic Operation'

Unit-4: (~8 Lecture Hours)

Resonant pulse inverters - Series resonant inverters with unidirectional and bidirectional switches - Frequency response of series resonant inverters - for series loaded, parallel loaded and series-parallel loaded - Parallel resonant inverters- Numerical problems.

Unit-5: (~10 Lecture Hours)

Resonant Converters- Zero Current Switching (ZCS) resonant converters- L type and M type ZCS resonant converter - Zero Voltage Switching (ZVS) resonant converters-Comparison between ZCS and ZVS resonant converters- Two quadrant ZVS resonant converters- Resonant dc link inverters-Evaluation of L and C for ZCS inverter-Numerical Problems.

Text books

1. Abraham I Pressman, "Switching Power Supply Design,". McGraw Hill Publishing Company, 2001.
2. Ned Mohan et.al, "Power Electronics," John Wiley and Sons 2006

Reference books

1. Daniel M Mitchell, "DC-DC Switching Regulator Analysis," McGraw Hill Publishing Company-1988.

Online Resources:

1. <http://nptel.ac.in/courses/108108036>

Course Outcomes:

After completion of subject, the student will be able to

1. Analyze the principles of operation of push full and forward converters.
2. Identify various loss components in a switched mode converter and choice of switching frequency with a view towards design of such converters.
3. Model existing and modified power converters under small signal perturbations and steady state conditions.
4. Analyze and interpret the concepts of resonant converters.
5. Analyze resonant pulse inverters.
6. Apply the concepts acquired to practical and meaningful applications.

ELECTRIC VEHICLES
(Program Specific Elective 3.3)

Prerequisites: Electrical Machines, Electric Drives, Power Electronics

Course Objectives:

1. To focus on the fundamentals of dynamic motion of electric vehicles.
2. To understand the concepts of batteries and fuel cells.
3. To impart the knowledge of electric motors of Hybrid vehicles.

UNIT 1: (~8 Lecture Hours)

Introduction to Electric Vehicles

Introduction, EV components, EV advantages, Vehicle mechanics- Roadway fundamentals, Vehicle kinetics, Dynamics of vehicle motion, Propulsion power-Force-velocity characteristics, Maximum Gradability, Velocity and Acceleration.

UNIT 2: (~8 Lecture Hours)

Battery

Basics-Types- Li and Nickle batteries, Parameters- capacity, discharge rate, state of charge and discharge, depth of discharge, Technical characteristics, Battery pack design , Properties of batteries, Fuel cells- Types, characteristics, Super Capacitors and Ultra Capacitors.

UNIT 3: (~10 Lecture Hours)

Power Electronics and Motor drives

DC Motor- Brushless DC Motor, AC Motor- Induction Motor, Optimization of Induction motors for Electric vehicles, Electric drive components, two –quadrant chopper, Open-loop drive- steady state analysis of quadrant-I, ripple reduction and I_a , Acceleration in CCM , DCM and Uncontrollable mode, Braking Operation(CCM in steady state), Regenerative power.

UNIT 4: (~10 Lecture Hours)

Electric Vehicle Drive Train

EV transmission configuration, Components-gears, differential, clutch, brakes, regenerative braking, Motor sizing.

UNIT 5: (~8 Lecture Hours)

Hybrid Electric Vehicles

Types-Series and Parallel EHV's, Advantages and disadvantages, Types of internal combustion engines, Design of an HEV-hybrid drive trains, sizing of components.

Text Books:

1. Iqbal Husain, “ Electric and Hybrid Vehicles-Design Fundamentals”, second edition, CRC press, 2011
2. James Larminie , “ Electric vehicle technology explained” . John wiley & sons, 2003

References:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric & Fuel cell Vehicles: Fundamentals, Theory & Design”, CRC press, 2010.
2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000.
<http://nptel.ac.in//courses//108103009>.

Course Outcomes:

1. Acquire and interpret fundamental concepts of advanced batteries and super capacitors.
2. Identify various energy conversion devices for vehicle electrification.
3. Acquire knowledge on series and parallel connections of EHV.
4. Understand the concept of multi quadrant operation of motors.
5. Analyze and interpret the concepts of Hybrid vehicles.
6. Distinguish between conventional and electric vehicles from the view point of ecological balance of nature.

Online Resources:

1. <http://nptel.ac.in/courses/108103009>

ADVANCED MICROCONTROLLER BASED SYSTEMS
(Program Specific Elective 4.1)

Prerequisites: Microprocessors and Microcontrollers

Course objectives:

1. To understand the architecture of basic and advanced microcontrollers
2. To understand the applications of these controllers
3. To get introduction to DSP and FPGA

Unit 1:(~10 Lecture Hours)

8051 ARCHITECTURE -Basic organization – 8051 CPU structure – Register file – Interrupts – Timers – Port circuits – Instruction set – Timing diagram – Addressing modes – Simple Program and Applications.

Unit 2:(~10 Lecture Hours)

PERIPHERALS AND INTERFACING -Typical Bus structure – Bus – memory organization – Timing characteristics –Memory Interfacing – Polling – Interfacing Basic I/O devices – Analog and Digital interfacing – PWM mode operation – Serial port application.

Unit 3: (~8 Lecture Hours)

80196 ARCHITECTURE - CPU operation – Interrupt structure – Timers – High Speed Input / Output Ports – I/O control and Status registers – Instruction Set – Addressing Modes – Simple Programming.

Unit 4: (~8 Lecture Hours)

ADVANCED CONTROLLERS – Digital signal processor (DSP) – Architecture – Programming- Introduction to Field Programmable Gate Array (FPGA).

Unit 5 : (~10 Lecture Hours)

CASE STUDIES FOR 8051 AND 80196 - Real Time clock – DC Motor Speed Control – Generation of Gating Signals for Converters and Inverters – Frequency Measurement – Temperature Control.

Text Books:

1. Muhammad Ali Mazidi, Janice GillispieMazidi., “The 8051 Microcontroller nd Embedded systems”, Person Education, 2004.
2. Michael Slater, “Microprocessor based design - A comprehensive guide to effective Hardware design”, Prentice Hall, New Jersey, 1989.

Reference Books:

1. Ayala, Kenneth, “The 8051 Microcontroller”, Upper Saddle River, New Jersey Prentice Hall, 2000.
2. Intel manual on 16 bit embedded controllers, Santa Clara, 1991.
3. “The concepts and Features of Microcontrollers”. Wheeler Publishing, 2005.

Course Outcomes:

Students will be able to:

1. Program effectively a processor in assembly language and develop an advanced processor based system.
2. Configure and use different peripherals in a digital system.
3. Compile and debug programs on advanced topics.
4. Generate an executable file and use it as a part of compilation of program in assembly language.

5. Apply the knowledge obtained to develop the programs for real time applications.
6. Apply the concepts of DSP and FPGA for few meaningful applications.

DISTRIBUTED GENERATION
(Program Specific Elective 4.2)

Prerequisites: Power Systems

Course Objectives:

1. To understand renewable energy sources.
2. To gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.
3. To introduce the concepts of microgrid.

Unit 1: (~6 Lecture Hours)

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

Unit 2: (~8 Lecture Hours)

Planning of DGs. Siting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.

Unit 3: (~10 Lecture Hours)

Technical impacts of DGs. 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 4: (~8 Lecture Hours)

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

Unit 5: (~10 Lecture Hours)

Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units. Transients in micro-grids, Protection of micro-grids.

Text books:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.

Reference books:

1. M.Godoy Simoes, Felix A.Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press.
2. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press

Course outcomes

Students will be able to:

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

3. Analyze the De-regulation Impact of DGs upon protective relaying and transient and dynamic stability of existing distribution systems.
4. Identify and apply Economic and control aspects of DGs wrt market factors.
5. Realize the significance of micro-grids.
6. Gain an overall picture of autonomous and non-autonomous grids in the backdrop of prevailing energy scenario.

DIGITAL SIGNAL PROCESSORS
(Program Specific Elective 4.3)

Prerequisites: Nil

Course Objectives:

1. To train the assembly language concepts.
2. To impart knowledge on I/O lines and ADC.
3. To understand the concepts of interrupts for real time applications.

Unit-1: (~8 Lecture Hours)

Introduction to the TMS320LF2407 DSP Controller: Basic architectural features - Physical Memory - Software Tools.

Unit-2 : (~10 Lecture Hours)

C2xx DSP CPU and Instruction Set: Introduction & code Generation - Components of the C2xx DSP core - Mapping External Devices to the C2xx core - peripheral interface - system configuration registers - Memory - Memory Addressing Modes - Assembly Programming Using the C2xx DSP Instruction set.

Unit-3: (~10 Lecture Hours)

General Purpose Input/Output (GPIO) Functionality: Pin Multiplexing (MUX) and General Purpose I/O Overview – Multiplexing – General Purpose I/O control registers – Using the General Purpose I/O Ports.

Unit-4: (~8 Lecture Hours)

Interrupts on the TMS320LF2407: Introduction to Interrupts – Interrupt Hierarchy – Interrupt Control Registers – Initializing and Servicing Interrupts in Software.

Unit-5: (~9 Lecture Hours)

The Analog-to-Digital Converter (ADC): ADC Overview - Operation of the ADC and programming modes. The Event Managers (EVA - EVB): Overview of the Event Manager - Event Manager Interrupts - General Purpose Timers - Compare Units - Capture Units and Quadrature Encoded Pulse (QEP) -General Event Manager Information - PWM signal Generation with Event Manager.

Text Books:

1. Hamid A. Tolyat, “DSP Based Electro Mechanical Motion Control”-CRC press, 2004.
2. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, programming and Applications –, 2002, TMH.

References:

1. Application Notes from the webpage of Texas Instruments.
2. Avtar Singh and S.Srinivasan, Digital Signal Processing, Thomson Publications, 2004.

Course Outcomes:

After completion of the subject, students will be able to

1. Write Assembly Language Programs for the Digital Signal Processors.
2. Configure and use Digital Input / Output lines and ADCs
3. Configure and use Interrupts for real-time control applications
4. Configure and use Event Managers for PWM generation.

5. Develop codes for the control of electric drives.
6. Implement event manager by applying the concepts of Digital Signal Processor.

POWER QUALITY LAB

Prerequisites: Power Electronics and Power Systems

Course Objectives:

1. To gain expertise on the behaviour of different electrical systems with non-linear loads.
2. To become familiar with the simulation tools like SIMULINK & PSCAD.
3. To be able to analyze harmonics in industrial & residential distribution systems using PSCAD and MATLAB.

Compulsory Experiments

1. To study the effect of nonlinear loads on power quality.
2. To demonstrate the voltage and current distortions experimentally.
3. To reduce the current harmonics with filters.
4. To study the voltage sag due to starting of large induction motor.
5. To study the capacitor switching transients.
6. To study the effect of balanced nonlinear load on neutral current, in a three phase circuit.
7. To study the effect of voltage flicker.
8. To study effect of voltage sag on electrical equipment's.

Simulation Experiments (Any TWO to be conducted)

9. To obtain the current harmonics drawn by power electronics interface using PSCAD software
10. Reducing the voltage sag and swell problem in distribution system using DVR with PI controller.
11. Modeling of non-linear loads and estimation of Harmonics in industrial distribution system using PSCAD.
12. Analysis and Simulation of harmonics for various residential loads using SIMULINK.

Course Outcomes:

The students will be able to:

1. Analyse the effect of nonlinear loads on Power Quality.
2. Carry out remedial analysis for commonly occurring PQ problems like sag & swell.
3. Carry out remedial analysis for commonly occurring PQ problems like sag & swell with the help of SIMULINK & PSCAD.
4. Model non-linear loads and estimate Harmonics in industrial distribution system using PSCAD.
5. Use the software tools like PSCAD to obtain the current harmonics drawn by power electronics interfaces.
6. Analyze the effect of Voltage sag on different electrical equipments.

POWER CONVERTERS SIMULATION LAB

Prerequisites: Power Electronics.

PROGRAM OBJECTIVES:

1. To simulate and design of Buck and Boost converters.
2. To familiarize the students by introducing software Simulink and help them to simulate and analyze different converters.
3. To study & simulation of power semi-conductor devices.

List of Experiments

1. Simulation of buck and boost converter with open loop operation.
2. Simulation of cuk and fly back converter with open loop operation
3. Simulation of z-source inverter
4. Three Level three phase Sinusoidal PWM based Diode Clamped Inverter.
5. Space vector pulse width modulation technique of Single phase inverter
6. Three Level three phase Sinusoidal PWM based H-bridge Inverter.
7. Five Level three phase Sinusoidal PWM based Diode Clamped Inverter.
8. Five Level three phase Sinusoidal PWM based Flying capacitor Inverter.
9. Five Level three phase Sinusoidal PWM based H- bridge Inverter.
10. Three Level three phase Sinusoidal PWM based Flying capacitor Inverter.

PROGRAM OUTCOMES:

The students at the end of the course will be able to

1. Design and conduct simulation and experiments.
2. Use the techniques, skills and modern engineering tools necessary for engineering practice.
3. Identify, formulate & solve engineering problems with simulation.
4. Simulate characteristics of SCR, MOSFET, IGBT.
5. Simulate Rectifiers, Choppers, AC voltage controller.
6. Simulate and interpret circuits and hardware kits.

SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit course -Common to all M.Tech courses)

Prerequisites:- Nil

Course Objectives:

1. To get a working knowledge in Illustrious SANSKRIT, the scientific language in the world.
2. To improve brain functioning.
3. To enhance the memory power to develop logic in Mathematics, Science and other subjects.
4. To explore the huge treasure of knowledge that is hidden in the ancient literature.

UNIT 1:(≅6 Lecture Hours)

Alphabets in SANSKRIT

Varnamala-Vowels (Swaraaha) and consonants (Vyanjanaani) – samyuktavarnaaha (compound letters) – Varna vishleshanam (Disjoining of letters) – Varna samshleshanam (Joining of letters) - Practise of simple words – Three genders – Pumlingam (Masculine Gender) – Streelingam (Feminine Gender) – Napumsaka lingam (Neutral Gender) – The forms of Nouns – Singular & Plural

UNIT 2:(≅6 Lecture Hours)

Pronouns & Demonstrative pronouns (Sarvanaamashabdaaha) Eshaha, Yeshaa & Yetat – Question words – Five Ws & one H (Kim, kadaa, kutra, Kaha, Kimartham & Katham) Different forms of verbs – Tenses – Present – Past & Future Tenses.

UNIT 3:(≅6 Lecture Hours)

Propositions (Vibhaktis) – Prathama – Dwitiya – Truteeya – Chaturthee – Panchami – Shashtee – Saptami – Sambodhana Prathama - The Three Purushas – Prathama (Ramaha Raamou Raamaaha) – Madhyama (twam Yuvaam Yooyam) – Uttama (Aham Aawaam Vayam)

UNIT 4:(≅6 Lecture Hours)

Order (Subject – Verb – Object) karta – Kriya - karma - Introduction of Roots – Ancient literature on Science & Technology in SANSKRIT language - Scope of SANSKRIT in India – Technical information about SANSKRIT Literature.- Technical concepts of Engineering.

UNIT 5:(≅ 06 lecture Hours)

Technical concepts of Engineering – Electrical, Mechanical, Architecture and Mathematics - Role of SANSKRIT in the field of Science & Technology. Scope of SANSKRIT as a powerful & alternative tool in the field of Computer Science.

Reference Books:

1. Dr. Vishwas, SamskruthaBharati, “ABHYAAS PUSTAKAM”, Publications, New Delhi.
2. Vempati Kutumba Shastri, Teach Yourself SANSKRIT, Prathama Deeksha, Rashtriya Sanskrit Sansthan, NewDelhi Publications.

3. Suresh Soni, “India’s glorious Scientific Tradition”, Ocean Books Pvt. Ltd., NewDelhi.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_hs35/preview

Course Outcomes:

After completion of the course the student will be able to

1. Gain knowledge in basic SANSKRIT language.
2. Understand the ancient SANSKRIT literature about Science & Technology.
3. Develop logical and analytical skills.

VALUE EDUCATION
(Audit course -Common to all M.Tech courses)

Prerequisites: Nil

Course Objectives:

Students will be able to

1. Understand value of Education and self-development.
2. Imbibe good values in students
3. Know the importance of character

UNIT 1: (~ 7 Lecture Hours)

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 - Importance of cultivation of values.

UNIT 2: (~ 6 Lecture Hours)

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

UNIT 3: (~ 6 Lecture Hours)

Personality and Behaviour Development – Soul and Scientific attitude. Positive thinking. Integrity and Discipline - Punctuality, Love and Kindness - Avoid Fault Thinking - Free from anger, Dignity of labour

UNIT 4: (~ 6 Lecture Hours)

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 5: (~ 6 Lecture Hours)

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.

Reference Books:

1. Chakroborty, SK. 'Values and Ethics for Organizations – Theory and Practise', - Oxford University Press, NewDelhi.

Online Resources:

1. <http://nptel.ac.in/courses/109104068/36>
2. <http://nptel.ac.in/courses/109104068/37>

Course Outcomes:

After completion of the course the student will be able to

1. Gain knowledge on self-development.
2. Learn the importance of Human Values.
3. Develop overall personality.

CONSTITUTION OF INDIA
(Audit course -Common to all M.Tech courses)

Prerequisites:-**Course Objectives:**

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. 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. 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.

UNIT 1:(≅8 Lecture Hours)**History of making of the Indian Constitution & Philosophy of the Indian Constitution**

History of making of the Indian Constitution: History, Drafting Committee (Composition & Working)

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT 2:(≅6 Lecture Hours)**Contours of Constitutional Rights and 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 3:(≅6 Lecture Hours)**Organs of Governance:**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions- Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT 4:(≅6 Lecture Hours)**Local Administration**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati Raj : Introduction, PRI : ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role, Block Level : Organizational Hierarchy (Different departments), Village level : Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 5:(≅6 Lecture Hours)**Election Commission**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Reference 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 Edition, Lexis Nexis, 2014.

Online Courses:

1. <http://www.nptel.ac.in/courses/103107084/Script.pdf>

Course Outcomes:

After completion of the course the student will be able to

1. Get the clarity and idea about function of Indian constitution.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies
3. Grab the knowledge of union government & their powers and function.
4. Understand state and central policies, fundamental duties
5. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies
6. Understand Electoral Process, special provisions

STRESS MANAGEMENT BY YOGA
(Audit course -Common to all M.Tech courses)

Prerequisites: Nil

Course Objectives:

1. Creating awareness about different types of Stress and role of Yoga in the management of Stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by Yoga practice.

UNIT 1: (≅4 Lecture Hours)

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT 2: (≅4 Lecture Hours)

Meaning and definition of Stress - Types of Stress-Eustress and Distress - Anticipatory Anxiety and Intense Anxiety and depression - Meaning of Management- Stress Management.

UNIT 3: (≅8 Lecture Hours)

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT 4: (≅10 Lecture Hours)

Asanas:: (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT 5: (≅10 Lecture Hours)

Pranayama: Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Reference Books:

1. Andrews, Linda Washer (2005) Stress control for peace of mind, London: Greenwich Editions.
2. Author's Guide -Yoga- The science of Holistic Living, Chennai: The Vivekananda Kendra Prakashan trust.
3. Iyengar BKS (2003) The art of Yoga, New Delhi: Harper Collins Publishers.
4. Lalvani, Vimla ((1998) Yoga for Stress, London: Hamlyn.
5. Maguire, Imelda (2005) Yoga for a healthy body, London: Greenwich editions.
6. Nagendra H.R. and Nagaratna.R (2004) Yoga prespective in stress management, Bangalore: Swami Vivekananda Yoga prakashan.
7. Nagendra H.R. and Nagaratna.R (2004) Yoga practices for Anxiety and Depression, Bangalore: Swami Sukhabhogananda Yoga prakashan.
8. Sukhabhogananda, Swami (2002) Stress management, Bangalore: Prakashan trust.
9. Udupa (1998) Stress management by Yoga , New Delhi: MotilalBandaridas Publishers pvt. Ltd.
10. Ravi Shankar N.S. (2001) Yoga for Health, New Delhi: Pustak Mahal.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. <https://freevideolectures.com/course/3539/indian-philosophy/11>

Course Outcomes:

After completion of the course the student will be able to

1. Enhance of Physical strength and flexibility.
2. Learn to relax and focus.
3. Relieve physical and mental tension
4. Improve work performance/ efficiency.

PLCs AND FPGAs
(Program Specific Elective -5.1)

Prerequisites: Microprocessors and Microcontrollers

Course Objectives:

1. To introduce the concepts of ON-OFF logic in industrial arena.
2. To introduce the concepts of Ladder logic or contact coil logic or programming.
3. To introduce the concepts of FPGAs as a sequel to VLSI.

Unit 1: (~10 Lecture Hours)

PLC Basics - PLC system - I/O modules and interfacing CPU processor - programming equipment - programming formats - construction of PLC ladder diagrams - devices connected to I/O modules.

PLC Programming - input instructions - output instructions - operational procedures - programming examples using contacts and coils - Drill press operation.

Unit 2: (~9 Lecture Hours)

Digital logic gates programming in the Boolean algebra system - conversion examples - Ladder diagrams for process control - Ladder diagrams and sequence listings - ladder diagram construction and flow chart for spray process system. PLC Registers: Characteristics of Registers - module addressing - holding registers - input registers - output registers.

Unit 3: (~8 Lecture Hours)

PLC Functions - Timer functions and industrial applications - counter functions - industrial applications, Arithmetic functions - Number comparison functions - number conversion functions. Data Handling functions: SKIP - Master control Relay - Jump - Move - FIFO - FAL - ONS - CLR and Sweep functions and their applications.

Unit 4: (~9 Lecture Hours)

Bit Pattern and changing a bit shift register, sequence functions and applications Controlling of two axes and three axis Robots with PLC - Matrix functions. Analog PLC operation: Analog modules and systems - Analog signal processing - multi bit data processing - analog output application examples

PID principles - position indicator with PID control - PID modules - PID tuning - PID functions.

Unit 5: (~9 Lecture Hours)

Over view of Field Programmable Gate Arrays – CPLD Vs FPGA - Types of FPGA - configurable logic blocks (CLBs) - Input Output Block (IOB) - Xilinx Processors - Overview of Spartan 3E and Virtex Pro-FPGA boards –Zynq Processors.

Text Books:

1. John W. Webb and Ronald A. Reis, Programmable Logic Controllers – Principles and Applications , Fifth Edition, PHI, 2006.
2. W.Bolton, Newnes, Program Logic Controllers, , 4th edition, 2011.
3. Learning FPGAs Justin Rajewski, O'Reilly Media (ISBN 9781491965498), 2015.

Reference Books:

1. Programmable Logic Controllers – Programming Methods and Applications by J R. Hackworth and FD. Hackworth, Jr.– Pearson, 2004.
2. FPGA based System Design, Wayne Wolf, Pearson, 2014.
3. Essentials of VLSI circuits and Systems, Kamram Eshraghian, Douglas A.Pucknell, Sholeh, Eshraghian, PHI (EEE).
4. Designing with Xilinx FPGAs using Vivado: Sanjay Churiwala (Editor), Springer.

Course Outcomes:

1. Apply the knowledge of Boolean algebra for constructing the ladder diagrams.
2. Apply the knowledge of contact-coil logic to real time control problems like Drill press operation.
3. Solve Industrial control problems by taking into consideration all the constraints including safety of the operating personnel.
4. Apply the knowledge of timers and counters to obtain better performance of Industrial manufacturing systems.
5. Apply the knowledge acquired in FPGA's for design of simple logic circuits.
6. Extend the concepts FPGAs to understand Xylinx processors for different Control logistics.

FACTS AND CUSTOM POWER DEVICES (Program Specific Elective 5.2)

Prerequisites: Power Electronics, Power Systems

Course Objectives:

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

Unit-1 (~9 Lecture Hours)

Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System. Power flow control -Constraints of maximum transmission line loading –Benefits of FACTS Transmission line compensation. Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation. Shunt and Series compensation principles – Reactive compensation at transmission and distribution level.

Unit-2 (~9 Lecture Hours)

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM -Compensator control. Comparison between SVC and STATCOM.

Unit-3 (~8 Lecture Hours)

Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation – GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

Unit-4 (~8 Lecture Hours)

SSR and its damping, Unified Power Flow Controller (UPFC): Circuit Arrangement, Operation and control of UPFC, Basic Principle of P and Q control- Independent real and reactive power flow control- Applications. Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers.

Unit-5 (~10 Lecture Hours)

Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt , series and hybrid and their control.Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.

Text Books:

1. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007.
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, Springer Verlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. G. T.Heydt, “Power Quality”, McGraw-Hill Professional, 2007.

Reference Books:

1. K.S.Sureshkumar, S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
2. T. J. E. Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Newyork, 1982.

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled.
3. Analyze Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.
4. Develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.
5. Analyze the different power quality issues.
6. Implement different controllers to effectively mitigate the power quality problems.

DESIGN OF POWER CONVERTERS (Program Specific Elective 5.3)

Prerequisites: Power Electronics, Electrical Machines.

Course Objectives:

1. To Understand the concepts of Hysteresis control and apply to the DC motor.
2. To Understand the steady-state and dynamic analysis of phase to phase converters.
3. To Design of transformers and magnetic circuits.

Unit-1: (~8 Lecture Hours)

Control strategies for power converters:

Basic control Principles-Hysteresis Control-Application of the Hysteresis control for DC motor drives- Hysteresis Control for regulating an ac variable-Linear Control-DC variable-Proportional Controller-RL Load and DC Motor Drive system-PI Controller RL Load and DC Motor Drive System-PID Controller-DC Motor-Linear Control-AC variable.

Unit-2: (~10 Lecture Hours)

1-Phase to 1-Phase Back to Back Converter

Full bridge converter-Model, PWM Strategy, Control approach, Power analysis, DC-Link capacitor voltage, Capacitor bank design Topology with Component count reduction- Model , PWM strategy, DC -link voltage requirement, Half-bridge converter Topologies with increased number of switches(Converters in parallel)- Model, PWM strategy, Control strategy Topologies with increased number of switches(Converters in series).

Unit-3: (~10 Lecture Hours)

3-Phase to 3-Phase and other Back to Back Converters

Full bridge Converter- Model, PWM Strategy, Control approach Topology with Component count reduction- Model, PWM strategies, DC -link voltage requirement, Half-bridge converter, Topologies with increased number of switches(Converters in parallel)- Model, PWM strategy, Control strategy Topologies with increased number of switches(Converters in series) other Back to Back Converters

Unit4: (~10 Lecture Hours)

Transformers and Magnetic circuit Design

Transformer Core Materials and Geometries and Peak Flux Density Selection- Ferrite Core Losses versus Frequency and Flux Density for Widely Used Core Materials- Ferrite Core Geometries- Peak Flux Density Selection - Maximum Core Output Power, Peak Flux Density, Core and Bobbin Areas, and Coil Current Density- Derivation of Output Power Relations for Converter Topology - Derivation of Output Power Relations for Push-Pull Topology Core and Copper Losses in Push-Pull, Forward Converter Topologies .

Unit5: (~8 Lecture Hours)

Doubling Output Power from a Given Core Without Resorting to a Push-Pull Topology - Derivation of Output Power Relations for Half Bridge Topology- Output Power Relations in Full Bridge Topology - Conversion of Output Power Equations

into Charts Permitting Core and Operating Frequency Selection at a Glance- Peak Flux Density Selection at Higher Frequencies -Transformer Temperature Rise Calculations - Transformer Copper Losses.

Phase shifting Transformers-Y/Z phase shifting transformers-Y/Z -1 and Y/Z -2 transformers- Δ /Z Transformers-Harmonic current cancellation-Phase displacement of harmonic currents-Harmonic Cancellation

Text Books:

1. Bin Wu-A John Wiley & Sons, High power converters and AC drives- Inc,Publication -IEEE Press.
2. Euzeli Cipriano Dos Santos Jr. and Edison Roberto Cabral Da Silva- A John Wiley & Sons, Advanced Power Electronics converters Inc,Publication -IEEE Press.
3. Abraham I Pressman, Switching Power Supply Design, McGraw Hill Publishing Company.

Reference books:

1. Vithyathil. J, "Power Electronics: Principles and Applications", McGraw Hill.
2. Erickson RW, "Fundamentals of Power Electronics", Chapman and Hall.
3. Technical literature: paper published in power electronics related journals.

Course Outcomes:

After completion of the subject, students will be able to

1. Acquire knowledge on hysteresis control.
2. Analyse the concept of Phase to phase transformation.
3. Recognize and use the following concepts and ideas Steady state and transient modeling and analysis of transformers.
4. Understand the concepts of push pull converters.
5. Apply different methods for electrical drive systems.
6. Correlate the design concepts of magnetic circuits with the development of power converters.

BUSINESS ANALYTICS (Open Elective)

Prerequisites: Nil

Course Objectives:

1. To understand the role of business analytics within an organization.
2. To gain an understanding in usage of business analytics in formulating and solving problems using analytical and management tools in managerial decision making.
3. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization and across various sectors.

UNIT 1:(~9 Lecture Hours)

Introduction to Business Analytics

Introduction to Business Analytics Overview of Business Analytics Evolution of Business Analytics, classification of Business Analytics, Trends of Business Analytics, frame work of Business Analytics, Data for Business Analytics, Decision models, Problem solving & decision making. Business analytics process and organization. Competitive and advantages.

UNIT 2:(~8 Lecture Hours)

Statistics for Business Analytics

Organization structure of Business Analytics; Team management issues, designing information policy, outsourcing, ensuring data quality, Introduction to Data mining Descriptive Analytic tools – Statistical notation. Data Summarization methods.

UNIT 3:(~9 Lecture Hours)

Descriptive Tools

Descriptive Statistical Tools – Tables, graphs, charts, histograms, frequency distribution, relative frequency. Measures of central tendency & dispersion. Introduction to Probability theory & distributions (Binomial, Poisson & Normal) Sampling & estimation methods.

UNIT 4:(~10 Lecture Hours)

Forecasting Techniques

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting models, Forecasting Models for stationary Time series. Forecasting Models for Time series with a linear trend, Forecasting Time series for seasonality, Regression Forecasting with casual variables, selecting Appropriate Forecasting Models. Monte Carlo simulation and Risk Analysis: Monte Carlo simulation using Analytic solver platform, Newsvendor Model, Overbooking Model.

UNIT 5:(~12 Lecture Hours)

Decision Analysis

Decision Analysis: Formulating Decision problems, Decision strategies, Decision trees, value of information utility & decision making, data story telling & Data Journalism, Recent Trends in: Embedded & collaborative business intelligence. Data warehousing & Data mining.

Text Books:

1. Gert H.N.Laursen, Jesper Thorlund, Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Publication, Wiley Publication, 2nd Edition.
2. Al bright/Winston, Business Analytics: Data Analysis & Decision Making, Cengage Learning Publication, 5th Edition.

Reference Books:

1. Marc I. Schniederjans, Dara G. Schniederjans, Christopher M. Sarkey, Business analytics Principles, Concepts, and Applications, Pearson FT Press, 1st Edition.
2. James Evans, Business Analytics, Pearsons Education, 2nd Edition.

Online Resources:

1. NPTEL: Business Analytics for Management Decision
<http://nptel.ac.in/courses/110105089/>

Course Outcomes:

After completion of the course the students will be able to

1. Have a knowledge of data analytics.
2. Think critically in making decisions based on data analytics.
3. Identify the befitting descriptive tool required for the business problem.
4. Identify appropriate prescriptive modeling technique for decision making.
5. Apply suitable predicative method that supports business decision making.
6. Translate data into clear, actionable insights in the decision making process

INDUSTRIAL SAFETY (Open Elective)

Prerequisites: Nil

Course Objectives:

The purpose of this course is to teach the students.

1. Concepts of industrial safety and provide useful knowledge for work place safety.
2. Helps in identification, evaluation and control of the hazards.
3. Mitigate harm to people, property and the environment.

Unit 1: (~10 Lecture Hours)

Industrial safety-Importance and objectives of safety, safety programs – components and realisation. Evolution of modern safety concept, safety policy, safety organisation. implementation of safety procedures-periodic inspection and replacement.

Unit 2: (~8 Lecture Hours)

Accidents causes, types, results and control, mechanical and electrical hazards types, causes and preventive steps, describe salient points and factories act 1948 for health and safety, wash rooms, drinking water layout, lights, cleanliness fire guarding etc. safety colour code, fire prevention and fire fighting equipments and methods.

Unit 3: (~10 Lecture Hours)

Fundamentals of maintenance engineering. Definition aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, types of maintenance, types of applications of tools used for maintenance, maintenance cost and its relations with replacement economy, service life of equipment.

Unit 4: (~9 Lecture Hours)

Quality and safety in maintenance: needs for quality maintenance process, maintenance work quality, use of quality control, charts in maintenance work sampling, post maintenance testing, reasons for safety problems in maintenance, guidelines to safety in maintenance work, safety officers' role in maintenance work, Protection of maintenance workers.

Unit 5: (~8 Lecture Hours)

Periodic and preventive maintenance:- Periodic inspection – concept and need, degreasing, cleaning and repairing schemes, over hauling of mechanical components, overhauling of electrical motors, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

Textbooks:-

1. Krishnan N.N. Safety management in industries, Jaico publishing house, Bombay, 1997.
2. H.P. Garg, S., Maintenance Engineering, S. Chand and company.

References :

1. Handley, W. Industrial safety Hand book, 2nd Edn, McGraw-Hill Book Company, 1969
2. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services.
3. Mc Cornick, E.J., Human Factors in Engineering and design, Tata McGraw-Hill, 1982

Course Outcomes: Students after completing this course would be able to .

1. Know the need for safety in industries
2. Know about factory acts and industrial safety regulations
3. Analyse causes and types of different hazards on their preventions
4. Assess quality maintenance processes and maintenance work quality
5. Assess safety practices and programs.
6. Know about periodic and preventive maintenance activities in industries

Online websites/ Materials :

1. <https://www.spplimited.co.in/industrial-safety-certificate-course-training-in-chennai/>
2. https://onlinecourses.nptel.ac.in/noc18_mg42/preview

OPERATIONS RESEARCH (Open Elective)

Prerequisites: NIL

Course objectives: The course will enable the students to:

1. Study the linear programming and non linear programming techniques used for business and engineering applications.
2. Understand the importance of dynamic programming concept in operations research
3. Know about the inventory, Game theory and waiting line model applications in real world.

UNIT 1:(~10 Lecture Hours)

Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem-Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M methods, Special cases in LP-Degeneracy, unbounded, infeasibility & alternative optima.

UNIT 2:(~8 Lecture Hours)

Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions-Northwest corner rule, least cost method and Vogel's approximation method. Optimality test by MODI method & stepping stone method.

Assignment problem: Formulation. Hungarian method for optimal solution. Solving unbalanced Assignment problem.

UNIT 3:(~8 Lecture Hours)

Non-linear Programming: Introduction to non-linear programming (NLP), Convex and concave functions, NLP with one variable, Line search algorithms, Multivariable unconstrained problems, constrained problems, Lagrange Multiplier, The Karush-Kuhn-Tucker (KKT) conditions, the method of steepest ascent, convex combination method, penalty function, Quadratic programming

UNIT 4:(~8 Lecture Hours)

a) **Dynamic programming.** Characteristics of dynamic programming. Dynamic programming approach for Coach/Shortest Path and cargo loading problems.

b) **Inventory models.** Inventory costs. Models with deterministic demand-model (a) demand rate uniform and production rate infinite, model (b) demand rate uniform and production rate finite.

UNIT 5:(~10 Lecture Hours)

a) **Games Theory.** Competitive games rectangular game saddle point, minimax (maximin) method of optimal strategies, and value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point-mixed strategy for 2*2 games.

b) **Waiting lines:** Single channel –poisson arrivals and exponential service times with infinite population and finite population models. Multi channel- poisson arrivals and exponential service times with infinite population

Text Books:

1. J K Sharma., Operations Research, theory and applications, 5th edition, Macmillan India Ltd ,2013
2. S S Rao, Engineering optimisation – Theory and Practice, 4th Edition, John Wiley & Sons Inc., 2009 .

Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. F.H. Hillier and G.J. Lieberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010
3. S.D. Sharma, Operations Research, Kedarnath, Ramnath& Co., Meerut, 2009.
4. V.K. Kapoor, Operations Research”, S. Chand Publishers, New Delhi, 2004.

Course outcomes

At the end of the course students will be able to

- 1 Apply linear programming models to several Engineering Applications.
- 2 Able to apply the concept of non linear programming.
- 3 In Dynamic Programming selected models were taught.
- 4 Apply simple mathematical models in Inventory into the real Engineering Applications.
- 5 Solve Game theory problems related to business applications,
- 6 To minimize waiting time of the customer and optimization of number of servers.

Online websites / Materials: IOR Tutorials(Interactive Operations Research Tutorial)Online Courses: onlinecourses.nptel.ac.in

COST MANAGEMENT OF ENGINEERING PROJECTS (Open Elective)

Prerequisites: Nil

Course Objectives:

1. Give inputs in handling the cost associated with engineering projects.
2. Acquaint the practical aspects of cost management.
3. Orient the quantitative techniques applicable to cost management.

UNIT 1: (~ 10 Lecture Hours)

Cost Management - Introduction and importance of Cost Management, Cost Classification on the basis of behaviour (as variable, fixed and semi variable), traceability (as direct and indirect), functions (as production cost, administration cost, selling cost and distribution cost), Various cost concepts. Objectives of costing system, Traditional Costing system, Activity Based Costing (ABC), and Cost Audit.

UNIT 2: (~7 Lecture Hours)

Project Management – Project Planning, Types of Project, Stages of Project execution importance of PERT and CPM, Project crashing – Problems.

UNIT 3: (~10 Lecture Hours)

Budgetary Control – Introduction to Budget, Concepts advantages, types of Functional budgets: Fixed and Flexible budget, Performance budget, Cash Budget and Production Budget. Introduction to Zero based budgeting, (Simple Problems on Functional based budget).

UNIT 4: (~10 Lecture Hours)

Inventory Management - Valuing the Inventory using LIFO, FIFO and Weighted Average Methods, Economic Order Quantity (EOQ), Just-in-time, Material Requirements Planning (MRP), ABC Analysis, VED Analysis and Value Chain Analysis.

UNIT 5: (~10 Lecture Hours)

Costing for Managerial Decision Making - Factors governing pricing policy, objectives of Pricing policy, concept of transfer pricing, objectives and methods. Choosing the right Pricing method with simple problems. International Transfer Pricing. Relevant costing for make or buy and evaluation of special order.

Text Books:

1. Charles T. Horngren and George Foster, Cost Accounting: A Managerial Emphasis, PHI, 1st edition.
2. Anthony A. Atkinson, Robert S Kalpan et al., Management Accounting, Pearson, 6th edition.
3. N. D. Vohra, Quantitative Techniques in Management, Tata Mc. Graw Hill, 4th edition.

Reference Books:

1. Blocher, Chen, Cokins, and Lin, Cost Management: A Strategic Emphasis.
2. John K. Shank and Vijay Govindarajan, Strategic Cost Management.

Online Resources:

1. Managerial Accounting: <http://nptel.ac.in/courses/110101004/24>

Course Outcomes:

After completion of the course the student will be able to

1. Perceive the cost associated in managing engineering projects
2. Prepare budgets for engineering projects.
3. Enumerate and effectively handle the inventory management in reducing the project management cost.
4. Envelope the cost associated in price fixation of the projects.
5. Orient the cost management decision-making using quantitative methodology in minimizing the cost associated with the projects.
6. Furnish effective cost management practices for better handling of engineering projects

COMPOSITE MATERIALS (Open Elective)

Prerequisites: Nil

Course Objectives:

1. To Learn to demonstrate a critical understanding of composite materials of their nature and application
2. To Critically evaluate the types of reinforcements and their advantages in application.
3. To Develop an understanding of different types of metal matrix composites and their preparation.
4. To Develop an understanding of different types of ceramic matrix composites and their preparation.
5. To Develop an understanding of different types of polymer matrix composites and their preparation.
6. To Critically evaluate strength of the composite materials through Laminar study.

UNIT1: (~ 9 Lecture Hours)

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.

UNIT2: (~ 9 Lecture Hours)

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.

UNIT3: (~ 9 Lecture Hours)

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.

UNIT4: (~ 8 Lecture Hours)

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepreps – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT5: (~ 9 Lecture Hours)

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygro-thermal failure. Laminate first ply failure-insight strength; Laminate strength-

ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text books:

1. R.W.Cahn, Material Science and Technology – Vol 13 – Composites VCH, WestGermany.
2. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons Materials Science and Engineering, An introduction., NY, Indian edition, 2007.

Reference books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.

Web resources:

1. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Composite%20Materials/pdf/Lecture_Notes/LNm1.pdf
2. https://www.asminternational.org/documents/10192/1849770/05287G_Sample_Chapter.pdf
3. http://home.iitk.ac.in/~mohite/Composite_introduction.pdf
4. https://onlinecourses.nptel.ac.in/noc18_me03/preview
5. <https://www.online.colostate.edu/courses/MECH/MECH530.dot>

Course Outcomes:

After completion of the course students will be able to

1. Learn different composite materials and their applications
2. Have capacity to integrate knowledge and to analyse, evaluate and manage the different the types of reinforcements.
3. Develop different types of metal matrix composites and prepare the same for their specific needs as engineers.
4. Develop different types of ceramic matrix composites and prepare the same for their specific needs as engineers.
5. Develop different types of polymer matrix composites and prepare the same for their specific needs as engineers.
6. Critically enhance strength of the composite materials through Laminar usage.

ENERGY FROM WASTE (Open Elective)

Prerequisites: NIL

Course Objectives:

1. To classify various waste resources.
2. To identify various methods of waste disposal.
3. To study various energy generation methods from waste.
4. To analyze various processes of recycling of waste and environmental benefits.
5. To know the significance of managing of waste.

Unit 1: (~8 Lecture Hours)

Introduction: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW, recycling of municipal waste, Segregation of waste, Managing waste, Medical waste / Pharmaceutical waste treatment, Environmental impacts. Solid waste: Land fill method of Solid waste disposal, Land fill classification, Types.

Unit 2: (~10 Lecture Hours)

Biomass: Pyrolysis – Types, Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit 3: (~8 Lecture Hours)

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit 4: (~10 Lecture Hours)

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes. Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Unit 5: (~8 Lecture Hours)

E-waste: e-waste in the global context- Environmental concerns and health hazards Recycling e-waste, Global trade in hazardous waste, e-waste legislation, Government regulations on e-waste management.

TEXT BOOKS:

1. Desai, Ashok V., "Non Conventional Energy" Wiley Eastern Ltd., 1990.
2. Khandelwal, K.C. and Mahdi S.S. "Biogas Technology-A Practical Hand Book Vol.I& II," Tata McGraw Hill Publishing Co.Ltd.' 1983.
3. Challal, D.S., " Food, Feed and Fuel from Biomass" IBH Publishing Co.Pvt.Ltd., 1991.
4. Nicholas P. Cheremisinoff. "Handbook of Solid Waste Management and Waste Minimization Technologies" An Imprint of Elsevier, New Delhi, 2003.

REFERENCE BOOKS:

1. C.Y.WereKo-Brobby and E.B.Hagan,” Biomass Conversion and Technology” John Wiley & Sons, 1996.
2. M.Dutta,B.P.Parida,B.K.Guha and T.R.Surkrishnan “ Industrial Solid Waste Management and Landfilling practice.”Narosa Publishing House, New Delhi, 1999.
3. P.AarneVesilind,WilliamA.Worrell and Debra R.Reinhart, “ Solid Waste Engineering” Thomson Asia Pte Ltd. Singapore (2002)

Course Outcomes:

Upon the completion of the subject,the students will be able to

1. Understand the methods of recycling of waste.
2. Compare the methods of waste disposal.
3. Identify different sources of energy from waste.
4. Analyze methods for management of waste.
5. Understand the global trade in hazardous waste.
6. Utilize different sources of energy from waste in an efficient and economical way for practical utilities.

POWER FROM RENEWABLE ENERGY SOURCES (Open Elective)

Prerequisites: NIL

Course Objectives:

1. To introduce various types of renewable energy technologies
2. To understand the technologies of energy conversion from the resources and their quantitative analysis

Unit 1: (~10 Lecture Hours)

Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface- Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications- Solar ponds- Heliostat systems-water heater-air heater-solar still

Unit 2: (~8 Lecture Hours)

Solar-Electric Power generation- Photovoltaic cells- Equivalent circuit- V-I Characteristics- Photovoltaic modules – constructional details- design considerations- Tracking- Maximum power point tracking - Solar Thermo electric conversion.

Unit 3: (~8 Lecture Hours)

Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines –their configurations- Wind Energy conversion systems

Unit 4: (~9 Lecture Hours)

Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes – Dry Processes- Bio Gas generation – Aerobic and anaerobic digestion - Factors affecting generation of bio gas - Classification of bio gas plants-Different Indian digesters- Digester design considerations - Gasification process - Gasifiers – Applications. Geothermal Energy - sources- Hydrothermal convective - Geo-pressure resources - Petro-thermal systems (HDR) - Magma Resources-Prime Movers.

Unit 5: (~9 Lecture Hours)

Ocean Thermal Energy Conversion Systems- Principle of operation - Open and closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants - Operation Methods - Estimation of Energy in Single and double basin systems - Energy and Power from Waves Wave energy conversion devices - Fuel Cells - Design and Principle of operation - Types of Fuel Cells - Types of Electrodes – Applications - Basics of Batteries - Constructional details of Lead acid batteries - Ni-Cd Batteries.

TEXT BOOKS:

1. "John Twidell & Wier", "Renewable Energy Resources", CRC Press, 2009
2. "G. D. Rai", "Non Conventional Energy sources", Khanna publishers, 2004

REFERENCE BOOKS:

1. "D. P .Kothari, Singal, Rakesh and Ranjan", "Renewable Energy sources and Emerging Technologies", PHI, 2009.
2. "F. C. Treble", Generating Electricity from Sun, Pergamon Press, 1st Edition 1991
3. "C. S. Solanki", "Solar Photovoltaics - Fundamentals- Principles and Applications", PHI, 2009
4. "S. P. Sukhatme", "Solar Energy Principles and Application", TMH, 2009.

Course Outcomes:

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

1. Analyse solar thermal and photovoltaic systems and related technologies for energy conversion
2. Understand Wind energy conversion and devices available for it
3. Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies
4. Realize Power from oceans (thermal, wave, tidal) and conversion devices
5. Understand fundamentals of fuel cells and commercial batteries.
6. Suggest suitable methods of power generation for a particular region/ organization based on the availability of resources.