INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)
Dundigal, Hyderabad - 500 043, Telangana

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

MASTER OF TECHNOLOGY
POWER ELECTRONICS AND ELECTRICAL DRIVES

ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABI UNDER AUTONOMOUS STATUS

M.Tech Regular Two Year Degree Program
(for the batches admitted from the academic year 2016 - 17)

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

CONTENTS

"Take up one idea.
Make that one idea you're life-think of it, dream of it, and live on that idea.
Let the brain muscles, nerves, every part of your body be full of that idea
and just leave every other idea alone.
This is the way to success" **Swami Vivekananda**

PRELIMINARY DEFINITIONS AND NOMENCLATURES

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two consecutive semesters i.e., Even and Odd semester.

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F) in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry, Biology etc., are considered to be foundational in nature.

Betterment: Betterment is a way that contributes towards improvement of the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Certificate course: It is a course that makes a student gain hands-on experience and skill required for holistic development in a specific area/field.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Commission: Means University Grants Commission (UGC), New Delhi.

Continuous Internal Examination: It is an examination conducted towards internal assessment.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week.

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

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed upto two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources and processes for evaluating the attainment of Program Educational Objectives.

Degree with Specialization: A student who fulfills all the program requirements of her/his discipline and successfully completes a specified set of professional elective courses in a specialized area is eligible to receive a degree with specialization like Structural Engineering, Embedded Systems, CSE, etc.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources in the process of study for a degree.

Detention in a course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for any semester can apply in writing in prescribed format before commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 point scale.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Course (MOOC): MOOC courses inculcate the habit of self learning. MOOC courses would be additional choices in all the elective group courses.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, Master of Technology (M.Tech) degree program / UG degree program: B.Tech.

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her second year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for the theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a Program.

Regulations: The regulations, common to all M.Tech programs offered by Institute are designated as "IARE-R16" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. The odd semester starts usually in July and even semester in December.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

S/he: Means "she" and "he" both.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means the Jawaharlal Nehru Technological University Hyderabad, Hyderabad.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of the odd or even semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Words 'he', 'him', 'his', occur, they imply 'she', 'her', 'hers' also.

FOREWORD

The autonomy is conferred to Institute of Aeronautical Engineering (IARE), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like J N T University Hyderabad (JNTUH), Hyderabad and AICTE. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system** and **monitoring mechanism**, independent of the affiliating University but under its observance.

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

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

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

PRINCIPAL

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ACADEMIC REGULATIONS

M. Tech. Regular Two Year Degree Program
(for the batches admitted from the academic year 2016 - 17)

For pursuing two year postgraduate Master Degree program of study in Engineering (M. Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

1.0 CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEI's) are changing from the conventional course structure to Choice Based Credit System (CBCS) along with introduction to semester system at first year itself. The semester system helps in accelerating the teaching learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises of lectures / tutorials / laboratory work / field work / project work / comprehensive examination / viva / seminars / assignments / presentations / self-study etc. or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.

The CBCS permits students to:

1. Choose electives from a wide range of elective courses offered by the departments of the Institute.
2. Undergo additional courses of interest.
3. Adopt an inter-disciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2.0 MEDIUM OF INSTRUCTION

The medium of instruction shall be English for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course curriculum in accordance with the prescribed syllabi.

3.0 ELIGIBILITY FOR ADMISSION

The admissions for category A and B seats shall be as per the guidelines of Telangana State Council for Higher Education (TSCHE) in consonance with government reservation policy.

a) Under Category A: 70% of the seats are filled based on GATE/PGECET ranks.

b) Under Category B: 30% seats are filled on merit basis as per guidelines of TSCHE.

4.0 UNIQUE COURSE IDENTIFICATION CODE

Every specialization of the M.Tech program will be placed in one of the seven groups as listed in the Table 1.

Table 1: Group of Courses

S. No	Specialization	Offering Department	Code
1	Structural Engineering	Civil Engineering	ST
2	Power Electronics and Electrical Drives	Electrical and Electronics Engineering	PE
3	CAD / CAM	Mechanical Engineering	CC
4	Embedded Systems	Electronics and Communication Engineering	ES
5	Computer Science and Engineering	Computer Science and Engineering	CS
6	Software Engineering	Information Technology	SE
7	Aerospace Engineering	Aeronautical Engineering	AE

5.0 TYPES OF COURSES

Courses in a program may be of two kinds: **Core and Elective.**

5.1 Core Course:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in said discipline of study.

5.2 Elective Course:

Electives provide breadth of experience in respective branch and applications areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An elective may be discipline centric (Professional Elective) focusing on those courses which add generic proficiency to the students or may be chosen from supportive/general discipline called as "Open Elective".

There shall be four professional elective groups out of which students can choose not more than two courses from each group. Overall, students can opt for four professional elective courses which suit their project work in consultation with the faculty advisor/mentor. In addition, one course from each of the two open electives has to be selected. A student may also opt for more elective courses in his/her area of interest.

6.0 SEMESTER STRUCTURE

The institute shall follow semester pattern. An academic year shall consist of a first semester and a second semester and the summer term. Each semester shall be of 23 weeks (Table 2) duration and this period includes time for course work, examination preparation and conduct of examinations. Each main semester shall have a minimum of 90 working days; out of which number of contact days for teaching / practical shall be 75 and 15 days shall be for examination preparation. The duration for each semester shall be a minimum of 17 weeks of instruction. The Academic Calendar is declared at the beginning of the academic year as given in Table 2.

Table 2: Academic Calendar

FIRST SEMESTER (23 weeks)	I Spell Instruction Period	9 weeks	21 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 week	
	Preparation and Practical Examinations	2 weeks	
	Semester End Examinations		2 weeks
Semester Break and Supplementary Exams			2 weeks
SECOND SEMESTER (23 weeks)	I Spell Instruction Period	9 weeks	21 weeks
	I Mid Examinations	1 week	
	II Spell Instruction Period	8 weeks	
	II Mid Examinations	1 Week	
	Preparation & Practical Examinations	2 weeks	
	Semester End Examinations		2 weeks
Summer Vacation			4 weeks
THIRD SEMESTER	Project Work Phase - I		18 weeks
FOURTH SEMESTER	Project Work Phase - II		18 weeks

7.0 PROGRAM DURATION

A student shall be declared eligible for the award of M.Tech degree, if s/he pursues a course of study and completes it successfully in not less than two academic years and not more than four academic years. A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

a) A student will be eligible for the award of M.Tech degree on securing a minimum of 5.0/10.0 CGPA.

b) In the event of non-completion of project work and/or non-submission of the project report by the end of the fourth semester, the candidate shall re-register by paying the semester fee for the project. In such a case, the candidate will not be permitted to submit the report earlier than three months and not later than six months from the date of registration.

8.0 CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Core Courses, Elective Courses, Laboratory Course, Comprehensive Examination, Internship and Project Work. The list of elective courses may include subjects from allied disciplines also.

Each Theory and Laboratory course carries credits based on the number of hours/week as follows:

- **Lecture Hours (Theory):** 1 credit per lecture hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 practical hours, 2 credits for 3 or 4 practical hours per week.
- **Project Work:** 1 credit for 4 hours of project work per week.

8.1 Credit distribution for courses offered is shown in Table 3.

Table 3: Credit distribution

S. No	Course	Hours	Credits
1	Core Courses	3	3
2	Elective Courses	3	3
3	MOOC Courses	-	2
4	Laboratory Courses	3	2
5	Seminar and Technical Writing	3	2
6	Comprehensive Examination	-	2
7	Project Work	128	30

8.2 Course wise break-up for the total credits:

Total Theory Courses (12) Core Courses (06) + Professional Electives (04) + Open Electives (02)	06 @ 3 credits + 06 @ 3 credits	36
Total Laboratory Courses (03)	03 @ 2 credits	06
MOOC Courses (02)	02 @ 2 credits	04
Seminar and Technical Writing (01)	1 @ 2 credits	02
Comprehensive Examination (01)	1 @ 2 credits	02
Project Work	1 @ 30 credits	30
TOTAL CREDITS		**80**

9.0 EVALUATION METHODOLOGY

9.1 Theory Course:

Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIE during the semester, marks are awarded by taking average of two sessional examinations.

9.1.1 Semester End Examination (SEE):

The SEE shall be conducted for 70 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern shall be as defined below. Two full questions with 'either' 'or' choice will be drawn from each unit. Each question carries 14 marks. There could be a maximum of three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

9.1.2 Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty/teacher handling the course as given in Table 4. CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Technical Seminar and Term Paper.

Table 4: Assessment pattern for Theory Courses

COMPONENT	**THEORY**		**TOTAL MARKS**
Type of Assessment	CIE Exam (Sessional)	Technical Seminar and Term Paper	
Max. CIA	25	5	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations are conducted during I year I semester and II semester. For seminar, a student under the supervision of a concerned faculty member, shall identify a topic in each course and prepare the term paper with overview of topic. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

9.2 Laboratory Course:

9.2.1 Each lab will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment. The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being a internal examiner and another is external examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

9.2.2 All the drawing related courses are evaluated in line with lab courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test for 10 marks each in a semester.

9.3 MOOC Courses:

Meeting with the global requirements, to inculcate the habit of self learning and in compliance with UGC guidelines, MOOC (Massive Open Online Course) courses have been introduced as electives.

9.3.1 The proposed MOOC Courses would be additional choices in all the elective groups subject to the availability during the respective semesters and respective departments will declare the list of the courses at the beginning of the semester. Course content for the selected MOOC Courses shall be drawn from respective MOOCs links or shall be supplied by the department. Course will be mentored by faculty members and Assessment and evaluation of the courses shall be done by the department.

9.3.2 There shall be one Mid Sessional Examination (Quiz exam for 30 marks) after 8 weeks of the commencement of the course and semester end evaluation (Descriptive exam for 70 marks) shall be done along with other regular courses.

9.3.3 Two credits will be awarded upon successful completion of each MOOC Course.

9.3.4 Students interested in doing MOOC Courses shall register the course title at their department office at the start of the semester against the courses that are announced by the department.

9.4 Project work

Normally, the project work should be carried out at Host Institute (Institute of Aeronautical Engineering). However, it can also be carried out in any of the recognized Educational Institutions, National Laboratories, Research Institutions, Industrial Organizations, Service Organizations or Government Organizations with the prior permission from the guide and concerned Head of the Department. A student shall submit the outcome of the project work in the form of a dissertation.

9.4.1 The student shall submit the project work synopsis at the end of III semester for Phase-I of project evaluation. The Phase-I of project work shall be evaluated by Project Review Committee (PRC) at the end of the third semester for a maximum of 100 marks. Head of the Department (HOD) shall constitute a PRC comprising of senior faculty of the specialization, Guide and Head of the Department.

9.4.2 The first phase of project work is to be carried out in IV semester for Phase –II of Project work. The student will be allowed to appear for final viva voce examination at the end of IV semester only if s/he has submitted s/he project work in the form of paper for presentation / publication in a conference/journal and produce the proof of acceptance of the paper from the organizers/publishers.

9.4.3 The student shall submit the project work in the form of dissertation at least four weeks ahead of the completion of the program. Head of the Department shall constitute an Internal Evaluation Committee (IEC) comprising of the Chairman BOS (PG), HOD and Guide. As per convenes of all meeting for open pre-submission seminar evaluation of the student. If the open pre-submission seminar by a student is not satisfactory, another seminar shall be scheduled within two weeks.

The evaluation of the project work and the marks allotted are as under:

S.No	Project Phases	Mode	Evaluation Committee	Marks
1	Phase - I	Continuous evaluation at the end of III Semester	Guide	30
2		Evaluation at the end of III Semester	Project Review Committee (PRC) comprising of senior faculty of the specialization, guide and HOD.	70
Total(Phase – I)				**100**
3	Phase - II	An open pre-submission seminar by the student	The Internal Evaluation Committee (IEC) comprising of the Chairman, BOS (PG), HOD and guide wherein the HOD convenes its meeting.	30
4		End Semester Examination (An open seminar followed by viva-voce)	The External Evaluation Committee (EEC) comprising of External Examiner, HOD and guide wherein the HOD shall be the chairman of the committee.	70
Total(Phase-II)				**100**

9.4.4 As soon as a student submits his project work, Principal shall appoint the External Examiner among the panel of examiners recommended by the Chairman, BOS (PG).

9.4.5 The Principal shall schedule the End Semester Examination in project work soon after the completion of the study of program and a student can appear for the same provided s/he has earned successfully all the requisite credits. The student shall produce the dissertation duly certified by the guide and HOD during the Examination.

9.4.6 The project reports of M. Tech students who have not completed their course work successfully will be evaluated in that semester itself and the result sent confidentially to the Controller of Examinations. The results of the project work evaluation will be declared by the Controller of Examinations only after the successful completion of the courses by those students.

9.5 Comprehensive Examination

The comprehensive examination is aimed at assessing the student's understanding of various Foundation, Skill and Core courses studied by the end of II semester and is intended to test the student's grasp of the chosen field of study. The comprehensive examination is an online test evaluated for 100 marks.

10.0 ATTENDANCE REQUIREMENTS AND DETENTION POLICY

10.1 It is desirable for a candidate to put on 100% attendance in each course. In every course (theory/laboratory), student has to maintain a minimum of 80% attendance including the days of attendance in sports, games, NCC and NSS activities to be eligible for appearing in Semester End Examination of the course.

10.2 For cases of medical issues, deficiency of attendance in each course to the extent of 15% may be condoned by the College Academic Committee (CAC) on the recommendation of Head of the Department if his/her attendance is between 80% to 65% in every course, subjected to submission of medical certificate and other needful documents to the concerned department.

10.3 The basis for the calculation of the attendance shall be the period prescribed by the institute by its calendar of events. For late admission, attendance is reckoned from the date of admission to the program.

10.3 However, in case of a student having less than 65% attendance in any course, s/he shall be detained in the course and in no case such process will be relaxed.

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

10.5 A prescribed fee shall be payable towards Condonation of shortage of attendance.

10.6 A candidate shall put in a minimum required attendance at least in three (3) theory courses for getting promoted to next higher class / semester. Otherwise, s/he shall be declared detained and has to repeat semester.

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

11.0 CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

11.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

11.2 Question papers may be moderated for the coverage of syllabus, pattern of questions by Semester End Examination Committee chaired by Head of the Department one day before the commencement of semester end examinations.

11.3 Internal Examiner shall prepare a detailed scheme of valuation.

11.4 The answer papers of semester end examination should be evaluated by the internal examiner immediately after the completion of exam and the award sheet should be submitted to COE in a sealed cover before the same papers are kept for second evaluation by external examiner.

11.5 In case of difference is more than 15% of marks, the answer paper shall be re-evaluated by a third examiner appointed by the Examination Committee and marks awarded by him shall be taken as final.

11.6 HOD shall invite 3-9 external examiners to evaluate all the end semester answer scripts on a prescribed date(s). Practical laboratory exams are conducted involving external examiners.

11.7 Examination Control Committee shall consolidate the marks awarded by internal and external examiners to award grades.

12.0 SCHEME FOR THE AWARD OF GRADE

12.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures:

i. Not less than 40% marks for each theory course in the semester end examination, and

ii. A minimum of 50% marks for each theory course considering both CIA and SEE

12.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Laboratory / Seminar and Technical Writing / Project, if s/he secures

i. Not less than 40% marks for each Laboratory / Seminar and Technical Writing / Project course in the semester end examination,

ii. A minimum of 50% marks for each Laboratory / Seminar and Technical Writing / Project course considering both internal and semester end examination.

12.3 If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

13.0 LETTER GRADES AND GRADE POINTS

13.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10 point grading system with the following letter grades as given below:

Range of Marks	Grade Point	Letter Grade
100 - 80	10	S (Superior)
70 – 79	9	A+ (Excellent)
60 – 69	8	A (Very Good)
55 – 59	7	B+ (Good)
50 – 54	6	B (Average)
Below 50	0	F (Fail)
Absent	0	Ab (Absent)
Authorized Break of Study	0	ABS

13.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: “S”, “A+”, “A”, “B+”, “B”.

13.3 A student obtaining Grade “F” shall be considered Failed and will be required to reappear in the examination.

13.4 "SA" denotes shortage of attendance (as per item 10) and hence prevention from writing Semester End Examination.

13.5 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

14.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and n represent the number of courses in which a student's is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m} (C_j S_j) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

15.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA

15.1 Illustration for SGPA

Course Name	Course Credits	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 x 8 = 24
Course 2	4	B+	7	4 x 7 = 28
Course 3	3	B	6	3 x 6 = 18
Course 4	3	O	10	3 x 10 = 30
Course 5	3	C	5	3 x 5 = 15
Course 6	4	B	6	4 x 6 = 24
	20			**139**

$$Thus, SGPA = 139 / 20 = 6.95$$

15.2 Illustration for CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit: 20 SGPA: 6.9	Credit: 22 SGPA: 7.8	Credit: 25 SGPA: 5.6	Credit: 26 SGPA: 6.0

$$Thus,\ CGPA = \frac{20x6.9 + 22x7.8 + 25x5.6 + 26x6.0}{93} = 6.51$$

16.0 PHOTOCOPY / REVALUATION

A student, who seeks the revaluation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s) within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the Department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

17.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of M .Tech degree.

17.1 Student shall register and acquire minimum attendance in all courses and secure 80 credits.

17.2 A student who fails to earn 80 credits within four consecutive academic years from the year of his/her admission with a minimum CGPA of 5.0, shall forfeit his/her degree and his/her admission stands cancelled.

18.0 AWARD OF DEGREE

Classification of degree will be as follows:

CGPA ≥ 7.5	CGPA ≥ 6.5 and < 7.5	CGPA ≥ 5.5 and < 6.5	CGPA ≥ 5.0 and < 5.5	CGPA < 5.0
First Class with Distinction	**First Class**	**Second Class**	**Pass Class**	**Fail**

a) In case a student takes more than one attempt in clearing a course, the final marks secured shall be indicated by * mark in the grade sheet.

b) All the candidates who register for the semester end examination will be issued grade sheet by the institute. Apart from the semester wise grade sheet, the institute will issue the provisional certificate subject to the fulfillment of all the academic requirements.

19.0 IMPROVEMENT OF GRADE:

A candidate, after becoming eligible for the award of the degree, may reappear for the final examination in any of the theory courses as and when conducted for the purpose of improving the

aggregate and the grade. But this reappearance shall be within a period of two academic years after becoming eligible for the award of the degree.

However, this facility shall not be availed of by a candidate who has taken the Original Degree Certificate. Candidates shall not be permitted to reappear either for CIE in any course or for Semester End Examination (SEE) in laboratory courses (including Project Viva-voce) for the purpose of improvement.

20.0 TERMINATION FROM THE PROGRAM

The admission of a student to the program may be terminated and the student may be asked to leave the institute in the following circumstances:

a) The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.

b) The student fails to satisfy the norms of discipline specified by the institute from time to time.

21.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the college / if any case of indiscipline / malpractice is pending against him/her, the results of the candidate will be withheld. The issue of the degree is liable to be withheld in such cases.

22.0 GRADUATION DAY

The institute shall have its own annual Graduation Day for the award of Degrees to students completing the prescribed academic requirements in each case, in consultation with the University and by following the provisions in the Statute.

The college shall institute prizes and medals to meritorious students annually on Graduation Day. This will greatly encourage the students to strive for excellence in their academic work.

23.0 DISCIPLINE

Every student is required to observe discipline and decorum both inside and outside the institute and not to indulge in any activity which will tend to bring down the honor of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations he/she shall be liable for punitive action as prescribed by the Institute from time to time.

24.0 GRIEVANCE REDRESSAL COMMITTEE

The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

25.0 TRANSITORY REGULATIONS

25.1 A student who has been detained in any semester of previous regulations for not satisfying the attendance requirements shall be permitted to join in the corresponding semester of this regulation.

25.2 Semester End Examination in each course under the regulations that precede immediately these regulations shall be conducted three times after the conduct of last regular examination under those regulations. Thereafter, the failed students, if any, shall take

examination in the equivalent papers of these regulations as suggested by the Chairman, BOS concerned.

26.0 REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body shall come into force and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

POWER ELECTRONICS AND ELECTRICAL DRIVES

COURSE STRUCTURE

I SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BPE001	Power Electronic Control of DC Drives	PC	Core	3	-	-	3	30	70	100
BPE002	AC to DC Converters	PC	Core	3	-	-	3	30	70	100
BPE003	Special Machines and their Controllers	PC	Core	3	-	-	3	30	70	100
	Professional Elective - I	PE	Elective	3	-	-	3	30	70	100
	Professional Elective - II	PE	Elective	3	-	-	3	30	70	100
	Open Elective - I	OE	Elective	3	-	-	3	30	70	100
BPE301	MOOC – I (Massive Open Online Course)	PE	Elective	-	-	3	2	30	70	100
PRACTICAL										
BPE101	Power Converters and Electric Drives Laboratory	PC	Core	-	-	3	2	30	70	100
TOTAL				**18**	**00**	**06**	**22**	**240**	**560**	**800**

II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BPE004	Power Electronic Control of AC Drives	PC	Core	3	-	-	3	30	70	100
BPE005	DC to AC Converters	PC	Core	3	-	-	3	30	70	100
BPE006	Flexible AC Transmission Systems(FACTS)	PC	Core	3	-	-	3	30	70	100
	Professional elective - III	PE	Elective	3	-	-	3	30	70	100
	Professional elective - IV	PE	Elective	3	-	-	3	30	70	100
	Open Elective - II	OE	Elective	3	-	-	3	30	70	100
PRACTICAL										
BPE102	Electrical Drives Simulation Laboratory	PC	Core	-	-	3	2	30	70	100
BPE103	Application Development Mini Project Laboratory	-	Core	-	-	3	2	30	70	100
TOTAL				**18**	**00**	**06**	**22**	**240**	**560**	**800**

III SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BPE401	Seminar & Technical Writing	PC	Core	-	-	3	2	30	70	100
BPE302	MOOC - II (Massive Open Online Course)	PE	Elective	-	-	3	2	30	70	100
Practical										
BPE501	Comprehensive Examination	-	Core	-	-	-	2	30	70	100
BPE601	Project Work (Phase-1)	-	Core	-	-	-	10	100	-	100
TOTAL				**0**	**0**	**06**	**16**	**190**	**210**	**400**

IV SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
BPE602	Project Work (Phase - II)	-	Core	-	-	-	20	30	70	100
TOTAL				**00**	**00**	**00**	**20**	**30**	**70**	**100**

PROFESSIONAL ELECTIVES

GROUP – I: CONTROL SYSTEMS

Course Code	Course Title
BPE201	Control system design
BPE202	Optimization Techniques in Power Electronics
BPE203	Programmable logic controllers and their applications
BPE204	Advanced control systems

GROUP – II: ADVANCED POWERELECTRONICS

Course Code	Course Title
BPE205	Computer Aided Design of Power Electronics Circuits
BPE206	Advanced Power Semiconductor Devices
BPE207	Power Electronics in Renewable Energy Systems
BPE208	Multilevel Inverters

GROUP-III: POWER ELECTRONICS INTERFACE TO POWER SYSTEMS

Course Code	Course Title
BPE209	Soft Computing Techniques
BPE210	Power Quality
BPE211	Analysis of Inverters
BPE212	Smart Grid Design and Analysis

GROUP-IV: CONTROLLERS FOR POWER ELECTRONICS

Course Code	Course Title
BPE213	Computer Aided Design of Instrumentation System
BPE214	Intelligent Controllers
BPE215	Software Tools for Power Electronics
BPE216	Digital Controller for Power Electronics

OPEN ELECTIVES – I

Course Code	Course Title
BST701	Disaster Management
BPE701	Renewable Energy Systems*
BCC701	Automotive Design
BES001	Embedded C
BCS701	Advanced JAVA Programming and Web Services
BAE701	Introduction to Aerospace Engineering
Note: * indicates that subject not offered to the students of Electrical and Electronics Engineering Department	

OPEN ELECTIVES – II

Course Code	Course Title
BST702	Geo Spatial Techniques
BPE702	Solar Photo Voltaic Energy Conversion*
BCC702	Computer Graphics
BES702	Microcontrollers for Embedded System Design
BCS702	Linux Programming
BCS703	Research Methodology
BAE702	Industrial Aerodynamics and Wind Energy
Note: * indicates that subject not offered to the students of Electrical and Electronics Engineering Department	

SYLLABI

POWER ELECTRONIC CONTROL OF DC DRIVES

I Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE001	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Illustrate the operation of single phase controlled rectifier fed DC motor.
II. Analyze the characteristics of three phase controlled rectifier fed DC motor and chopper controlled DC motor drives.
III. Analyze the design of current and speed controllers for specific applications.
IV. Simulate DC motor drives

UNIT-I	SINGLE PHASE CONTROLLED RECTIFIERS FED DC MOTOR	Classes: 09

Single phase full converter: Separately excited DC motors with rectified single phase supply, single phase semi converter and single phase full converter for continuous and discontinuous modes of operation, power and power factor.

UNIT-II	THREE PHASE CONTROLLED RECTIFIERS FED DC MOTOR	Classes: 10

Three phase controlled rectifiers fed DC motor: Three phase semi converter and three phase full converter for continuous and discontinuous modes of operations, power and power factor, addition of freewheeling diode, three phase double converter, three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply, highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

UNIT-III	PHASE, CURRENT AND SPEED CONTROLLED DC DRIVE	Classes: 08

Phase current and speed controlled DC drive: Three phase controlled converter, control circuit, control modeling of three phase converter, steady state analysis of three phase converter, control of DC motor drive, two quadrant, three phase converter controlled DC motor drive, DC motor and load.

Current and speed controllers, current and speed feedback, design of controllers, current and speed controllers, motor equations, filter in the speed feedback loop, speed controller current reference generator, current controller and flow chart for simulation, harmonics and associated problems, sixth harmonics torque.

UNIT-IV	CHOPPER CONTROLLED DC MOTOR DRIVES	Classes: 09

Chopper controlled DC motor drives: Principle of operation of the chopper, four quadrant chopper circuit, chopper for inversion, chopper with other power devices, model of the chopper, input to the chopper, steady state analysis of chopper controlled DC motor drives, rating of the devices, pulsating torque, closed loop operation**,** speed controlled drive system, current control loop, pulse width modulated current controller, hysteresis current controller, modeling of current controller, design of current controller.

UNIT-V	SIMULATION OF DC MOTOR DRIVES	Classes: 09

Simulation of DC motor drives: Dynamic simulations of the speed controlled DC motor drives, feedback speed controller, command current generator, current controller.

Text Books:

1. MH Rashid, "Power Electronics Circuits Devices and Applications", Pearson, 1st Edition, 1995.
2. R. Moorthi, "Power Electronics Devices", Oxford University Press, 4th Edition, 2005.
3. M. D. Singh, K. B. Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998.

Reference Books:

1. Shepherd, Hulley, Liang, "Power Electronics and motor control", Cambridge University Press, 2nd Edition, 1985.
2. MH Rashid, "Power Electronics circuits, Devices and Applications", PHI, 1st Edition, 1995.
3. GK Dubey, "Fundamentals of Electric Drives", Narosa Publishers, 1st Edition, 1995.

Web References:

1. Power Electronic Web Course by NPTEL, IIT Kharagpur, www.nptel.iitm.ac.in
2. Lecture notes from iare website http://www.iare.ac.in
3. Bookboon.com/en/introduction-to-power-electronics-ebook/

E-Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/POWER-ELECTRONICS-HANDBOOK
3. https://www.circuitstoday.com

AC TO DC CONVERTERS

I Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE002	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Demonstrate single phase and three phase power semiconductor devices.
II. Illustrate various power converter circuits.
III. Analyze the waveforms of various power converter circuits.

UNIT-I	MODERN POWER SEMICONDUCTOR DEVICES	Classes: 09

Modern power semiconductor devices: MOS turn off thyristor (MTO), emitter turn off thyristor integrated gate, commutated thyristor, MOS controlled thyristors (MCTs), static induction circuit, comparison and their features.

UNIT-II	THREE PHASE SEMI CONVERTER	Classes: 10

Three phase semi converter and three phase full converter for continuous and discontinuous modes of operations, power and power factor, addition of freewheeling diode, three phase double converter, three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply, highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

UNIT-III	THREE PHASE AC VOLTAGE CONTROLLERS AND CYCLO CONVERTERS	Classes: 08

Single phase AC voltage controllers: Resistive, inductive and resistive, inductive induced EMF loads, AC voltage controllers with PWM Control, effects of source and load inductances, synchronous tap changers, applications, numerical problems.

Three phase AC voltage controllers: Analysis of controllers with star and delta connected resistive, resistive inductive loads, effects of source and load inductances, applications and numerical problems.
Single phase to single phase cycloconverters: Analysis of midpoint and bridge configurations, three phase to three phase cycloconverters, analysis of midpoint and bridge configurations, limitations, advantages, applications, numerical problems.

UNIT-IV	SINGLE PHASE AND THREE PHASE CONVERTERS	Classes :09

Single phase converters: Half controlled and fully controlled converters, evaluation of input power factor and harmonic factor, continuous and discontinuous load current, single phase dual converters, power factor improvements, extinction angle control, symmetrical angle control, PWM, single phase sinusoidal PWM, single phase series converter, applications, numerical problems.

UNIT-V	DC TO DC CONVERTERS	Classes: 09

Choppers:Analysis of step down and step up DC to DC converters with resistive and resistive, inductive loads, switched mode regulators, analysis of buck regulators, boost regulators, buck and boost regulators, cuk regulators, condition for continuous inductor current and capacitor voltage, comparison of regulators, multi output boost converters, advantages applications, numerical problems.

Text Books:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rd Edition, 2004.
2. Ned Mohan, Tore M. Undeland20, William P. Robbins, "Power Electronics", John Wiley and Sons, 2nd Edition, 1990.
3. R. Moorthi, "Power Electronics Devices, Circuits and Industrial applications", Oxford University Press, 1st Edition, 2005.

Reference Books:

1. Dr. P. S. Bimbhra, "Power Electronics", Khanna Pubishers.
2. Philip T. Krein, "Elements of Power Electronics", Oxford University Press.
3. M. S. JamilAsghar, "Power Electronics", PHI Private Limited.
4. John G. Kassakian ,"Principles of Power Electronics", Martin F. Schlect, Geroge C.

Web References:

1. Power Electronic Web Course by NPTEL, IIT Kharagpur, www.nptel.iitm.ac.in
2. Lecture notes from iare website http://www.iare.ac.in
3. Bookboon.com/en/introduction-to-power-electronics-ebook

E-Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/POWER-ELECTRONICS-HANDBOOK
3. https://www.circuitstoday.com

SPECIAL MACHINES AND THEIR CONTROLLERS

I Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE003	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Understand various special machines used in Power Electronics.
II. Describe characteristics of special machines.
III. Understand DC to DC and AC to AC power conversion for driving special machines.

UNIT-I	SYNCHRONOUS RELUCTANCE MOTORS	Classes: 09

Constructional features, types axial and radial air gap motors operating principle reluctance phasor diagram characteristics vernier motor.

UNIT-II	STEPPING MOTORS	Classes: 09

Constructional features principle of operation variable reluctance motor hybrid motor single and multi stack configurations theory of torque predictions linear and nonlinear analysis dynamic characteristics drive systems and circuit for open loop control & closed loop control of stepping motor.

UNIT-III	SWITCHED RELUCTANCE MOTORS	Classes: 09

Constructional features principle of operation torque prediction power controllers, nonlinear analysis.

Microprocessor based control speed torque characteristics computer control.

UNIT-IV	PERMANENT MAGNET BRUSHLESS D.C. MOTOR	Classes: 09

Difference between mechanical and electronic commutators, hall sensors, optical sensors, square wave permanent magnet brushless motor drives, torque and emf equation, torque - speed characteristics of permanent magnet brush less DC motors - controllers pm DC motor, applications.

UNIT-V	PERMANENT MAGNET SYNCHRONOUS MOTORS	Classes: 09

Principle of operation emf and torque equations reactance phasor diagram power controllers converter volt ampere requirements 36 torque speed characteristics, self control, microprocessor based control, applications.

Text Books:

1. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives ", Clarendon Press, Oxford, 1st Edition, 1989.
2. Kenjo, T, "Stepping motors and their microprocessor control ", Clarendon Press, Oxford, 1989.

Reference Books:

1. Kenjo. T, Nagamori. S, "Permanent Magnet and Brushless DC Motors, Clarendon Press, Oxford, 1989.
2. Kenjo. T, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford, 1989.
3. Krishnan R, "Switched Reluctance Motor Drives", Modelling, Simulation, Analysis, Design and

applications, CRC press.
4. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

Web References:

1. http://www.academia.edu/9885014/SPECIAL_ELECTRICAL_MACHINES_NPTEL_NOTES
2. http://een.iust.ac.ir/profs/Arabkhabouri/Electrical%20Drives/Books/
3. https://ktu.edu.in/eu/att/attachments.htm?download=file&id=156232

E-Text Books:

1. http://www.mlbd.com/BookDecription.aspx?id=13779
2. http://www.leeson.com/documents/PMAC_Whitepaper.pdf

POWER CONVERTERS AND ELECTRIC DRIVES LABORATORY

I Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE101	Core	-	-	3	2	30	70	100
Contact Classes: 33	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 33			

OBJECTIVES :

This course should enable the students to:

I. Apply power electronics devices for speed control of electric drives.

LIST OF EXPERIMENTS

Week 1	**PMDC MOTOR**
Speed Measurement and closed loop control using PMDC motor.	
Week 2	**PMDC**
Thyristorised drive for PMDC motor with speed measurement and closed loop control.	
Week 3	**4 QUADRANT CHOPPER DRIVE**
IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.	
Week 4	**1HP DC MOTOR**
Thyristorised drive for 1HP DC motor with closed loop control.	
Week5	**3HP DC MOTOR**
3 Phase input, thyristorised drive 3 Hp DC motor with closed loop.	
Week 6	**43 PHASE INPUT IGBT**
3 phase input IGBT, 4 quadrant chopper drive for DC motor with closed loop control equipment.	
Week 7	**CYCLO CONVERTER**
Cyclo converter based AC induction motor control equipment.	
Week 8	**INDUCTION MOTOR**
Speed control of 3 phase wound rotor induction motor.	
Week 9	**SINGLE PHASE FULL CONTROLLER**
Single phase fully controlled converter with inductive load.	
Week10	**SINGLE PHASE HALF CONTROLLER**
Single phase half wave controlled converter with inductive load.	
Week11	**V/F CONTROL**
V/F Control of VSI fed three phase induction motor	

Text Books:
1. Dr. P. S. Bimbhra, “Power Electronics”, Khanna Pubishers. 2. Philip T. Krein, “Elements of Power Electronics”, Oxford University Press.
Reference Books:
1. M. S. JamilAsghar, “Power Electronics”, PHI Private Limited. 2. John G. Kassakian ,”Principles of Power Electronics”, Martin F. Schlect, Geroge C.
Web References:
1. https://www.ni.com/newsletter/51141/en/http://www.csun.edu/~rd436460/Labview/Lecture-Overview.pdf 2. https://www.labviewmakerhub.com/ 3. https://www.home.hit.no/~hansha/documents/labview.
E-Text Books:
1. https://www.freebookcentre.net 2. https://www.amazon.in/POWER-ELECTRONICS-HANDBOOK 3. https://www.circuitstoday.com

LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 24 STUDENTS

S. No	Name of the Equipment	Range
1.	Four quadrant chopper unit	--
2.	DC motor with speed sensor	12V
3.	Cathode Ray Oscilloscope	(0-30) MHz
4.	Thyristorised converter unit	--
5.	PMDC motorset	--
6.	Chopper PMDC motor control module	--
7.	DC power supply	30V/1A
8.	Thyristorised converter unit	--
9.	DC motor set	1HP
10.	isolation transformer	415V input 185V output
11.	controlled rectifier module	--
12.	firing unit	--
13.	DC shunt motor	--
14.	Chopper power module, chopper firing unit	--
15.	three phase auto transformer	--
16.	Cyclo converter	--
17.	power circuit with firingcircuit	--
18.	Loading rheostat	100 Ohm/2A
19.	AC Induction motor	2HP
20.	controlled rectifier module	--
21.	firing unit	--
22.	rheostat 230 Ohm/3A	230 Ohm/3A

POWER ELECTRONIC CONTROL OF AC DRIVES

II Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE004	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Understand various converters used in AC drives.
II. Distinguish the speed control of induction motors with various power electronics converters.
III. Understand the speed control of synchronous motors with various power electronics converters.
IV. Apply the knowledge of reluctance motor drives.

UNIT-I	INDUCTION MOTOR DRIVES	Classes: 09

Introduction to induction motor drives: Torque production, equivalent circuit analysis, speed, torque characteristics with variable voltage operation variable frequency operation constant v/f operation, variable stator current operation, induction motor characteristics in constant torque and field weakening regions.

UNIT-II	STATOR SIDE CONTROL OF INDUCTION MOTOR DRIVES	Classes:10

Scalar control: Voltage fed inverter control , open loop volts / Hz control, speed control 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.

UNIT-III	ROTOR SIDE CONTROL OF INDUCTION MOTOR DRIVES	Classes: 08

Slip power recovery drives: Static Kramer Drive, phasor diagram and torque expression, speed control of Kramer drive, static Scheribus drive modes of operation.

Vector control of induction motor drives: Principles of vector control, vector control methods, direct methods of vector control, indirect methods of vector control, adaptive control principles, self tuning regulator model referencing control.

UNIT-IV	CONTROL OF SYNCHRONOUS MOTOR DRIVES	Classes: 09

Synchronous motor and its characteristics: Control strategies, constant torque angle control, unity power factor control, constant mutual flux linkage control. Controllers, flux weakening operation, maximum speed, direct flux weakening algorithm, constant torque mode controller, flux weakening controller, indirect flux weakening, maximum permissible torque, speed control scheme, implementation strategy speed controller design.

UNIT-V	VARIABLE RELUCTANCE MOTOR DRIVE	Classes: 09

Variable Reluctance motor drive: Torque production in the variable reluctance motor drive characteristics and control principles, current control of variable reluctance motor drive, brushless DC motor drives, three phase full wave brushless DC motor drive, sinusoidal type of brushless DC motor, current controlled brushless DC motor servo drive, applications and numerical problems.

Text Books:

1. M H Rashid, "Power Electronic circuits Devices and Applications", PHI, 1st Edition 1995.
2. G. K. Dubey, "Fundamentals of Electrical Drives", Narora publications, 1st Edition 1995.
3. BK Bose, "Power Electronics and Variable frequency drives", IEEE Press, Standard publications, 1st Edition 2002.
4. Bimal Bose, "Power Electronics and Motor Drives Advances and Trends", Elesevier 1st Edition

Reference Books:

1. R. Krishnan, "Electric Motor Drives Pearson Modeling, Analysis and control", PHI Publications, 1st Edition, 2002.
2. B K Bose, "Modern Power Electronics and AC Drives", Pearson Publications, 1st Edition, 2005.
3. MD Murthy, FG Turn Bull, " Power Electronics and Control of AC Motors", Pergman Press, 1st Edition.
4. BK Bose, "Power Electronics and AC Drives", Prentice Hall Eagle wood 1st Edition.

Web References:

1. https://nptel.ac.in/courses/108108077/
2. https://en.wikipedia.org/wiki/Variable-frequency_drive
3. https://www.ti.com.cn/cn/lit/wp/slyy078/slyy078.pdf

E-Text Books:

1. https://www4.hcmut.edu.vn/~nntu/files/Modern_Power_Electronics_and_AC_Drives.pdf
2. https://een.iust.ac.ir/profs/Arabkhabouri/Electrical%20Drives/Books/Bimal%20K.%20Bose Power%20Electronics%20And%20Motor%20Drives_%20Advances%20and%20Trends%20(2006).pdf
3. https://www.ene.ttu.ee/elektriajamid/oppeinfo/materjal/AAV0050/ELECTRONIC_SYSTEMS_OF_MOTOR_DRIVE.pdf

DC TO AC CONVERTERS

II Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE005	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

This course should enable the students to:

I. Analyze single phase and three phase PWM inverters.
II. Analyze the frequency response of resonant pulse inverters and converters.
III. Classify multilevel inverters and their applications.
IV. Explain DC power supplies and their applications.
V. Analyze AC power supplies and their applications.

UNIT-I	PWM INVERTERS (SINGLE PHASE AND THREE PHASE)	Classes: 09

PWM Inverters: Principle of operation, performance parameters, single phase bridge inverter, evaluation of output voltage and current with resistive, inductive and capacitive loads, voltage control of single phase inverters, single PWM, multiple PWM, sinusoidal PWM, modified PWM, phase displacement control, advanced modulation techniques for improved performance, trapezoidal, staircase, stepped, harmonic injection and delta modulations, advantages, applications and numerical problems. Three phase inverters, analysis of 180 degree condition for output voltage and current with resistive, inductive loads, analysis of 120 degree conduction, voltage control of three phase inverters, sinusoidal PWM, third harmonic PWM, 60 degree PWM, space vector modulation, comparison of PWM techniques, harmonic reductions, current source inverter, variable DC link inverter, buck and boost inverter, inverter circuit design, advantages, applications and numerical problems.

UNIT-II	RESONANT PULSE INVERTERS	Classes: 10

Resonant pulse inverters: Series resonant inverters, series resonant inverters with unidirectional switches, series resonant inverters with bidirectional switches, analysis of half bridge resonant inverter, evaluation of currents and voltages of a simple resonant inverter, analysis of half bridge and full bridge resonant inverter with bidirectional switches, frequency response of series resonant inverters, for series loaded inverter, for parallel loaded inverter, for series and parallel loaded inverters parallel resonant inverters, voltage control of resonant inverters, class E inverter and class E rectifier, numerical problems. resonant converters: Resonant converters, zero current switching resonant converters, L type ZCS resonant converter, M type ZCS resonant converter, zero voltage switching resonant converters, comparison between ZCS and ZVS resonant converters, two quadrant ZVS resonant converters, resonant DC link inverters, evaluation of L and C for a zero current switching inverter and numerical problems.

UNIT-III	MULTILEVEL INVERTERS	Classes: 08

Multilevel concept: Classification of multilevel inverters, diode clamped multilevel inverter, principle of operation, main features, improved diode clamped inverter, principle of operation, flying capacitors multilevel inverter, principle of operation and main features.

Cascaded multilevel inverter: Principle of operation, main features, multilevel inverter applications, reactive power compensation, back to back inertia system, adjustable drives, switching device currents, DC link capacitor voltage balancing, features of multilevel inverters, comparisons of multilevel converters.

UNIT-IV	DC POWER SUPPLIES	Classes: 09
DC power supplies: Classification, switched mode DC power supplies, fly back converter, forward converter, push pull converter, half bridge converter, full bridge converter, resonant DC power supply, bidirectional power supplies and applications.		
UNIT-V	**AC POWER SUPPLIES**	**Classes: 09**
AC power supplies: Classification, switched mode ac power supplies, resonant AC power supplies bidirectional ac power supplies, multistage conversions, control circuits, applications, power line disturbances, power conditioners, uninterruptible power supplies and applications.		

Text Books:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rd Edition, 1985.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics", John Wiley and Sons Publications, 3rd Edition, 2006.

Reference Books:

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

Web References:

1. Power Electronic Web Course by NPTEL, IIT Kharagpur, https://www.nptel.iitm.ac.in
2. https://www.Bookboon.com/en/introduction-to-power-electronics-ebook/

E-Text Books:

1. https://www.yildiz.edu.tr/~fbakan/GE/GE1.pdf
2. https://books.mcgraw-hill.com/engineering/PDFs/Beaty_Sec22.pdf
3. https://encon.fke.utm.my/notes/inverter-2002.pdf
4. https://www.wpi.edu/Pubs/E-project/Available/E-project-042507-092653/unrestricted/MQP_D_1_2.pdf

FLEXIBLE AC TRANSMISSION SYSTEMS

II Semester : PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE006	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Interpret the concept of Flexible AC Transmission Systems.
II. Analyze Voltage source converters and Current source converters.
III. Describe static shunt compensation and static VAR generators.
IV. Classify reactive power compensation and transient stability enhancement.
V. Apply static series compensation to improve transient stability.

UNIT-I	FACTS CONCEPTS	Classes: 09

Facts concept: Transmission inter connections power flow in an AC system, loading capability limits, dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-II	VOLTAGE SOURCE CONVERTERS	Classes:10

Voltage source converters: Single phase and three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation, three level voltage source converter, pulse width modulation converter, basic concept of current source converters and comparison of current source converters with voltage source converters.

UNIT-III	STATIC SHUNT COMPENSATION	Classes: 08

Static shunt compensation: Objectives of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, power oscillation damping.

Methods of controllable VAR generation, variable impedance type static VAR generators, switching converter type VAR generators, hybrid VAR generators.

UNIT-IV	SVC AND STATCOM	Classes: 09

SVC and STATCOM: Principle of operation of SVC and STATCOM, characteristics of SVC and STATCOM, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT-V	STATIC SERIES COMPENSATORS	Classes: 09

Static Series compensators: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping and functional requirements of GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC) and thyristor controlled series capacitor (TCSC) Control schemes for GSC, TSSC and TCSC.

Text Books:

1. N.G. Hingorani, L. Guygi, "Understanding FACTS Devices", IEEE Press Publications, 1st Edition, 2000.

Reference Books:

1. R. Krishnan, "Electric Motor Drives Modeling, Analysis and Control", Pearson Publications, 1st Edition, 2002.
2. B K Bose, Modern Power Electronics and AC Drives", Pearson Publications, 1st Edition, 2002.
3. MD Murthy, FG Turn Bull, " Power Electronics and Control of AC Motors", Pergman Press, 1st Edition.
4. BK Bose, "Power Electronics and AC Drives", Prentice Hall Eagle wood 1st Edition.

Web References:

1. Power Electronic Web Course by NPTEL, IIT Kharagpur, www.nptel.iitm.ac.in
2. https://www.Bookboon.com/en/introduction-to-power-electronics-ebook/

E-Text Books:

1. http://www.chettinadtech.ac.in/g_articlen/10-10-12/10-10-12-08-46-17-bresnav.pdf
2. http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1208&context=ecetr
3. https://docs.google.com/a/iare.ac.in/file/d/1QAmwi0gy0kOQKiIgpAfxu10N7Bk82TU3avy8wisTBEjtIGuKclHMSwH3-SPH/edit

ELECTRICAL DRIVES SIMULATION LABORATORY

II Semester: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE102	Core	-	-	3	2	30	70	100
Contact Classes: 36	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 36			

OBJECTIVES:

The course should enable the students to:

I. Design and simulate three phase power electronic converters using MATLAB.
II. Simulate DC motor and AC motor drives using MATLAB and illustrate speed control.

List of Experiments

WEEK-1	**THREE PHASE PMSM DRIVE**
Three phase permanent magnet synchronous motor drive simulation using MATLAB.	
WEEK-2	**VOLTAGE SOURCE CONVERTER**
Three phase voltage source converter with fixed low side bias simulation using MATLAB.	
WEEK-3	**VOLTAGE SOURCE CONVERTER**
Three phase voltage source converter with space vector PWM simulation using MATLAB.	
WEEK-4	**BUCK CONVERTER**
Simulation of buck converter simulation using MATLAB.	
WEEK-5	**SIX PULSE CYCLOCONVERTER**
Simulation of six pulse cycloconverter simulation using MATLAB.	
WEEK-6	**SPEED CONTROL OF DC MOTOR**
Speed control of DC motor using BJT H-Bridge simulation using MATLAB.	
WEEK-7	**THREE PHASE THYRISTOR CONVERTER**
Simulation of three phase thyristor converter simulation using MATLAB.	
WEEK-8	**THREE PHASE 48 PULSE GTO CONVERTER**
Simulation of three phase 48 pulse GTO converter simulation using MATLAB.	
WEEK-9	**THREE PHASE THREE LEVEL PWM CONVERTER**
Simulation of three phase three level PWM converter simulation using MATLAB.	
WEEK-10	**THREE PHASE SVPWM CONVERTER**
Three phase space vector PWM converter simulation using MATLAB.	

WEEK-11	THREE PHASE THREE LEVEL PWM CONVERTER
Simulation of three phase three level PWM converter simulation using MATLAB.	
WEEK-12	**CHOPPER FED DC MOTOR DRIVE**
Simulation of chopper fed DC motor Drive simulation using MATLAB.	

Reference Books:

1. R. Krishnan, "Electric Motor Drives Pearson Modeling Analysis and Control", Pearson Publications, 1st Edition, 2002.
2. B K Bose, "Modern Power Electronics and AC Drives", Pearson Publications, 1st Edition.
3. Ned Mohan, Tore M. Undeland20, William P. Robbins, "Power Electronics", John Wiley and Sons, 2nd Edition, 1990.

Web References:

1. Power Electronic Web Course by NPTEL, IIT Kharagpur, http://www.nptel.iitm.ac.in
2. hppt//www.Bookboon.com/en/introduction-to-power-electronics-ebook/
3. https://books.google.co.in/books?id=mjQskFwGUF8C&pg=PA396&lpg=PA396&dq=power+electronic+circuit+simulation+matlab

SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 18 STUDENTS

SOFTWARE: Microsoft Windows 7 and MATLAB R2015a

HARDWARE: 18 numbers of Intel Desktop Computers with 2 GB RAM

CONTROL SYSTEM DESIGN

Group I: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE201	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Design controllers using conventional methods.
II. Design controllers using discrete methods.
III. Formulate optimal control problems.
IV. Apply discrete methods to optimal control problems.
V. Apply state estimation methods to control systems design.

UNIT-I	CONVENTIONAL DESIGN METHODS	Classes: 09

Design specifications, PID controllers and compensators, Root locus based design, bode based design, design examples.

UNIT-II	DESIGN IN DISCRETE DOMAIN	Classes: 09

Sample and hold, digital equivalents, impulse and step invariant transformations, methods of discretisation, effect of sampling, direct discrete design, discrete root locus, design examples.

UNIT-III	OPTIMAL CONTROL	Classes: 10

Formation of optimal control problems, results of calculus of variations, Hamiltonian formulation.

Solution of optimal control problems, evaluation of Riccati's equation, state and output regulator problems, design examples.

UNIT-IV	DISCRETE STATE VARIABLE DESIGN	Classes: 08

Discrete pole placement, state and output feedback, estimated state feedback discrete, optimal control, dynamic programming, design examples.

UNIT-V	STATE ESTIMATION	Classes: 09

State estimation problem, state estimation, Luenberger's observer, noise, characteristics, Kalman, Bucy filter, separation theorem, controller design, Wiener filter, design examples.

Text Books:

1. M. Gopal, "Modern control system Theory", New Age International, 1st Edition, 2005.
2. Benjamin C. Kuo "Digital control systems", Oxford University Press,1st Edition, 2004.
3. G. F. Franklin, J. D. Powell and A. E. Naeini "Feedback Control of Dynamic Systems", PHI (Pearson), 6thEdition, 2015.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control system Design", PHI (Pearson), 1st Edition, 2003.

Reference Books:

1. G. F. Franklin, J. D. Powell, M Workman, "Digital Control of Dynamic Systems", PHI (Pearson), 1st Edition, 2002.
2. B.D.O. Anderson and J.B. Moore., "Optimal Filtering", prentice hall Inc, 1st Edition, 1979.
3. Loan D. Landau, GianlucaZito, "Digital Control Systems, Design, Identification and Implementation", Springer, 2006.

Web References:

1. https:// www.nptel.ac.in/courses/108101037/
2. https://www.princeton.edu/~stengel/MAE345Lecture8.pdfhttp://
3. https:// www.en.wikipedia.org/wiki/Hamiltonian_(control_theory)
4. https://www.nptel.ac.in/courses/108103008/

E-Text Books :

1. https://www.ece.mcmaster.ca/~ibruce/courses/EE4CL4_lecture31.pdf
2. https://www3.nd.edu/~pantsakl/Publications/348A-EEHandbook05.pdf
3. https://www.uodiyala.edu.iq/uploads/PDF%20ELIBRARY%20UODIYALA/EL43/Control%20System%20Design.pdf
4. https://www.calpoly.edu/~fowen/AutoMech2012/SampleBook.pdf

OPTIMISATION TECHNIQUES IN POWER ELECTRONICS

Group I: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE202	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Explain regarding optimization problems involving constraints.
II. Understand various evolutionary computational algorithms.
III. Apply various advanced hybrid approaches to optimization.
IV. Implement multi objective optimization algorithms.
V. Apply optimization technique applied to power electronics applications.

UNIT-I	INTRODUCTION	Classes: 09

Introduction to fitness evaluation, definition, classification of optimization problems, unconstrained and constrained optimization, optimality conditions, classical optimization techniques (linear and non linear programming, quadratic programming, mixed integer programming), encoding and decoding functions, introduction to constraint handling techniques.

UNIT-II	EVOLUTIONARY COMPUTATION TECHNIQUES	Classes: 09

Fundamentals of evolutionary algorithms, principle of simple genetic algorithm, evolutionary strategy and evolutionary programming, direction based search, genetic operators, selection, cross over and mutation issues in genetic algorithm implementation.

UNIT-III	ADVANCED OPTIMIZATION METHODS	Classes: 10

Fundamental principle, velocity updating, advanced operators, hybrid approaches implementation issues (hybrid of genetic algorithm and particle swarm optimization, hybrid of evolutionary programming and particle swarm optimization). Simplifying particle swarm optimization.

Optimizer simplification and meta optimization: Fundamental principle, classification of differential evolution techniques, bacterial foraging, bees colony algorithm, concept of maximum power point tracking.

UNIT-IV	MULTI OBJECTIVE OPTIMIZATION	Classes: 08

Concept of pare to optimality conventional approaches for multi objective optimization, multi objective genetic algorithm fitness assignment sharing function non dominated sorting genetic algorithm, multi objective particle swarm optimization (dynamic neighborhood particle swarm optimization, vector evaluated particle swarm optimization).

UNIT-V	OPTIMISATION TECHNIQUE APPLIED TO POWER ELECTRONICS APPLICATIONS	Classes: 09

Passive filter design using genetic algorithm, harmonics elimination in inverters, tuning of controllers, photo voltaic systems, wind electric conversion system genetic algorithm, particle swarm optimization, differential evolution, optimized fuzzy logic control for the maximum power point tracking.

Text Books:

1. Singiresu S. Rao,"Engineering Optimization – Theory and Practice" by John Wiley & Sons, Inc.,New Jersey, 1st Edition, 2009.
2. Kothari D.P. and Dillon J.S., "Power system optimization", PHI, 2004.
3. Thomas Back, David B Fogel, ZbigniewMichalewicz, "Evolutionary Computation 2 Advanced Algorithms and Operators", Institute of Physics Publishing, UK, 2000.
4. Kalyanmoy Deb, "Muti-objective Optimization using Evolutionary Algorithms", John Wiley & Sons 2001.

Reference Books:

1. Charles L. Phillips, Troy Nagle, AranyaChakrabortty, "Digital Control System Analysis and Design", Pearson, 4th Edition, 2015.
2. Conference on Renewable Energies and Power Quality (ICREPQ'10), Granada (Spain), 23rd to 25th March, 2010.

Web References:

1. https:// www.en.wikipedia.org/wiki/Power_electronics
2. http:// www.bookboon.com/en/electrical-electronic-engineering-ebooks
3. https:// www.en.wikipedia.org/wiki/Power_optimization_(EDA)

E-Text Books :

1. https://www.utwente.nl/ewi/te/projects/past/mope/https:
2. https//www.pes.ee.ethz.ch/uploads/tx_ethpublications/ecpe_bayerninnovativ_VirtualPrototyping Optimization_FINAL.pdf
3. http://www.faculty.ece.vt.edu/lindner/Ref_PE-O-J3.pdf
4. http://www.nptel.ac.in/courses/108105066/PDF/L-1(SSG)(PE)%20((EE)NPTEL).pdf

PROGRAMMABLE LOGIC CONTROLLERS AND THEIR APPLICATIONS

Group I: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE203	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Illustrate programmable logic controller (PLC).
II. Understand the architecture of PLC.
III. Learn programming methods and functions of PLC.
IV. Understand plc programs.
V. Create ladder diagram from process control descriptions.

UNIT-I	INTRODUCTION TO PLC	Classes: 09

Introduction to PLC: History, principles of operation, types of PLCs, PLC vs. other types of control, advantages of PLCs. Digital logic, number systems & binary codes: Review.

UNIT-II	PLC ARCHITECTURE	Classes: 09

PLC architecture: General block diagram, processors, power supply, memory systems, analog I / O systems, discrete I / O systems, special function I / O modules, brief overview of architecture of different PLC manufacturers.

UNIT-III	PLC PROGRAMMING:	Classes: 10

Programming Methods: Ladder diagrams (detailed coverage), functional blocks, sequential functional charts, instruction list, structured text.

PLC functions: Data transfer, data manipulation, program control, arithmetic, special functions.

UNIT-IV	IEC 1131 STANDARD, PROGRAMMING LANGUAGES, SOFTWARE SYSTEMS (BRIEF COVERAGE) DESIGN ASPECTS	Classes: 08

Flow charts, pseudo code, PLC system and safety, emergency stop, commissioning process, documentation process (brief coverage); Simple programs: On / off control, one shot, toggle action, latch up, code conversion, alarm annunciator etc.

UNIT-V	CASE STUDIES	Classes: 09

Case studies and creation of ladder diagram from process control descriptions, PLC Applications.

Text Books:

1. L. A. Bryan, E. A. Bryan, "Programmable Controllers: Theory & Implementation", Industrial Text Company Publications, 2nd Edition, 1997.
2. John R Hackworth & Frederick D. Hackworth Jr, "Programmable Logic Controllers: Programming methods and applications", Pearson education, 2008.

Reference Books:
1. W. Bolton, "Programmable Logic Controllers', Elsevier, 4th Edition, 2006. 2. E. A. Parr, "Programmable Controllers: An Engineers Guide", Newness, 3rd Edition, 2003.
Web References:
1. https://www.igniteengineers.com 2. https://www.ocw.nthu.edu.tw 3. https://www.uotechnology.edu.iq 4. https://www.iare.ac.in
E-Text Books :
1. https://www.etf.unssa.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Controllers%204th%20Edition%20(W%20Bolton).pdf 2. https://www.idc-online.com/technical_references/pdfs/instrumentation/IntrotoPLCs.pdf 3. https://mycourses.ntua.gr/courses/ECE1254/document/Programmable_Controllers_-Theory_and_Implementation-.pdf 4. https://www.file:///C:/Users/iare10074/Downloads/pet10882OLCSampleChapterconstrained72.pdf

ADVANCED CONTROL SYSTEMS

Group I: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE204	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Implement PID Controllers and their tuning methods.
II. Understand state space design methods.
III. Analyse non linear control systems.
IV. Illustrate the optimal control methods.
V. Apply the principles of optimization to digital control systems.

UNIT-I	CLASSICAL CONTROLLER DESIGN	Classes: 09

Tuning of PID controller: Proportional (P), Integral (I), Derivative (D), P, PD, PID controllers, characteristics, design, controller tuning, Ziegler, Nichol's method and Cohen Coon method, damped oscillation method.

UNIT-II	STATE SPACE DESCRIPTION &DESIGN	Classes: 09

Modern control system design: Review of state model for systems state transition matrix, controllability, observability, Kalman decomposition state feedback, output feedback, design methods, pole placement controller, full order and reduced order observers, dead beat control.

UNIT-III	NON LINEAR SYSTEMS	Classes: 10

Analysis of non linear system: Types of non linearity, typical examples, describing function method, phase plane analysis, stability analysis of non linear systems.

Lyapunov function, construction of Lyapunov function, Lyapunov's direct method, Lyapunov's indirect method.

UNIT-IV	OPTIMAL CONTROL	Classes: 08

Statement of optimal control problem: Problem formulation and forms of optimal control, performance measures for optimal control, selection of performance measure, various methods of optimization, necessary conditions for optimal control, linear quadratic regulator problem, algebraic Riccati equation, solving algebraic Riccati equation using eigen vector method.

UNIT-V	DIGITAL CONTROL SYSTEMS	Classes: 09

Pulse transfer function, state equation, solutions, realization, controllability, observability, stability, Jury's test, digital controller design, direct design method, pole placement controller, dead beat control, discrete, linear quadratic regulator.

Text Books:

1. J.Nagrath and M.Gopal "Control System Engineering", new age international publishers, 2003.
2. M.Gopal "Modern Control System Theory", New Age International Ltd., 1st Edition, 2002.

Reference Books:

1. Donald P. Eckman, "Automatic Process Control", Wiley Eastern Ltd., New Delhi, 1993.
2. Benjamine C. Kuo, "Digital Control Systems", Oxford University Press, 1992.
3. B. Sarkar, "Control system design-The Optimal Approach", Wheeler Publishing, New Delhi, 1997.

Web References:

1. https://www.acspower.com/
2. https:// www.advancedcontrol.com/
3. https://www.youtube.com/playlist?list=PLbMVogVj5nJTNkhtkCEKQHhPOr2bpS3za
4. https:// www.en.wikipedia.org/wiki/Advanced_process_control

E-Text Books :

1. https://www.bput.ac.in/lecture_notes/advanced_contol_systems.pdf
2. https:// www.textofvideo.nptel.iitm.ac.in/108103007/lec1.pdf
3. https:// www.nptel.ac.in/courses/101108047/module1/Lecture%201.pdf
4. https://www.nt.ntnu.no/users/skoge/presentation/plantwide-course-brasil-july2011/Hovd-Kompendium-2010.pdf

COMPUTER AIDED DESIGN OF POWER ELECTRONIC CIRCUITS

Group II: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE205	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand introduction of computer aided design of computer electronic circuits.
II. Apply advanced techniques in simulation.
III. Implementation of modeling of power electronic devices.
IV. Simulate circuits.
V. Analyze case studies.

UNIT-I	INTRODUCTION	Classes: 09

Importance of simulation, general purpose circuit analysis, methods of analysis of power electronic systems, review of power electronic devices and circuits.

UNIT-II	ADVANCED TECHNIQUES IN SIMULATION	Classes: 09

Analysis of power electronic systems in a sequential manner, coupled and decoupled systems, various algorithms for computing steady state solution in power electronic systems, future trends in computer simulation.

UNIT-III	MODELING OF POWER ELCTRONIC DEVICES	Classes: 09

Introduction, AC sweep and DC sweep analysis, transients and the time domain analysis, Fourier series and harmonic components.

BJT, FET, MOSFET and its model, amplifiers and oscillator, non-linear devices.

UNIT-IV	SIMULATION OF CIRCUITS	Classes: 09

Introduction, schematic capture and libraries, time domain analysis, system level integration and analysis, Monte Carlo analysis, sensitivity / stress analysis, Fourier analysis.

UNIT-V	CASE STUDIES	Classes: 09

Simulation of converters, choppers, inverters, AC voltage controllers, and cycloconverters feeding R, RL, and RLE loads, computation of performance parameters: harmonics, power factor, angle of overlap.

Text Books:

1. Rashid M., "Simulation of Power Electronic Circuits using PSPICE', PHI, 2006.
2. Raja gopalan, "Computer Aided Analysis of Power Electronic systems", Marcell – Dekker Inc., 1987.

Reference Books:

1. John Keown "Microsim, Pspice and circuit analysis", Prentice Hall Inc., 1998.

Web References:

1. https://ieeexplore.ieee.org/Xplore/defdeny.jsp?url=http%3A%2F%2Fieeexplore.ieee.org%2Fstamp%2Fstamp.jsp%3Ftp%3D%26arnumber%3D4643960%26userType%3Dinst&denyReason=-133&arnumber=4643960&productsMatched=null&userType=inst
2. https://cordis.europa.eu/project/rcn/8960_en.html
3. https://www.researchgate.net/publication/3549822_Magnetics_modeling_for_computer-aided_design_of_power_electronics_circuits
4. https://books.google.co.in/books/about/Design_of_Electronic_Circuits_and_Comput.html?id=NwFkDi-XPHcC

E-Text Books:

1. https://www.pwrx.com/pwrx/app/HighPwr.pdf
2. https:// www.injapan.no/energy2015-day1/files/2015/06/ESW-Iwamuro-SES.pdf
3. https://www.ijcsit.com/docs/Volume%203/vol3Issue4/ijcsit2012030403.pdf
4. https:// www.digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1043&context=elecengtheses

ADVANCED POWER SEMICONDUCTOR DEVICES

Group II: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE206	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Importance of simulation, general purpose circuit analysis, methods of analysis of power electronic systems review of power electronic devices and circuits.
II. Understand the introduction of advanced power semi conductor devices.
III. Analyse current controlled devices.
IV. Apply voltage controlled devices.
V. Implementation of firing and protecting circuits.

UNIT-I	INTRODUCTION	Classes: 09

Power switching devices overview, attributes of an ideal switch, application requirements, circuit symbols; power handling capability, (SOA); Device selection strategy, on-state and switching losses, EMI due to switching, power diodes, types, forward and reverse characteristics, switching characteristics, rating.

UNIT-II	CURRENT CONTROLLED DEVICES	Classes: 09

BJT's, construction, static characteristics, switching characteristics, negative temperature co-efficient and secondary breakdown; Power darlington, thyristors, physical and electrical principle underlying operating mode, two transistor analogy, concept of latching, gate and switching characteristics, converter grade and inverter grade and other types, series and parallel operation, comparison of BJT and thyristor, steady state and dynamic models of BJT & thyristor.

UNIT-III	VOLTAGE CONTROLLED DEVICES	Classes: 09

Power MOSFETs and IGBTs, principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs.

Basics of GTO, MCT, FCT, RCT and IGCT.

UNIT-IV	FIRING AND PROTECTING CIRCUITS	Classes: 09

Necessity of isolation, pulse transformer, optocoupler, gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT, over voltage, over current and gate protections, design of snubbers.

UNIT-V	THERMAL PROTECTION	Classes: 09

Heat transfer, conduction, convection and radiation, cooling liquid cooling, vapour phase cooling, guidance for hear sink selection, thermal resistance and impedance, electrical analogy of thermal components, heat sink types and design, mounting types.

Text Books:

1. B.W Williams, "Power Electronics Circuit Devices and Applications", Wiley, 1st Edition, 1987.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, 3rdEdition, New Delhi, 2004.

Reference Books:

1. MD Singh, K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2. Mohan, Undcland, Robins, "Power Electronics – Concepts, applications and Design",John Wiley and Sons, Singapore, 2000.

Web References:

1. http://www.inderscience.com/info/ingeneral/cfp.php?id=905
2. http:// www.documents.mx/documents/10-advanced-power-semiconductor-devices-and-protection.html
3. https://www.books.google.co.in/books/about/Advanced_Power_Semiconductor_Devices.html?id=Q34eAQAAIAAJ&redir_esc=y
4. http://www.nist.gov/pml/div683/grp06/power.cfm

E-Text Books:

1. https:// www.theses.lib.vt.edu/theses/available/etd-12042003-161511/unrestricted/ETD_Xu_12_03.pdf
2. http://www.pdfdrive.net/25-advanced-power-semiconductor-devices-apsd-e456994.html
3. http://catalogue.pearsoned.co.uk/samplechapter/0130167436.pdf
4. http://www.electronics.dit.ie/staff/ypanarin/Lecture%20Notes/K235-1/1%20Power%20Switches.pdf

POWER ELECTRONICS IN RENEWABLE ENERGY SYSTEMS

Group II: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE207	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand introduction of power electronics in renewable energy systems.
II. Apply solar energy conversion.
III. Implementation of wind energy systems.
IV. Evaluate fuel cell power electronics for distributed generation (DG).
V. Analyse hybrid renewable energy systems.

UNIT-I	INTRODUCTION	Classes: 09

Recent trends in energy consumption, world energy scenario, energy, sources and their availability, qualitative study of different renewable energy resources: solar, wind, ocean, biomass, fuel cell, hydrogen energy systems and hybrid renewable energy systems, need to develop new energy technologies, modeling of renewable energy sources, PV array, wind electric generators, fuel cells etc., in MATLAB / PSCAD simulink environment

UNIT-II	SOLAR ENERGY CONVERSION	Classes: 09

Photovoltaic energy conversion: working principle, energy conversion, maximum power tracker, photovoltaic system components, factor influencing output, system design, power electronics for photovoltaic power systems, DC Power conditioning converters, AC power conditioners, line commutated inverters, synchronized operation with grid supply, harmonic problem, applications, modeling and simulation various power converters for PV fed applications, experimental verifications PV characteristic curves.

UNIT-III	WIND ENERGY CONVERSION	Classes: 09

Wind energy conversion systems: Basic principle of wind energy conversion, nature of wind, wind survey in India, power in the wind, components of a wind energy conversion system, performance of induction generators for WECS, IG-SCIG-PMSG, classification of WECS.

Power electronics converter for variable speed wind turbines, matrix, multilevel converters for very high power wind turbines, future trends, modeling of power generators like IG –SCIG-PMSG for wind energy conversion system(WECS), modeling and simulation of power converters, multilevel, matrix and other contemporary topologies.

UNIT-IV	FUEL CELL POWER ELECTRONICS FOR DISTRIBUTED GENERATION (DG)	Classes: 09

Fuel cell, working principle, distributed generation, fuel cell based energy system for DG, power electronic topologies for residential stationary fuel cell energy systems, issues in fuel cell power conditioning system, energy management system issues, auxiliary storage, modeling of fuel cell, power extraction for fuel cell, stand alone fuel cell system with consumer/load.

UNIT-V	HYBRID RENEWABLE ENERGY SYSTEMS	Classes: 09

Need for hybrid systems, types of hybrid system, optimization of system components in hybrid power system, various power quality issues, hybrid renewable power system, modeling and simulation of hybrid renewable power system in MATLAB/PSCAD, simulation and study of various power quality problems in hybrid /renewable energy power system.

Text Books:

1. B.W Williams 'Power Electronics Circuit Devices and Applications'.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.

Reference Books:

1. MD Singh, K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2. Mohan, Undcland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

Web References:

1. https:// www.as.wiley.com/WileyCDA/WileyTitle/productCd-1118634039.html.
2. https://www.academia.edu/3409546/Power_Electronics_Application_in_Renewable_Energy_System.
3. https://www.springer.com/us/book/9788132221180.
4. https://www.springer.com/us/book/9781447151036.

E-Text Books:

1. https://www.ijtra.com/view/role-of-power-electronics-in-non-renewable-and-renewable-energy-systems.pdf.
2. https://www.nitgoa.ac.in/News_files/STC.pdf.
3. https://www.jee.ro/covers/art.php?issue=WN1438788776W55c22ca867606.
4. https://www.magnelab.com/wp-content/uploads/2015/01/Role-of-power-electronics-in-renewable-energy-systems.pdf.

MULTI LEVEL INVERTERS

Group II: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE208	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand concepts of Multilevel Inverters and be able to apply it in the field.

II. Learn different multilevel inverter topologies and PWM techniques.

III. Describe power converters.

UNIT-I	**INTRODUCTION**	**Classes: 09**

Introduction, Conventional two level inverters for single and three phase applications. Gate drive circuits for devices. Ratings and device stress. Harmonics.

UNIT-II	**MULTILEVEL INVERTERS**	**Classes: 09**

Concept of multilevel inverters: Its effect on switch stress and harmonics and EMC, topologies and waveforms, effect of multilevel inverters on AC motors. SPWM and SVPWM techniques.

UNIT-III	**TYPES OF MULTILEVEL INVERTERS**	**Classes: 09**

Neutral point clamped (NPC) inverters: 3 level, and 5 level, features, advantages and disadvantages. cascaded H bridge inverter.

Higher levels attained using asymmetrical DC sources, and employing capacitors instead of DC sources. Requirements of number of devices, cost and reliability aspects for different configurations.

UNIT-IV	**TOPOLOGY OF MULTILEVEL INVERTERS**	**Classes: 09**

Generalized multilevel inverter topology with self voltage balancing, multilevel inverters with flying capacitor topology, cascading two level inverters, higher level inverter by using an open end induction machine with multilevel inverters on each side.

UNIT-V	**CAPACITOR VOLTAGE BALANCING**	**Classes: 09**

Issues of capacitor balancing and common mode voltage elimination, 12 and 18 sided polygonal voltage space vector generation, hybrid inverters and recent trends in multilevel inverters.

Text Books:

1. Bin Wu, “High Power Converters and AC drives”, IEEE press. John Wiley and Sons, Inc. 2006
2. Keith Corzine, “Operation and Design of Multilevel Inverters”, Developed for the office of Naval Research, Dec 2003, Revised June 2005

Reference Books:

1. J. Rodriguez, J. S. Lai and F. Z. Peng, "Multilevel Inverters: Survey of Topologies, Controls, and Applications," IEEE Transactions on Industry Applications, vol. 49, no. 4, Aug. 2002, pp. 724-738.
2. F. Z. Peng, "A generalized multilevel inverter topology with self voltage balancing," IEEE Trans. Ind. Applicaions. vol. 37, pp. 611–618, Mar./Apr. 2001.A. Nabae, I. Takahashi, and H. Akagi, "A New Neutral-point Clamped PWM inverter," IEEE Trans. Ind. Applicaions., vol. IA-17, pp. 518-523, Sept./Oct. 1981.

Web References:

1. https://www.elprocus.com/multilevel-inverter-types-advantages/
2. https://www.theengineeringprojects.com/2014/12/introduction-multilevel-inverters.html
3. https:// www.theengineeringprojects engineering.electrical-equipment.org/electrical-distribution/introduction-to-multilevel-inverter.html
4. https:// www.theengineeringprojects engineering.electrical-equipment.org/electrical-distribution/cascaded-h-bridge-multilevel-inverters.html

E-Text Books:

1. https:/www.theengineeringprojects/web.eecs.utk.edu/~tolbert/publications/multilevel_book_chapter.pdf
2. https://www.theengineeringprojectsethesis.nitrkl.ac.in/4289/1/Study_and_Analysis_of_Three_Phase_Multilevel_Inverter_06.pdf
3. https:// www.theengineeringprojects theses.lib.vt.edu/theses/available/etd-100899 000251/ unrestricted/Chapter2.pdf
4. https://www.motorlab.com/Motor%20Lab%20Web%20Site_files/04%2020Code!_files/Operation%20and%20Design%20of%20Multilevel%20Inverters.pdf

SOFT COMPUTING TECHNIQUES

Group III: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE209	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Explain the concept of artificial intelligence.
II. Understand various mathematical models of various neural networks.
III. Implement the fuzzy logic based systems.
IV. Illustrate the steps in genetic algorithm implementation.
V. Apply concepts of soft computing in other areas.

UNIT-I	INTRODUCTION	Classes: 09

Approaches to intelligent control: Architecture for intelligent control, symbolic reasoning system, rule, based systems, the AI approach, knowledge representation, expert systems.

UNIT-II	ARTIFICIAL NEURAL NETWORKS	Classes:10

Concept of Artificial Neural Networks and its basic mathematical model, Mc Culloch, Pitts neuron model, simple perceptron, adaline and madaline, feed, forward multilayer perceptron, learning and training the neural network, data processing: scaling, fourier transformation, principal component analysis and wavelet transformations; Hopfield network, self, organizing network and recurrent network; neural network based controller.

UNIT-III	FUZZY LOGIC SYSTEM	Classes:08

Introduction to crisp sets and fuzzy sets: basic fuzzy set operation and approximate reasoning, introduction to fuzzy logic modeling and control, fuzzification, inferencing and defuzzification.

Fuzzy knowledge and rule bases: Fuzzy modeling and control schemes for nonlinear systems self organizing fuzzy logic control, fuzzy logic control for nonlinear time, delay system.

UNIT-IV	GENETIC ALGORITHM	Classes: 09

Basic concept of genetic algorithm and detail algorithmic steps, adjustment of free parameters; solution of typical control problems using genetic algorithm, concept on some other search techniques like tabu search and and colony search techniques for solving optimization problems.

UNIT-V	APPLICATIONS	Classes: 09

GA application to power system optimization problem; Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab, neural network toolbox, stability analysis of neural, network interconnection systems, implementation of fuzzy logic controller using Matlab fuzzy, logic toolbox, stability analysis of fuzzy control systems.

Text Books:
1. Jacek. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999. 2. B. KOSKO, "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994. 3. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice- Hall of India Pvt. Ltd., 1993
Reference Books:
1. Zimmerman H.J., "Fuzzy set theory-and its Applications", Kluwer Academic Publishers, 1994. 2. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers, 1st Edition, 1995.
Web References:
1. https:// www.en.wikipedia.org/wiki/ neural networks 2. https://www.jaicobooks.com/j/PDF%20HED/J-878%20Artificial%20Neural%20Systems.pdf 3. https://www.abebooks.co.uk/book-search/title/an-introduction-to-fuzzy-control/system.pdf
E-Text Books:
1. https://www.books.google.com / Computers/ Software Development & Engineering.pdf 2. https://www.springer.com/us/book/9783319046921.pdf 3. https://www .bookboon.com/en/introduction-to-soft-computing-ebook.pdf

POWER QUALITY

Group III: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE210	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Classify power quality problems.
II. Understand the nature of non linear loads.
III. Apply time domain and frequency domain methods to analyze steady state and transient error.
IV. Implement various techniques to mitigate power quality problems.
V. Apply various power electronics based methods to improve power quality.

UNIT-I	INTRODUCTION	Classes: 09

Introduction: Characterization of electric power quality, transients, short duration and long duration voltage variations, voltage imbalance, waveform distortion, voltage fluctuations, power frequency variation, power acceptability curves; Power quality problems: Poor load power factor, non linear and unbalanced loads, DC offset in loads, notching in load voltage, disturbance in supply voltage, power quality standards.

UNIT-II	NONLINEAR LOADS	Classes: 10

Non linear loads: Single phase static and rotating AC / DC converters, three phase static AC / DC converters, battery chargers, arc furnaces, fluorescent lighting, pulse modulated devices, adjustable speed drives.

UNIT-III	MEASUREMENT AND ANALYSIS METHODS	Classes: 08

Measurement: Voltage, current, power and energy measurements, power factor measurements and definitions, event recorders, Measurement.

Error Analysis: Analysis in the periodic steady state, time domain methods; Frequency domain methods: Laplace's, Fourier and Hartley transform, the Walsh transform, wavelet transform.

UNIT-IV	ANALYSIS AND CONVENTIONAL MITIGATION METHODS	Classes: 09

Analysis of power outages, analysis of unbalance, symmetrical components of phasor quantities, instantaneous symmetrical components, instantaneous real and reactive powers;Analysis of distortion: Online extraction of fundamental sequence components from measured samples, harmonic indices; Analysis of voltage sag: Detorit Edison sag score, voltage sag energy, voltage sag lost energy index (VSLEI), analysis of voltage flicker, reduced duration and customer impact of outages; Classical load balancing problem: Open loop balancing, closed loop balancing, current balancing, harmonic reduction, voltage sag reduction.

UNIT-V	POWER QUALITY IMPROVEMENT	Classes: 09

Power quality improvement: Utility, customer interface, harmonic filters, passive, active and hybrid filters; Custom power devices: Network reconfiguring devices, load compensation using DSTATCOM,

voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC;Control strategies: P-Q theory, synchronous detection method, custom power park, status of application of custom power devices.

Text Books:

1. ArindamGhosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 1st Edition, 2002.
2. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 2nd Edition, 1994.
3. Jos Arrillaga, Neville R. Watson, "Power system harmonics", Wiley, 2nd Edition, 2003.

Reference Books:

1. R.C. Duggan, Mark F. McGranaghan, "Electrical Power Systems Quality", Wiley, 3rd Edition, 2012.
2. Derek A. Paice, "Power electronic converter harmonics", Wiley, 1st Edition, 1999.

Web References:

1. https:// www.en.wikipedia.org/wiki/Power_quality
2. https://www.energycentral.com/reference/directories/publications/690/Power-Quality-Assurance
3. https://www.cpccorp.com/pq.htm
4. https:// www.adfpowertuning.com/technology/power-quality.html

E-Text Books:

1. https://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_systems_quality.pdf
2. https:// www.prof.usb.ve/bueno/Libros/power_quality-0849310407.pdf
3. https://www.fer.unizg.hr/_download/repository/Power_Quality_Primer_-_Barry_W._Kennedy.pdf
4. https://www.pqmonitoring.com/papers/Power%20Quality%20Standards/overview.PDF

ANALYSIS OF INVERTERS

Group III: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE211	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Understand the single phase inverter applications and implementation.
II. Analyze three phase voltage source inverter.
III. Evaluate various applications of current source inverters.
IV. Apply multilevel inverters in power electronic circuits.
V. Apply various types of resonant inverters.

UNIT-I	SINGLE PHASE INVERTERS	Classes: 09

Introduction to self commutated switches: MOSFET and IGBT, principle of operation of half and full bridge inverters, performance parameters, voltage control of single phase inverters using various PWM techniques, various harmonic elimination techniques, forced commutated thyristor inverters.

UNIT-II	THREE PHASE VOLTAGE SOURCE INVERTERS	Classes: 10

Three phase voltage source inverter: 180 degree and 120 degree conduction mode inverters with star and delta connected loads,voltage control of three phase inverters, single, multi pulse, sinusoidal, space vector modulation techniques.

UNIT-III	CURRENT SOURCE INVERTERS	Classes: 08

Current source inverters: Operation of six step thyristor inverter, inverter operation modes, load commutated inverters, waveforms.

Auto sequential current source inverter (ASCI), principle of operation, current pulsations, comparison of current source inverter and voltage source inverters.

UNIT-IV	MULTILEVEL INVERTERS	Classes: 09

Multilevel concept: Diode clamped, flying capacitor, cascade type multilevel inverters, comparison of multilevel inverters, application of multilevel inverters.

UNIT-V	RESONANT INVERTERS	Classes: 09

Resonant inverters: Series and parallel resonant inverters, voltage control of resonant inverters, class E resonant inverter, and resonant DC link inverters.

Text Books:

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004. Jai P.Agrawal, “Power Electronics Systems”, Pearson Education, Second Edition, 2002.
2. BimalK.Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003.
3. Ned Mohan,Undeland and Robbin, “Power Electronics: converters, Application and design” John

Wiley and sons.Inc,Newyork,1995.
4. Philip T. krein, “Elements of Power Electronics” Oxford University Press -1998

Reference Books:

1. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co., 1st Edition, New Delhi, 1998.
2. P.S.Bimbra, “Power Electronics”, Khanna Publishers, 11th Edition, 2003.

Web References:

1. https:// www.en.wikipedia.org/wiki/Power_inverter
2. https://www.energy.ca.gov/electricity_analysis/rule21/
3. https:// www.nptel.ac.in/syllabus/108108035/

E-Text Books:

1. https:// www.ethesis.nitrkl.ac.in/3464/1/Final025.pdf
2. https://www.smps.us/power-inverter.html
3. https:// www.ethesis.nitrkl.ac.in/1873/1/piyush.pdf
4. https:// www.ecee.colorado.edu/copec/book/slides/Ch6slide.pdf

SMART GRID DESIGN AND ANALYSIS

Group III: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE212	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Understand the role of smart grid in power systems.
II. Illustrate smart grid communications, GIS and wide area measurement technology.
III. Apply performance analysis tools for smart grid design
IV. Analyze stability of smart grid.
V. Describe sustainable energy options for smart grid.

UNIT-I	SMART GRID ARCHITECTURAL DESIGNS	Classes: 09

Introduction: Comparison of power grid with smart grid, power system enhancement, communication and standards; General view of the Smart Grid Market Drivers: Stakeholder roles and function, measures, representative architecture, functions of smart grid components, wholesale energy market in smart grid, smart vehicles in smart grid.

UNIT-II	SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY	Classes: 10

Communication and measurement: Monitoring, phasor measurement unit (PMU), smart meters, wide area monitoring systems (WAMS), advanced metering infrastructure, GIS and Google mapping tools.

UNIT-III	PERFORMANCE ANALYSIS TOOLS FOR SMART GRID DESIGN	Classes: 08

Introduction to Load Flow Studies: Challenges to load flow in smart grid and weaknesses of the present load flow methods.

Load flow state of the art: Classical, extended formulations and algorithms, load flow for smart grid design, contingencies studies for smart grid.

UNIT-IV	STABILITY ANALYSIS TOOLS FOR SMART GRID	Classes: 09

Stability analysis tools: Voltage stability analysis tools, voltage stability assessment techniques, voltage stability indexing, application and implementation plan of voltage stability in smart grid, angle stability assessment in smart grid, approach of smart grid to state estimation, energy management in smart grid.

UNIT-V	RENEWABLE ENERGY AND STORAGE	Classes: 09

Renewable Energy Resources: Sustainable energy options for the smart grid, penetration and variability issues associated with sustainable energy technology, demand response issues, electric vehicles and plug in hybrids, PHEV technology, environmental implications, storage technologies, grid integration issues of renewable energy sources.

Text Books:

1. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, 1st Edition, 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & sons inc, 1st Edition, 2012.
3. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press,1st Edition, 2012.
4. Clark W.Gellings, "The smart grid: Enabling energy efficiency and demand response", Fairmont Press Inc, 1st Edition, 2009.

Reference Books:

1. Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable,
2. Distributed & Efficient Energy", Academic Press, 2012.
3. Clark W. Gellings, "The smart grid: Enabling energy efficiency and
4. demand response", Fairmont Press Inc,2009.

Web References:

1. http://www.smartgridnews.com/story/understanding-and-designing-smart-grid/2012-02-07
2. http://w3.usa.siemens.com/smartgrid/us/en/transmission-grid/products/grid-analysis-tools/pages/grid-analysis-tools.aspx
3. http://digitalcommons.georgiasouthern.edu/cgi/viewcontent.cgi?article=1021&context=electrical-eng-facpubs
4. http://energy.sandia.gov/energy/ssrei/gridmod/renewable-energy-integration/smart-grid-tools-and-technology/

E-Text Books:

1. http:// www.s1.downloadmienphi.net/file/downloadfile6/192/1385280.pdf
2. http://www.gbv.de/dms/tib-ub-hannover/664445780.pdf
3. http://www.ieee-pes.org/presentations/gm2014/PESGM2014P-001876.pdf

COMPUTER AIDED DESIGN OF INSTRUMENTATION SYSTEMS

Group III: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE213	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Understand various instrument automation system and interfaces.
II. Design software utilizing virtual instrumentation programming techniques.
III. Analyze and test power spectrum.
IV. Digital simulation of physical systems.

UNIT-I	DATA ACQUISITION AND INSTRUMENT INTERFACE	Classes: 09

Programming and simulation of building block of instrument automation system, signal analysis, input and output port configuration with instrument bus protocols, ADC, DAC, DIO, counters and timers, PC hardware structure, timing, interrupts, DMA, software and hardware installation, current loop, RS 232/RS485, GPIB, USB protocols.

UNIT-II	VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES	Classes: 10

Block diagram and architecture of a virtual instrument, graphical programming in data flow, comparison with conventional programming, VIs and sub VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I / O.

UNIT-III	DESIGN TEST AND ANALYSIS	Classes: 08

Spectral estimation using Fourier Transform, power spectrum, correlation methods, stability analysis, fault analysis, sampling, data parity and error coding checks, synchronization testing.

Watch dog timer, DMA method, real time clocking, Noise Gaussian, White analysis.

UNIT-IV	PC BASED INSTRUMENTATION	Classes: 09

Introduction, evolution of signal standard, HART communication protocol, communication modes, HART networks, control system interface, HART commands, HART field controller implementation, HART and the OSI model.

UNIT-V	SIMULATION OF PHYSICAL SYSTEMS	Classes: 09

Simulation of linear and Non linear models of systems, hardware, simulation of physical systems using special software.

Text Books:

1. K. Ogatta, "Modern control Engineering", Pearson Education, 4th Edition, 2002.
2. Dorf, Bishop, "Modern Control Engineering", Addison Weseley, 2nd Edition, 1998.

Reference Books:
1. Patrick H. Garrett," High performance Instrumentation and Automation", CRC Press, Taylor & Francis Group. 2. MATHCAD/VIS SIM user manual. 3. LABVIEW simulation user manual.
Web References:
1. https://www.sites.google.com/site/vrpsundar/Home/lecture. 2. https://www.Bookboon.com/en/introduction-to-power-electronics-ebook/ 3. https://www.en.wikipedia.org/wiki/Virtual_instrumentation
E-Text Books:
1. https://www.dsp-book.narod.ru/302.pdf 2. https://www.amazon.in/CAD-CAM-Computer-Aided-Design-Manufacturing-ebook/dp/B001JNJDGY 3. https://www.eolss.net/sample-chapters/c05/e6-39a-04-08.pdf

INTELLIGENT CONTROLLERS

Group IV: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE214	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Explain biological and artificial neurons.
II. Understand models and control schemes in an.
III. Demonstrate fuzzy logic and controllers.
IV. Understand generic algorithms.
V. Understand pc based instrumentation.

UNIT-I	NEURAL NETWORKS	Classes: 09

Neural networks, biological neurons, artificial neurons, activation function, learning rules, feed forward networks, supervised and unsupervised learning, perceptron network, linear separability, back propagation networks algorithms, radial basis function networks.

UNIT-II	MODELS AND CONTROL SCHEMES IN ANN	Classes:10

Auto and hetero associative memory, bidirectional associative memory, self organizing feature maps, Hopfield networks, neural networks for non linear system, schemes of neuro control, system identification, forward model and inverse model , case studies.

UNIT-III	FUZZY LOGIC AND ITS CONTROLLERS	Classes:08

Fuzzy set, Crisp set, vagueness, uncertainty and imprecision, fuzzy set, fuzzy operation, properties, crisp versus fuzzy relations, fuzzy relations, fuzzy cartesian product and composition, composition of fuzzy relations, fuzzy to crisp conversion.

Structure of fuzzy logic controller, database, rule base inference engine.

UNIT-IV	GENETIC ALGORITHMS	Classes:09

Genetic Algorithms: Working principles, terminology, importance of mutation, comparison with traditional methods, constraints and penalty function, GA operators, real coded GA.

UNIT-V	APPLICATIONS	Classes:09

Applications of neural network, fuzzy system and genetic algorithms for power systems and power electronics systems, designing of controllers using simulation software, NN tool box and fuzzy Logic toolbox.

Text Books:

1. Zimmerman H.J. "Fuzzy set theory and its applications", Kluwer Academic Publishers, 1st Edition, 1994.
2. Simon Haykin, "Neural Networks A comprehensive foundation", Pearson Education Asia, 1st Edition, 2002.
3. Kalyanmoy Deb, "Optimization for engineering design", Prentice Hall India, 1st Edition, 1988.
4. David E.Goldberg, "Genetic Algorithms in search,optimization and machine learning", Pearson Education , 1st Edition, 1989.

Reference Books:

1. Lawrence Fausatt, "Fundamentals of neural networks", Prentice Hall India, New Delhi, 1994.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill International Edition, USA,
3. 1997.
4. Bart kosko, "Neural Networks and Fuzzy Systems", Prentice Hall of India, New Delhi, 1994.
5. Jack M.Zurada, "Introduction to Artificial Neural Systems", Jaico publishing house 2006.

Web References:

1. https:// www.en.wikipedia.org/wiki/ neural networks
2. https://www.jaicobooks.com/j/PDF%20HED/J-878%20Artificial%20Neural%20Systems.pdf.
3. https://www.abebooks.co.uk/book-search/title/an-introduction-to-fuzzy-control/system.pdf

E-Text Books:

1. https://www.engr.mun.ca/~baxter/Publications/ClassicalvsIntelligentControl.pdf
2. https://www.werbos.com/HICChapter3.pdf
3. https://www.engr.mun.ca/~baxter/Publications/ClassicalvsIntelligentControl.pdf

SOFTWARE TOOL FOR POWER ELECTRONIC APPLICATIONS

Group IV: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE215	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Explain Computer Aided Design software.
II. Apply of various drive conventional designs in simulation using cad software.
III. Program using Magnet software.
IV. Design of motors using Motor solve software.
V. Simulate motor with various controllers for speed, torque ripple and current control using PSIM software.

UNIT-I	INTRODUCTION	Classes: 09

CAD, Design procedure and limitation, development of torque and force, magnetic vector / scalar potential, electrical vector / scalar potential, stored energy infield, problems, energy functional and principle of energy conversion, design of C core and cylinder shield using CAD software.

UNIT-II	MATHEMATICAL MODEL AND ELEMENTS OF CAD SYSTEM	Classes:10

Differential / Integral equation, finite difference method, finite element method, energy method, variational method, discretisation shape function; Elements of CAD system: Preprocessing, modeling, meshing material properties, post processing, modeling and mesh analysis of various drive conventional design in simulation using cad software.

UNIT-III	MAGNET	Classes:08

Introduction to magnet, model building, modeling flowchart, geometric modeling, drawing edges, creating surface, creating components, selecting edges surfaces and components.

Positioning the construction slice material, boundary condition and finite element mesh, solving the model, modeling and simulation of SRM motor with 6:4 slots using Magnet software.

UNIT-IV	MOTORSOLVE	Classes:09

Introduction to Motor solve, design parameter and geometric modeling, various design in motor solve, modification and optimization, result and analysis, cogging torque, output power and efficiency, design of BLDC motor and Induction motor using Motor solve.

UNIT-V	PSIM	Classes:09

Introduction to PSIM :elements of psim , power circuit and control circuit component , circuit schematic design using simcad , simcoupler , Magnet plugins , waveform process using sim view , voltage and current control in bldc motor , Simulation of BLDC with various controllers for speed, torque ripple and current control using PSIM.

Text books:

1. Silvester, Ferrari, "Finite elements for electrical engineers," Cambridge university press, 1st Edition, 1983.
2. S.R.H. Hoole, "Computer Aided, Analysis and Design of Electromagnetic Devices", Elsevier, Newyork, A, 1st Edition, 1989.
3. D. A. Lowther, P. P. Silvester, "Computer Aided Design in Magnetics", Springer verlag, New york, 1956.

Reference books:

1. S. J. Salon, "Finite Element Analysis of Electrical Machines", Kluwer academic publishers, London, 1st Edition, 1995.
2. C. W. Trowbridge, "An Introduction to Computer Aided Electromagnetic Analysis", Vector field ltd.

Web references:

1. https:// www.engineering.purdue.edu/people/steven.d.pekarek.1/papers/powerelectroniclab.pdf
2. https:// www.en.wikipedia.org/wiki/Computer-aided_design
3. https:// www.citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.558.1317&rep=rep1&type=pdf
4. https://www.calvin.edu/~pribeiro/misc/papers%20published/guidelines%20modeling%20power%20electronics.pdf

E-text books:

1. https://www.schaffner.com/fileadmin/media/content/jobs/schaffnerdeutschland_software-engineer.pdf
2. https://www.maklab.org/core/wp-content/uploads/2016/02/abb.pdf
3. https://www.google.co.in/search?q=software+tool+for+power+electronic+applications&client=firefox-b&biw=1366&bih=657&ei=wr6hv5jxc4lfvgtp1ziqba&start=20&sa=n

DIGITAL CONTROLLERS FOR POWER ELECTRONIC APPLICATIONS

Group IV: PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE216	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Understand principles of Digital Signal Processing and apply this for the speed control of induction motor drives.
II. Illustrate Field Programmable Gate Arrays.
III. Understand the concepts of data acquisition.
IV. Illustrate the concepts of signal conditioning.

UNIT-I	DIGITAL SIGNAL PROCESSORS	Classes: 09

Introduction to the DSP core and code generation, the components of the DSP core, mapping external devices to the core, peripherals and peripheral interface, system configuration registers, memory, types of physical memory, memory addressing modes, assembly programming using DSP, instruction set; Software Tools: Pin Multiplexing (MUX) and General Purpose I / O Overview, multiplexing and general purpose I / O control registers, introduction to interrupts, interrupt hierarchy, interrupt control registers, initializing and servicing interrupts in software, review of power electronic converters for drive control, VSI fed IM Drive, drive configuration, commutation at different speed, control structure, DSP based scalar control of induction motor drives.

UNIT-II	FIELD PROGRAMMABLE GATE ARRAYS	Classes: 10

RTL Design, simulation and synthesis, Combinational logic, types, operators, packages, sequential circuit, subprograms, test benches (Examples: adders, counters, flip flops, FSM, Multiplexers / Demultiplexers), overview of Field Programmable Gate Arrays, CPLD Vs FPGA, types of FPGA, Xilinx XC3000 series, configurable logic Blocks (CLB), input / output Block (IOB), overview of Spartan 3E and Virtex III pro FPGA boards, case study, controlled rectifier, switched mode power converters, PWM Inverters, DC motor control, induction motor control using Virtex III pro FPGA boards.

UNIT-III	VIRTUAL INSTRUMENTATION	Classes: 08

Introduction of Lab VIEW, virtual instrumentation, definition, flexibility, block diagram and architecture of virtual instruments, virtual instruments versus traditional instruments.

Review of software in virtual instrumentation, VI programming techniques, sub, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, string and file input and output.

UNIT-IV	DATA ACQUISITION SYSTEM	Classes: 09

Basic structures, the GUI, controls and indicators, debugging, XY graphs using pre written VIs software as virtual instrument object, front panel controls, indicators, block diagram arithmetic and logic functions, data acquisition system, elements of data acquisition systems, block diagram and details of computerized data acquisition systems, control of electric drive using Lab VIEW, 4 quadrant operation of DC motor, design of current controller and speed controller for VSI fed induction motor drives.

UNIT-V	SIGNAL CONDITIONING	Classes: 09

Signal conditioning: Necessity, instrumentation amplifiers, chopper stabilized amplifiers, impedance converters, noise problems, shielding and grounding, concept of filters, dynamic compensation, linearization, concept of A / D and D / A converters (voltage to frequency and frequency to voltage converter), sample hold amplifiers, microprocessor applications in signal conditioning.

Text Books:

1. Hamid.A.Toliyat, Steven G.Campbell, "DSP Based Electro Mechanical Motion Control", CRC Press New York,1 st Edition ,2004.
2. Wayne Wolf, "FPGA Based System Design", Prentice hall, 1st Edition , 2004.
3. Robert H. Bishop, "Learning with Lab VIEW", National Instruments, 1st Edition, 1999.
4. TMS320C240, "User's Guide – Preliminary", Texas Instruments, 1996.

Reference Books:

1. Farzad Nekoogar, Genemoriarty, "Digital control using DSP", Prentice Hall Pvt.Ltd, 1999.
2. Douglas Perry, "VHDL Programming by example", Tata McGraw Hill, 1st Edition, 2005
3. Eugene D.Fabricius, "Introduction to VLSI Design", Tata McGraw Hill, 1st Edition, 2015
4. Texas Instruments, "Digital Signal Processing Solution for AC Induction Motor", Application Note BPRA043.
5. Rick Bitter, TaqiMohiuddin and Matt Nawrocki, "Labview AdvancedProgramming Techniques", CRC Press, 2nd Edition, 2007.

Web References:

1. https://www.iea.lth.se/publications/MS Theses/Full%20document/5230_DSP%20Controller%20for%20Power%20Electronic%20Converter.pdf
2. https://shodhganga.inflibnet.ac.in/bitstream/10603/16546/7/07_chapter2.pdf
3. https://www.dsce.fee.unicamp.br/~antenor/pdffiles/Lesson1.pdf

E-Text Books:

1. https://www.calvin.edu/~pribeiro/misc/Papers%20Published/guidelines%20modeling%20power%20electronics.pdf
2. https://www.srmuniv.ac.in/sites/default/files/downloads/april_2016_curriculum_syllabus_ped_m.tech_2015_16.pdf
3. https://electronics.etfbl.net/journal/Vol17No2/xPaper_07.pdf
4. books.google.com › Technology & Engineering › Electronics › Semiconductors

DISASTER MANAGEMENT

Open Elective I : AE / (CAD/CAM) / CSE / ES / SE /PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BST701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The student should enable the students to:

I. Exposure to disasters, their significance and types.
II. Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
III. Explore on Disaster Risk Reduction (DRR) approaches.
IV. Enhance awareness of institutional processes in the country.
V. Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live,with due sensitivity.

UNIT-I	INTRODUCTION TO NATURAL AND MANMADE DISASTERS	Classes: 09

Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks. Impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic. political, environmental, health, psychosocial, etc.).

UNIT-II	DISASTER, DIFFERENTIAL IMPACTS, CYCLONES AND FLOODS	Classes: 09

Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc. Differential Impacts in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change.Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India.

UNIT-III	APPROACHES TO DISASTER RISK REDUCTION	Classes: 09

Disaster cycle, its analysis, phases, culture of safety, prevention, mitigation and preparedness community based Disaster risk reduction.

Structural, nonstructural sources, roles and responsibilities of community, Panchayati raj Institutions, Urban local bodies, states, centre and other stake holders.

UNIT-IV	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	Classes: 09

Factors affecting vulnerabilities, differential impacts, impact of development projects such as darns, embankments, changes in Land-use etc. Climate Change Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-V	DISASTER RISK MANAGEMENT IN INDIA	Classes: 09

Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness,

OM Act and Policy, other related policies, plans, programmes and legislation).
Field work and case Studies to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the institute is located.

Text Books:

1. Nick, "Disaster Management: A Disaster Manager's Handbook", Asian Development Bank, Manila Philippines, 1991.
2. Kapur, et al., "Disasters in India: Studies of Grim Reality", Rawat Publishers, Jaipur, 2005.
3. Pelling Mark, "The Vulnerability of Cities: Natural Disaster and Social Resilience", Earthscan Publishers, London, 2003.

Reference Books:

1. Sharma, V. K. (1999), "Disaster Management", National Centre for Disaster Management, IIPE, Delhi, 1999.
2. Anil, K. Gupta and Sreeja, S. Nair (2011), "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011.

Web References:

1. http://humanityroad.org/
2. http://www.wcpt.org/disaster-management/what-is-disaster-management
3. http://www.ndmindia.nic.in/
4. http://nidm.gov.in/default.asp
5. http://www.unisdr.org/2005/mdgs-drr/national-reports/India-report.pdf

E–Text Books:

1. http://www.ekalavvya.com/disaster-management-in-india-volume-i-free-ebook/
2. http://cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf
3. http://www.undp.org/content/dam/india/docs/disaster_management_in_india.pdf
4. http://www.digitalbookindex.org/_search/search010emergencydisastera.asp

RENEWABLE ENERGY SYSTEMS

Open Elective I : AE / (CAD / CAM) / CSE / ES / SE / ST

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

This course should enable the students to:

I. Illustrate the concept of photo voltaic power generation.
II. Discuss the Magneto hydrodynamic (MHD) and wind energy power conversion systems.
III. Explain tidal and wave energy.
IV. Design energy conversion systems with low impact on environment.
V. Understand the technology of fuel cells.

UNIT-I	PHOTOVOLTAIC POWER GENERATION SYSTEMS	Classes: 09

Photo voltaic power generation: spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

UNIT-II	MHD WIND ENERGY CONVERSION AND WIND POWER GENERATION	Classes:10

Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology; Wind Energy conversion: Power from wind, properties of air and wind, types of wind turbines, operating characteristics.

UNIT-III	TIDAL AND WAVE ENERGY CONVERSION	Classes:08

Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.

Wave energy conversion: Properties of waves, power content, vertex motion of waves, device applications, types of ocean thermal energy conversion systems application of OTEC systems examples.

UNIT-IV	ENERGY CONVERSION SYSTEMS AND ENVIRONMENTAL EFFECTS	Classes:09

Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, co generation and energy storage, combined cycle co generation, energy storage; Global energy position and environmental effects: energy units, global energy position.

UNIT-V	FUEL CELLS	Classes:09

Fuel cells: Types of fuel cells, H_2O_2 Fuel cells, application of fuel cells, batteries, description of batteries, battery application for large power, environmental effects of energy conversion systems.

Text Books:

1. Ashok Desai V, Non-Conventional Energy, Wiley Eastern Ltd, 1990.
2. Rakosh das Begamudre, "Energy conversion systems", New age International publishers, New Delhi - 2000.
3. Freris L.L. Prentice Hall1, "Wind energy Conversion Systems", 1990.
4. Spera D.A., "Wind Turbine Technology: Fundamental concepts of wind turbine technology", ASME Press, NY, 1994.

Reference Books:

1. Mittal K.M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, 1997.
2. Ramesh R, Kurnar K.U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 1997.
3. John Twidell, Tony Weir "Renewable Energy Resources", 2nd edition.
4. Kreith, Kreider, "Solar Energy Handbook", McGrawHill

Web References:

1. http://www.nrel.gov/docs/fy13osti/54909.pdf
2. http://www.gisday.com/resources/ebooks/renewable-energy.pdf
3. http://www.geni.org/globalenergy/library/energytrends/currentusage/renewable/Renewable-Energy-Potential-for-India.pdf
4. http://www.cerien.upc.edu/jornades/jiie2005/ponencies/power%20converters%20and%20control%20of%20renewable%20energy%20systems%20paper.pdf
5. https://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-SOLAR_PV.pdf

E-Text Books:

1. http://maxwell.sze.hu/~marcsa/MegujuloEnergiaforrasok/Books/renewable%20energy%20resources.pdf
2. http://lab.fs.uni-lj.si/kes/erasmus/Renewable%20Energy%20Conversion,%20Transmission,%20and%20Storage.pdf
3. http://www.landartgenerator.org/LAGI-FieldGuideRenewableEnergy-ed1.pdf

AUTOMOTIVE DESIGN

Open Elective I : AE / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand and Specify automotive styling and design principles of automotive exteriors.
II. Analyze automotive exterior design trends.
III. Design automotive exteriors using manual and digital renderings.
IV. Create clay models of automotive exterior design.

UNIT-I	AUTOMOTIVE DESIGN TERMINOLOGY , CLASSIFICATION OF CARS BASED ON BODY STYLE	Classes: 09

Overview, Automotive design terminology, automotive design process and factors influencing automotive design, development and history behind different body styles, micro cars, hatchback and it sub types, sedan and its sub-types, coupe and its variants, convertible and its variants, station wagon, sports utility vehicles, multi utility vehicles.

UNIT-II	PLATFORM TECHNOLOGY, TYPES OF CHASSIS, AND AUTOMOTIVE PACKAGING	Classes: 09

Platform technology, types of chassis, and automotive packaging: Definition, motivation, versions of platform, benefits of platform sharing and downside of platform technology; History of automotive chassis, composite construction, unibody construction, tubular space frame, glass-fibre monocoque chassis, aluminium monocoque construction, carbon fibre monocoque construction, ULSAB type, definition and different layout sectors in packaging, Interior dimensions, exterior dimensions, front end (engine compartment), rear end (luggage space), under-body, major factors influencing automotive packaging, regulatory requirements.

UNIT-III	AUTOMOTIVE FRONT- REAR END DESIGN	Classes: 09

Factors affecting the front end design, front end design for better air cooling, latest design trends, bumper design theme, regulation for bumper design.

Evolution of grille design, grille design as a new brand image, hood design and new trends in exterior design, tail lamp, spoiler, bumper design, overall rear design for aerodynamics.

UNIT-IV	AUTOMOTIVE LIGHTING SYSTEM , AUTOMOTIVE GLASSES	Classes: 09

History and development in automotive lighting, different types of optical system, light sources used in lighting, headlamp design and styling, advanced lighting technology, pedestrian friendly lights, signal lamps, latest trends in automotive lighting, different types of automotive glasses, recent development in automotive glass design, importance of glass in car design, role of glazing for car safety, developments in automotive glass design.

UNIT-V	AUTOMOTIVE EXTERIOR DESIGN, PAINTING , SURFACE PROTECTION	Classes: 09

Design methodology, image boards: lifestyle board, mood board, theme board, design trends, design movements, application of design principles, product aesthetics, different types of corrosion on automotive bodies, corrosion protection methods, automotive body painting procedure, paint components and latest trends in automotive body colors.

Text Books:

1. J.Fenton, "Handbook of Automotive Body and System Design", Professional Engineering Publishing, 1st Edition, 2000.
2. Erik Eckermann, "World History of the Automobile", SAE International, 1st Edition, 2002.

Reference Books:

1. Stephen Newbury, "Car Design Year Book 1 to 5", Marrell, 1st Edition, London, 2007.
2. Tony Lewin, "How to Design Car Like A Pro", Motorbooks International, 1st Edition, 2003

Web References:

1.www.carbodydesign.com
2.www.style4cars.com
3.www.cardesignnews.com

E-Text Books:

1.http://www.sciencedirect.com/science/book/9780750656924
2.http://books.sae.org/r-312/

EMBEDDED C

Open Elective I: AE / (CAD / CAM) / CSE / SE / ST /PEED | I Semester: ES

Course code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BES001	Core/Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand embedded C and use it for programming embedded system.
II. Apply techniques for data transfer between I/O ports and memory.
III. Apply object oriented programming for designing embedded system.
IV. Use timers to generate time delays.

UNIT-I	PROGRAMMING EMBEDDED SYSTEMS IN C	Classes: 09

Introduction, what is an embedded system, which processor should you use, which programming language should you use, which operating system should you use, how do you develop embedded software, conclusions; Introduction, what's in a name, the external interface of the standard 8051, reset requirements, clock frequency and performance, memory issues, I/O pins, timers, interrupts, serial interface, power consumption, conclusions.

UNIT-II	SWITCHES	Classes: 09

Introduction, basic techniques for reading from port pins; Example: Reading and writing bytes, example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), example: counting goats, conclusions.

UNIT-III	ADDING STRUCTURE TO THE CODE	Classes: 09

Introduction, object oriented programming with C, the project header (MAIN.H), the port header (PORT.H);

Example: Restructuring the 'Hello Embedded World' example, Example: Restructuring the goat-counting example, further examples and conclusions.

UNIT-IV	MEETING REAL-TIME CONSTRAINTS	Classes: 09

Introduction, creating hardware delays using Timer 0 and Timer 1, example: Generating a precise 50 ms delay, example: Creating a portable hardware delay, Why not use Timer 2? The need for timeout mechanisms, creating loop timeouts and example: Testing loop timeouts, example: A more reliable switch interface, Creating hardware timeouts, example: Testing a hardware timeout, conclusions.

UNIT-V	CASE STUDY: INTRUDER ALARM SYSTEM	Classes: 09

Introduction, The software architecture, key software components used in this example, running the program, the software, conclusions.

Text Books:

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008.

Reference Books:

1. Nigel Gardner, "The Microchip PIC in CCS C", Ccs Inc, 2nd Revision Edition, 2002.

Web References:

1. http://www.keil.com/forum/5973/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Embedded%20systems /New_index1.html
3. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Delhi/Embedded%20Systems%20(Video).htm
4. http://freevideolectures.com/Course/2999/Embedded-Systems-I/5

E-Text Books:

1. http://teachers.teicm.gr/kalomiros/Mtptx/e-books/eBook%20-%20PIC%20Programming%20with %20C.pdf
2. http://www.ecpe.nu.ac.th/ponpisut/22323006-Embedded-c-Tutorial-8051.pdf
3. http://dsp-book.narod.ru/CPES.pdf
4. http://staff.ustc.edu.cn/~shizhu/WinCE/winCE6%20Fundamentals.pdf
5. http://read.pudn.com/downloads167/ebook/769402/Wrox.Professional.Microsoft.Windows.Embedd
6. ed.CE.6.0.Nov.2008.eBook-DDU.pdf
7. https://syhpullpdf.files.wordpress.com/2015/05/embedded-systems-textbook-pdf.pdf

ADVANCED JAVA PROGRAMMING AND WEB SERVICES

Open Elective I: AE / (CAD/CAM) / ES / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCS701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to :

I. Understand OOPS Concepts Describe client side technologies.
II. Implement database connections.
III. Develop the skills to design user interfaces for web Applications.

UNIT-I	INTRODUCTION TO OOPs	Classes: 09

Basic concepts of OOPs: Java History, Java Features, Comparison in Java and C++ ,Java Virtual Machine, Java Environment, Program, Data types, operators, Control Structure, Classes and Objects, Constructors, Interfaces, Exception Handling.

UNIT-II	APPLETS AND SWINGS	Classes: 09

Applets: Introduction to applet, applet vs application, applet class, advantages of applet, applet lifecycle, applet tag, passing parameters to applet, types of applets, examples; swing: introduction to JFC, swing, Swing, Features, JComponent, JApplet, JFrame, JPannel, JButtons, Jcheckboxes and JRadiobuttons, JTextField, JMenu, JMenuBar

UNIT-III	HTML AND XML	Classes: 09

HTML common tags: list, tables, images, forms, frames; cascading style sheets; introduction to java scripts, objects in java script, dynamic HTML with java script.

XML: document type definition, XML schemas, document object model, presenting XML, using XML processors: DOM and SAX.

UNIT-IV	WEB SERVERS,SERVLETS AND JSP	Classes: 09

Web servers: Tomcat server installation and testing, introduction to servelets: lifecycle of a servelet, JSDK, servelet API, javax. servelet package, reading servelet parameters, reading initialization parameters; servlets: javax, servelet HTTP package, handling http request and responses, using cookies session tracking, security issues, JSP: problem with servelet, anatomy of a JSP Page, JSP processing, JSP application design with MVC architecture, AJAX.

UNIT-V	JDBC AND ODBC	Classes: 09

JDBC & ODBC :Java and JDBC , JDBC vs ODBC, JDBC driver model, JDBC driver types, two-tier architecture for data access ,three-tier architecture for data access , types of driver managers, connecting to an ODBC data source, JDBC programs

Text Books:

1. WILEY Dreamtech Chris Bates, "Web Programming, building internet applications", 2nd edition.
2. Patrick Naughton and Herbert Schildt, "The complete Reference Java 2" , TMH, 5th Edition.
3. Hans Bergsten , "Java Server Pages", SPD O'Reilly.

Reference Books:

1. Sebesta, "Programming world wide web", Pearson Core,8th Edition 2008.
2. Marty Hall, Larry Brown, "Servlets and Javaserver Pages", Volume 1: Core Technologies, Pearson 2nd Edition 1998.

Web References:

1. http://engineeringppt.blogspot.in/2010/01/advance-java-web-technology.html
2. http://www.scoopworld.in/2015/02/ajwt-ppt-lab-materials-cse.html
3. http://jntuh.ac.in/new/bulletin_board/WEB_TECHNOLOGIES.pdf

E-Text Books:

1. http://www.freetechbooks.com/advanced-programming-for-the-java-2-platform-t36.html
2. https://www.mkyong.com/featured/top-5-free-java-ebooks/
3. http://www.e-booksdirectory.com/listing.php?category=226

INTRODUCTION TO AEROSPACE ENGINEERING

Open Elective I: (CAD/CAM) / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BAE701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Outline different aspects of flight vehicles and their operational environment.
II. Description of flow behavior of one-dimensional incompressible and compressible flow, two-dimensional flow and finite wing.
III. Apprise about boundary layer effects, aerodynamic forces on airfoils, wings and high-lift systems.
IV. Analyze airplane performance, stability and control.

UNIT-I	INTRODUCTION TO AERONAUTICS AND ASTRONAUTICS	Classes: 08

Historical perspective of aeronautics and astronautics, anatomy of the airplane, anatomy of a space vehicle, aerodynamic forces; Parameters affecting aerodynamic forces: Dimensional analysis; Theory and experiment, wind tunnels; Atmosphere: Properties of U.S. standard atmosphere, definitions of altitude.

UNIT-II	ONE DIMENSIONAL FLOW IN INCOMPRESSIBLE AND COMPRESSIBLE FLUIDS, TWO DIMENSIONAL FLOW AND FINITE WING	Classes: 10

Continuity equation, Bernoulli's equation; Application of Bernoulli's equation: Airspeed indicators and wind tunnels, one dimensional compressible flow concepts, speed of sound, compressible flow equations in a variable-area stream tube, application to airspeed measurement, applications to channels and wind tunnels; Two dimensional flow and finite wing: Limitations of one dimensional flow equations; Theory of lift: circulation, Airfoil pressure distribution, Helmholtz vortex theorems, Simulating the wing with a vortex Line, downwash, elliptic lift distribution; Lift and drag: Momentum and energy, Slope of finite wing lift curve, verification of Prandtl wing theory, additional effects of wing vortices, search for reduced induced drag.

UNIT-III	VISCOUS EFFECTS, DRAG DETERMINATION, AIRFOILS, WINGS AND HIGH-LIFT SYSTEMS	Classes: 10

Boundary layer, boundary layer on bluff bodies, creation of circulation, laminar and turbulent boundary layers: skin friction, nature of Reynolds number, effect of turbulent boundary layer on separation; Total Incompressible drag: Parasite drag, drag due to lift, importance of aspect ratio; Compressibility drag: Prediction of drag divergence Mach number, sweptback wings, total drag.

Supersonic flow: Shock waves and Mach waves, supersonic wing lift and drag, area rule, supersonic aircraft, airfoils; Wings: early airfoil development, modern airfoils, supersonic airfoils, airfoil pitching moments, effects of sweepback on lift, airfoil characteristics, airfoil selection and wing design; High-lift Devices: Airfoil maximum lift coefficient, leading and trailing edge devices, effect of sweepback, deep stall, effect of Reynolds number, propulsive lift.

UNIT-IV	AIRPLANE PERFORMANCE, STABILITY AND CONTROL, AEROSPACE PROPULSION	Classes: 09
Level flight performance, climb performance, range, endurance, energy-state approach to airplane performance, takeoff performance, landing performance; Static longitudinal stability; Dynamic longitudinal stability; Dynamic lateral stability; Control and maneuverability: Turning performance, control systems, active controls; Aerospace propulsion: Piston engines, gas turbines; Speed limitations of gas turbines: Ramjets, propellers, overall propulsion efficiency, rocket engines, rocket motor performance, propulsion-airframe integration.		
UNIT-V	**AIRCRAFT STRUCTURES, HYPERSONIC FLOWS, ROCKET TRAJECTORIES AND ORBITS**	**Classes: 08**
Aircraft structures: Importance of structural weight and integrity, development of aircraft structures, importance of fatigue, materials, loads, weight estimation; Hypersonic flows: temperature effects, Newtonian theory; rocket trajectories, multistage rockets, escape velocity, circular orbital or satellite velocity, elliptical orbits, orbital maneuvers.		

Text Books :

1. Richard S. Shevell, Fundamentals of Flight, Pearson Education Publication, 2nd Edition, 1988.
2. Anderson J. D, "Introduction to Flight", McGraw-Hill, 5th Edition, 1989.
3. Newman D, "Interactive Aerospace Engineering and Design", McGraw-Hill, 1st Edition, 2002.
4. Barnard R.H and Philpot. D.R, "Aircraft Flight", Pearson, 3rd Edition, 2004.

Reference Books:

1. Introduction to Flight, John D. Anderson, Jr., Tata McGraw-Hill Publishing Company, Fifth Edition, Fifth Edition, 2007.
2. Kermode, A. C, "Flight without Formulae", McGraw Hill, 4th Edition, 1997.
3. Swatton P. J, "Flight Planning", Blackwell Publisher, 6th Edition, 2002.

Web References:

1. https://fas.org/irp/doddir/army/fm3-04-203.pdf
2. http://www.aerospaceengineering.es/book/
3. http://www.ne.nasa.gov/education/
4. http://nptel.ac.in

E-Text Books:

1.http://www.e-booksdirectory.com/
2.http://www.adl.gatech.edu/extrovert/Ebooks/ebook_Intro.pdf
3.http://www.academia.edu/7950378/Introduction_to_Flight_-_Anderson_5th_Ed._

GEOSPATIAL TECHNIQUES

Open Elective-II: AE / (CAD/CAM) / CSE / ES / SE /PEED

Course Code	Category	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BST702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Provide technical skills to use geo-referenced data for the purpose of economic, educational, and social development.
II. Learn the art of image interpretation and mapping.
III. Learn the applications of geospatial technologies.

UNIT-I	INTRODUCTION TO GEOSPATIAL DATA	Classes: 09

Geospatial data, why to study geospatial data, importance of geospatial technology, spatial data infrastructure, three important geospatial technologies, spatial elements., coordinates and coordinate systems, basic electromagnetic radiation.

UNIT-II	PHOTOGRAMMETRY AND REMOTE SENSING	Classes: 10

Definition and scope, history of photogrammetry and remote sensing, principle, remote sensing data acquisition, Remote sensing data analysis methods, advantages and limitations, hardware and software required. Map Vs mosaic, ground control points. Energy interactions with atmosphere and earth surface features.

UNIT-III	MAPPING AND CARTOGRAPHY	Classes: 10

What is map and its importance, map scale and types, elements of map and Indexing, map coordinate systems, visual interpretation of satellite images, and interpretation of terrain evaluation.

Introduction to digital data analysis, cartographic symbolization, classification of symbols, colours in cartography, scale and purpose of a map, cartographic design, thematic cartography, digital cartography.

UNIT-IV	GEOGRAPHIC INFORMATION SYSTEM	Classes:10

Introduction to GIS, definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, theoretical framework for GIS, GIS data structures, data collection and input overview, processing of spatial data, data Input or output, vector data model, raster data model, geometric representation of spatial feature and data structure. Spatial data and modeling, TIN, DTM, overlay, spatial measurement etc.,

UNIT-V	GEOSPATIAL TECHNOLOGIES APPLICATIONS	Classes:09

Visual image analysis for land use / land cover mapping, land use and land cover in water resources, surface water mapping and Inventory, geological and soil mapping, agriculture applications for forestry applications, water resources applications, urban and regional planning, environmental assessment, principles of land form identification and evaluation: sedimentary, igneous and metamorphic rock terrain.

Text Books :

1. John D. Bossler, "Manual of Geospatial Science and Technology" Taylor & Francis.
2. M. Anji Reddy, "Textbook of Remote Sensing and Geographical Information Systems", BS Publications.

Reference Books:

1. C. P. Lo Albert, K.W. Yonng, "Concepts and Techniques of GIS", Prentice Hall (India) Publications.
2. Peter A Burragh and Rachael A. Mc Donnell, "Principles of Geo- Physical Information Systems", Oxford Publishers, 2004.
3. M. Anji Reddy, "Geo-informatics for Environmental Management" BS Publications.

Web References:

1. https://www.aaas.org/content/what-are-geospatial-technologies
2. http://www.istl.org/10-spring/internet2.htmls

E-Text Books:

1. http://www.springer.com/us/book/9781441900494
2. https://www.amazon.com/Introduction-Geospatial-Technologies-Bradley-Shellito/dp/146413345X
3. http://www.springer.com/us/book/9784431555186
4. http://gep.frec.vt.edu/VCCS/materials/2011/Day1/Handouts/1.2-Ch.1_GIS_Intro.pdf
5. http://www.slideshare.net/CuteGirl11/introduction-to-geospatial-technologies-pdf

SOLAR PHOTOVOLTAIC ENERGY CONVERSION

Open Elective II : AE / (CAD / CAM) / CSE / ES / SE / ST

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Illustrate the operation of Photo voltaic power generation.
II. Analyze the characteristics of solar photovoltaic power generation.
III. Design energy conversion systems with low impact on environment.
IV. Understand the technology of fuel cells.

UNIT-I	INTRODUCTION	Classes: 09

Introduction: Highlights, an atomic description of silicon, the effect of light on silicon the potential barrier, the function of the barrier, the potential barrier in action the electric current.

UNIT-II	PHYSICAL ASPECTS OF SOLAR CELL EFFICIENCY	Classes: 09

Physical aspects of solar cell efficiency: Reflection light with too little or too much energy, recombination of electron hole pairs, direct recombination indirect recombination, resistance, self shading, performance degradation at non optimal temperatures, high temperature losses, low temperature losses.

UNIT-III	SINGLE CRYSTAL SILICON SOLAR CELLS AND ARRAYS	Classes: 09

Single Crystal Silicon Solar cells: New fabrication edge, defined film fed growth (dendritic web growth, Ribbon to ribbon (rtr) growth innovative cell designs back surface fields (BSF) and other minority carrier mirrors (MCM). Schottky barrier cells, inversion layer cells, cells for concentrated sun light advances in component technology highlights, PV building blocks, boosting voltage and amperage design requirements for connecting components, the physical connection. placing the cells;

Arrays: Array support, module covers, module cooling, hybrid designs, Brayton cycle, electricity production, the rmo electric generators, intercepting sunlight, arrays with relectors, arrays that follow the sun, controlling intensity, imaging optics, mirrors,
lenses tracking devices, steering mechanisms, tracking device controls, optimizing the use of the spectrum, splitting the spectrum, converting the spectrum to a single color.

UNIT-IV	SOLAR ARRAY CONSTRUCTIONS	Classes: 09

Solar array constructions: Intercepting sunlight, arrays with relectors, arrays that follow the sun, controlling intensity, imaging optics, mirrors, lenses; Tracking devices: steering mechanisms, tracking device controls, optimizing the use of the spectrum, splitting the spectrum, converting the spectrum to a single color.

UNIT-V	PV SUPPORT EQUIPMENT	Classes: 09

PV support equipment: PV vs conventional electricity, storing PV's electricity, batteries, fuel cells, power conditioning equipment the inverter regulators other devices; system analysis, design procedure, design constraints, other considerations.

Text Books:

1. CS Solanki, "Solar photovoltaic's fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., 2011.
2. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
3. Rai,G.D., "Non- conventional resources of energy", Khanna publishers, Fourth edition, 2010.

Reference Books:

1. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
2. Pai, B. R. and Ram Prasad, "Power Generation through Renewable Sources of Energy", Tata McGraw Hill, New Delhi, 1991.
3. Bansal, Kleeman and Meliss, "Renewable Energy Sources and Conversion Techniques", Tata Mc Graw Hill, 1990.
4. Godfrey Boyl, "Renewable Energy: Power sustainable future", Oxford University Press, Third edition, 2012.
5. B.H.Khan, "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2009.
6. John W Twidell and Anthony D Weir, "Renewable Energy Resources", Taylor and Francis, 2006.

Web References:

1. http://www.tue.nl/fileadmin/content/faculteiten/tn/PMP/White_papers/Delft2012_-_ALD4PV.pdf
2. http:// www.en.wikipedia.org/wiki/Photovoltaics
3. http://www.desware.net/Sample-Chapters/D06/D10-014.pdf
4. http://www.southampton.ac.uk/~solar/files/Strasbourg.pdf
5. http:// www.science.nasa.gov/science-news/science-at-nasa/2002/solarcells/

E-Text Books:

1. http://www.nrel.gov/docs/legosti/old/1448.pdf
2. http://www.irena.org/DocumentDownloads/Publications/IRENAETSAP%20Tech%20Brief%20E11%20Solar%20PV.pd
3. http://www.opalrt.com/sites/default/files/technical_papers/SOLAR%20PHOTOVOLTAIC%20ENERGY%20GENERATION%20AND%20CONVERSION.pdf

COMPUTER GRAPHICS

Open Elective II: AE / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand the basics of Computer Graphics needed for CAD/ CAM applications.
II. Apply the geometrical modeling for computer graphics.
III. Apply data structures in computer graphics.

UNIT-I	INTRODUCTION TO COMPUTER GRAPHICS	Classes: 09

Introduction: Role of computer graphics in CAD/CAM, configuration of graphic workstations, menu design and graphical user interfaces, customization and parametric programming.

UNIT-II	GEOMETRIC TRANSFORMATIONS, PROJECTIONS AND FUNDAMENTALS OF 2D AND 3D TRANSFORMATIONS	Classes: 09

Geometric transformations and projections: Vector representation of geometric entities, homogeneous coordinate systems; Fundamentals of 2D and 3D transformations: reflection, translation, rotation, scaling, and shearing, various types of projections.

UNIT-III	DEVELOPMENT OF GEOMENTRICAL MODELLING	Classes: 09

Curves: Modeling planar and space curves, analytical and synthetic approaches, non-parametric and parametric equations.

Surfaces: Modeling of bi-parametric freedom surfaces, Coons, Bezier, B-spline, and NURBS surfaces, surface manipulation techniques.

UNIT-IV	GEOMENTRICAL MODELING	Classes: 09

Geometric Modeling: Geometric modeling techniques, wireframe modeling, solid modeling: B Rep CSG, hybrid modelers, feature based, parametric and variation modeling.

UNIT-V	DATA STRUCTURES IN COMPUTER GRAPHICS	Classes: 09

Data Structure in Computer Graphics: Introduction to product data standards and data structures, data-base integration for CIM.

Text Books:

1. D. F. Rogers, J. A. Adams, “Mathematical Elements for Computer Graphics”, Tata McGraw Hill. 1989.
2. I. D. Faux, M. J. Pratt, “Computational Geometry for Design and Manufacture”, Ellis Horwood, 1979.
3. Mortenson, M. E., “Geometric Modeling”, 3rd Ed., Industrial Press. 2006
4. Ibrahim Zeid, “CAD/CAM: Theory and Practice”, Tata McGraw Hill, 1998.
5. B. K. Choi, B. K., “Surface Modeling for CAD/CAM", John Wiley & Sons 1991

Reference Books:
1.C. Pozrikidis, “Introduction to Theoretical and Computational Fluid Dynamics”, Oxford University Press, 2nd Edition, 2013. 2.V. Patankar, Hema shava Suhas , “ Numerical heat transfer and fluid flow”, Tata McGraw Hill
Web References:
1. http://nptel.ac.in/courses/106106090/ 2. http://nptel.ac.in/courses/112102101/
E-Text Books:
1. http://www.freebookcentre.net/CompuScience/Free-Computer-Graphics-Books-Download.html 2.https://docs.google.com/file/d/0B_YZ665nBRhlYmNiOTU5ZDItMmU2OC00YTVmLThiNmMtMjg 3 Y2E3ZTgwZDYw/edit?hl=en_US&pref=2&pli=1

MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN

Open Elective II: AE / (CAD / CAM) / CSE / SE / ST /PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BES702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand hardware units and devices for design of embedded systems.
II. Use architectures of embedded RISC processors and system on chip processor design of embedded systems.
III. Analyze interrupt latency, context switching time, for development of device drives for timing devices.

UNIT-I	INTRODUCTION TO EMBEDDED SYSTEMS	Classes: 09

Overview of embedded systems, processor embedded into a system, embedded hardware units and devices in system, embedded software, complex system design, design process in embedded system, formalization of system design, classification of embedded systems.

UNIT-II	MICROCONTROLLERS	Classes: 09

8051 architecture, input/output ports and circuits, external memory, counters and timers, PIC controllers; Interfacing processor 8051, PIC, memory interfacing, I/O devices, memory controller and memory arbitration schemes.

UNIT-III	EMBEDDED RISC PROCESSORS	Classes: 09

programmable system on chip architectures, continuous timer blocks, switched capacitor blocks, I/O blocks, digital blocks, programming of PSOC;

Embedded RISC processor architecture, ARM processor architecture, registers set, modes of operation and overview of Instructions.

UNIT-IV	INTERRUPTS AND DEVICE DRIVERS	Classes: 09

Exceptions and Interrupt handling Schemes, Context and periods for context switching, deadline and interrupt latency; Device driver using interrupt service routine, serial port device driver and device drivers for internal programmable timing devices.

UNIT-V	NETWORK PROTOCOLS	Classes: 09

Serial communication protocols, Ethernet protocol, SDMA, Channel and IDMA, external bus interface.

Text Books:

1. Raj Kamal, "Embedded Systems, Architecture Programming and Design", Tata Mc Graw Hill, 2nd Edition, 2008.
2. Muhammad Ali Mazidi, Rolin D. Mckinaly, Danny Causy, "PIC Microcontroller and Embedded Systems", Pearson Education, 1st Edition, 2008.

3. Robert Ashpy, “Designers Guide to the Cypress PSOC”, Elsevier, 1st Edition, 2005.

Reference Books:

1. Jonathan W. Valvano – Brookes / Cole, “Embedded Microcomputer Systems, Real Time Interfacing”, Thomas Learning, 1st Edition, 1998.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, “ARM Systems Developers Guides, Design & Optimizing System Software”, Elsevier, 1st Edition, 2004.
3. John B. Peatman, “Designing with PIC Microcontrollers”, PH Inc, 1st Edition, 1998.

Web References:

1. http://nptel.ac.in/syllabus/108102045/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT,KANPUR/microcontrollers/micro/ui/Course_home1_1.Htm

E-Text Books:

1. http://microcontrollershop.com/default.php?cPath=239
2. http://www.sciencedirect.com/science/book/9780750667555
3. https://books.google.co.in/books/about/Embedded_Systems_Design_with_8051_Microc.html?id=YiTa,HChn0UC&redir_esc=y
4. https://books.google.co.in/books/about/Microcontroller_And_Embedded_Systems.html?id=4GrXJeC6HFkC

LINUX PROGRAMMING

Open Elective II: AE / (CAD/CAM) / ES / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCS702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Total Tutorials: Nil	Total Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to :

I. Understand basic Linux utilities and Shell scripting language (bash) to solve Problems.
II. Explore on implementation of Linux utilities using system calls.
III. Develop the skills necessary for systems programming
IV. Illustrate the basic skills required to write inter process communication programs.

UNIT-I	LINUX UTILITIES	Classes: 09

File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities; Sed-Scripts, Operation, Addresses, Commands, awk-Execution, Fields and Records, Scripts, Operation, Patterns, Actions, Associative Arrays, String and Mathematical functions, System commands in awk, Applications.

UNIT-II	SHELL PROGRAMMING	Classes: 09

Introduction, shell responsibilities, pipes and Redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, debugging shell scripts.

UNIT-III	FILES AND DIRECTORIES	Classes: 09

Files: File types, File System Structure, file metadata: Inodes, kernel support for files, system calls for file I/O operations: open, create, read, write, close, lseek, dup2, file status information: stat family, file and record locking: fcntl function.

File permissions - chmod, fchmod, file ownership, links: soft and hard links: symlink, link, unlink. Directories: Creating, removing and changing Directories, obtaining current working directory: getcwd, Directory contents, Scanning Directories: opendir, readdir, closedir, rewinddir functions.

UNIT-IV	INTERPROCESS COMMUNICATION AND MESSAGE QUEUES	Classes: 09

Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pies-creation, IPC between related processes using unnamed pipes, FIFOs: creation, IPC between unrelated processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions, Message Queues: Kernel support for messages, APIs for message queues, client/server example. Semaphores-Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

UNIT-V	SHARED MEMORY AND SOCKETS	Classes: 09

Shared Memory: Kernel support for shared memory, APIs for shared memory, shared memory example, Sockets: Introduction to Berkeley Sockets, IPC over a network, Client-Server model, Socket address structures (unix domain and Internet domain), Socket system calls for connection oriented protocol and connectionless protocol.

Text Books:

1. T. Chan , "Unix System Programming using C++", PHI, 2nd Edition,2005.
2. Sumitabha Das, "Unix Concepts and Applications", 4th Edition, TMH, 2011.
3. W. R. Stevens , "Unix Network Programming", PHI, 2nd Edition ,1999.

Reference Books:

1. Mathew, R. Stones, Wrox, "Beginning Linux Programming", Wiley India Edition,4th Edition,2008.
2. Graham Glass, King Ables, "Unix for programmers and users", 3rd Edition,Pearson, 2006.
3. Hoover, "SystemProgramming with C and Unix", Pearson, 2nd Edition ,2009.
4. K. A. Robbins, "Unix System Programming, Communication, Concurrency and Threads", Pearson Education, 6th Edition, 2007.

Web References:

1. http://www.fuky.org/abicko/beginning-linux-programming.pdf
2. https://www.pdc.kth.se/about/links/linux-programming-for-beginners
3. http://www.tutorialspoint.com/unix/unix_tutorial.pdf
4. http://www.rpi.edu/dept/arc/training/shell/slides.pdf

E-Text Books:

1. http://onlinevideolecture.com/ebooks/?subject=Linux
2. http://www.onlineprogrammingbooks.com/linux-succinctly/
3. http://ebook-dl.com/item/beginning_linux_programming_4th_edition_neil_matthew_richard_stones/

RESEARCH METHODOLOGY

Open Elective II: AE / (CAD / CAM) / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCS703	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Identify an appropriate research problem in their interesting domain.
II. Organize and conduct research project.
III. Prepare a research project thesis report.
IV. Understand the law of patent and copyrights.
V. Adequate knowledge on process for filing Patent.

UNIT-I	INTRODUCTION	Classes: 09

Definition, types of research, research approaches, research process, validity and reliability in research, features of good design, types of research design, and basic principles of experimental design.

UNIT-II	MEASUREMENT AND SCALING TECHNIQUES	Classes: 09

Errors in measurement, tests of sound measurement, scaling and scale construction techniques, forecasting techniques, time series analysis, interpolation and extrapolation.

UNIT-III	METHODS OF DATA COLLECTION	Classes: 09

Primary data, questionnaire and interviews, collection of secondary data, cases and schedules.

Professional attitude and goals, concept of excellence, ethics in science and engineering, some famous frauds in science, case studies.

UNIT-IV	INTERPRETATION OF DATA AND REPORT WRITING	Classes: 09

Layout of a research paper, techniques of interpretation, making scientific presentation at conferences and popular lectures to semi technical audience, participating in public debates on scientific issues.

UNIT-V	INTRODUCTION TO INTELLECTUAL PROPERTY	Classes: 09

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights; Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law; Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Text Books:

1. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publishers, 2nd Edition, 2004.
2. P. Gupta, "Statistical Methods", Sultan Chand and Sons, New Delhi, 1st Edition, 2005.
3. Richard W. Stim, "Intellectual Property: Patents, Trademarks, and Copyrights", Cengage learning, 2nd Edition, 2001.

Reference Books:

1. P. Narayana Reddy, G. V. R. K. Acharyulu, "Research Methodology and Statistical Tools", Excel Books, New Delhi, 1st Edition, 2008.
2. Prabuddha Ganguli, "Intellectual Property Right, Unleashing the Knowledge Economy", Tata Mc Graw Hill Publishing Company Ltd, 1st Edition, 2001.

Web References:

1. http://nptel.ac.in/courses/109103024/40
2. http://study.com/academy/topic/introduction-to-research-methods.html
3. https://www.vutube.edu.pk/vu-lectures/viewcategory/240/research-methods-sta630

E-Text Books:

1. http://www.metastudio.org/Science%20and%20Ethics/file/readDoc/535a76367d9d331598f49e2d/34_Hb_on_IPR.pdf
2. http://www.bits-pilani.ac.in/uploads/Patent_ManualOct_25th_07.pdf
3. http://euacademic.org/BookUpload/9.pdf

INDUSTRIAL AERODYNAMICS AND WIND ENERGY

Open Elective II : (CAD/CAM) / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BAE702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand the atmospheric boundary layer and conditions.
II. Describe the wind energy and its application in turbines.
III. Familiarize with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

UNIT-I	ATMOSPHERIC WINDS AND ATMOSPHERIC BOUNDARY LAYER	Classes: 08

Causes of wind thermal drive, Coriolis effect, pressure gradient effect, Geotropic winds; Land and sea breeze, mountain winds, thermals, cause of turbulence at ground level; Atmospheric boundary layer, velocity profile laws, effects of terrain on atmospheric boundary Layer; Wind tunnels basic features and components; Wind tunnel models, role of non-dimensional groups; Creation of atmospheric boundary layer type flow in a wind tunnel.

UNIT-II	WIND ENERGY	Classes: 10

Ship propulsion, sails, lift and drag translators, modern yachts; Horizontal and vertical axis wind turbines: History, first example of automatic feedback control for yaw in 16^{th} century English windmills, classification. Horizontal axis wind turbine: Elementary actuator disc theory, Betz coefficient; Definition of power coefficient and torque coefficient for all wind turbines; Working principle, power coefficients, tip speed ratio explanation, by introductory blade element theory, conventional horizontal axis wind turbine, savonious vertical axis wind turbine, Darries vertical axis wind turbine, merits and demerits of horizontal axis wind turbines and vertical axis wind turbines.

UNIT-III	VEHICLE AERODYNAMICS	Classes: 10

Relative importance of rolling resistance and aerodynamics resistance, power requirements and drag coefficients of automobiles, notch front and notch rear wind screens versus streamlined shape, causes of vortex formation and drag, attached transverse vortex , trailing vortex, trailing vortex drag, effect of floor height on lift, effects of cut bank angle; Rear end taper.

Side panels and bottom, effects of chamfering of edges and cambering of roof and side panels; Racing cars: Traction and steering strip and use of aerofoils, high cornering seed; Commercial transport vehicles: Drag reduction on buses and tucks, driver cabin and trailer combinations.

UNIT-IV	BUILDING AERODYNAMICS	Classes: 09

Use of light weight components in modern buildings, pressure distribution on low-rise buildings, wind forces on buildings-aerodynamics of flat plate and circular cylinder , critical Reynold's no, sub -, super- & ultra critical Reynold's No. Role of wind tunnel requirements in determining shape factors (Drag coefficients) of building/structure shapes such as circular cylinder (chimneys & towers), rectangle, I-shape, L-shape, H-shape etc. vortex shedding & transverse oscillating loads. Slenderness ratio & correction factor. Special problems of tall buildings, interference effect of building.

UNIT-V	FLOW INDUCED VIBATIONS	Classes: 08

Classification: Vortex induced vibration and flow induced instability such as galloping and stall flutter; Effects of Reynolds number on wake formation of bluff shapes; Vortex induced vibration: Experimental determination of strouhal numbers for different shapes such as circular cylinder, square, rectangle, L-shape ect, universal strouhal number, unsteady Bernoulli equation, concept of added mass, resonance; Fluid-structure interaction: Effect of transverse cylinder motion on flow and wake, lock-in vortex shedding near resonant frequency, experimental evidence of cylindrical motion influencing flow and thereby reducing strength of shed vortices; Methods of suppression of vortex induced vibration; Galloping & Stall flutter: Motion of one degree-of-freedom, quasi steady flow assumption, aerodynamic damping; Galloping: Force in the direction of plunging (transverse motion) and positive force coefficient, critical speed, galloping of transmission wire with winter ice, stall flutter of airfoils.

Text Books :

1. Siraj Ahmed, "Wind Energy theory and practice", PHI learning Pvt Ltd., 3rd Edition, 2015.
2. R. D. Blevins, "Flow Induced Vibrations", Van Nostard, 2nd Edition, 1990.
3. P. Sachs, "Wind Forces in Engineering", Pergamon press, 2nd Edition, 1988.
4. N. G. Calvert, "Wind Power Principles", Charles Griffin & co. London, 1st Edition, 1979.

Reference Books:

1. R. S. Scorer, "Environmental Aerodynamics", Ellis Harword Ltd, England, 1st Edition, 1978.
2. M. Sorvan, "Aerodynamics Drag Mechanisms of Bluff Bodies and Road vehicles", plenum press, 2nd Edition, 1978.

Web References:

1. http://www.mech.canterbury.ac.nz/research/fluid%20mechanics.shtml
2. http://www.journals.elsevier.com/journal-of-wind-engineering-and-industrial-aerodynamics

E-Text Books:

1. http://www.sciencedirect.com/science/journal/01676105
2. https://www.scribd.com/doc/42602999/Flow-Induced-Vibration-by-Robert-D-Blevins-2nd-Ed
3. http://store.elsevier.com/Wind-Forces-in-Engineering/Peter-Sachs/isbn-9781483148359/

VISION AND MISSION OF THE INSTITUTE

Vision

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

Mission

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

M.Tech - Program Outcomes (PO's)

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**).

PO-2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).**

PO-3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).**

PO-4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).**

PO-5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations **(Modern Tool Usage).**

PO-6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).**

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).**

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).**

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).**

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).**

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(Life-long learning).**

OBJECTIVES OF DEPARTMENT

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Programme Educational Objectives (PEO's)

A graduate of the Electrical and Electronics Engineering Program should:

PEO – I: To experience success in electrical and electronics engineering areas or other diverse fields that requires analytical and professional skills.

PEO – II: To stimulate students to contribute to their fields or professions and to excel them in professional ethics and leadership qualities.

PEO – III: To inculcate in students, professional attitude, effective communication skills and capability to succeed in multi-disciplinary and diverse fields.

PEO – IV: To promote students to continue to pursue professional development, including continuing or advanced education relevant to their career growth and to create enthusiasm for life-long learning.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO – I: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based teamwork.

PSO – II: Can explore the scientific theories, ideas, methodologies and the new cutting edge Technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems universally.

PSO – III: The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. Who grants Autonomy? UGC, Govt., AICTE or University

In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its ownpowersto grant autonomy directly to Govt. and Govt. aided Colleges.

2 Shall IARE award its own Degrees?

No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3 What is the difference between a Deemed University and an Autonomy College?

A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4 How will the Foreign Universities or other stake – holders know that we are an Autonomous College?

Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5 What is the change of Status for Students and Teachers if we become Autonomous?

An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6 Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?

There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Programme Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7 Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?

No. IARE has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8 Can IARE have its own Convocation?

No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9 Can IARE give a provisional degree certificate?

Since the examinations are conducted by IARE and the results are also declared by IARE, the college sends a list of successful candidates with their final Grades and Grade Point Averages including

CGPA to the University. Therefore with the prior permission of the University the college will be entitled to give the provisional certificate.

10 Will Academic Autonomy make a positive impact on the Placements or Employability?

Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11 What is the proportion of Internal and External Assessment as an Autonomous College?

Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12 Is it possible to have complete Internal Assessment for Theory or Practicals?

Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13 Why Credit based Grade System?

The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14 What exactly is a Credit based Grade System?

The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15 What are the norms for the number of Credits per Semester and total number of Credits for UG/PG programme?

These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16 What is a Semester Grade Point Average(SGPA)?

The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th}course and $G_i$is the grade point scored by the student in the i^{th} course and I represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17 What is a Cumulative Grade Point Average (CGPA)?

An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{n} (C_i S_i) / \sum_{j=1}^{n} C_i$$

Where, S_i is the SGPA of the i^{th} semester and $C_i$is the total number of credits in that semester and *j*represent the number of courses in which a student's is registered upto the semester. CGPA is rounded to two decimal places.

18 Is there any Software available for calculating Grade point averages and converting the same into Grades?

Yes, The institute has its own MIS software for calculation of SGPA, CGPA,etc.

19 Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?

No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20 Will there be any Revaluation or Re-Examination System?

No. There will double valuation of answer scripts. There will be a make-up Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21 How fast Syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

22 Will the Degree be awarded on the basis of only final year performance?

No. The CGPA will reflect the average performance of all the semester taken together.

23 What are Statutory Academic Bodies?

Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in every body is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24 Who takes Decisions on Academic matters?

The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Board of Studies level are to be ratified at the Academic Council and Governing Body.

25 What is the role of Examination committee?

The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations spot valuations, tabulations preparation of Grade Cards etc fall within the duties of the Examination Committee.

26 Is there any mechanism for Grievance Redressal?

The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27 How many attempts are permitted for obtaining a Degree?

All such matters are defined in Rules & Regulation

28 Who declares the result?

The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29 Who will keep the Student Academic Records, University or IARE?

It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30 What is our relationship with the JNT University?

We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31 Shall we require University approval if we want to start any New Courses?

Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32 Shall we get autonomy for PG and Doctoral Program also?

Yes, Presently our PG program also enjoying autonomous status.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	**Nature of Malpractices/Improper conduct**	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Controller of Examinations.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the COE 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 COE 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 Institute premises or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already

		appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

UNDERTAKING BY STUDENT/PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr./Ms. ---------- joining I Semester for the academic year 2016-2017 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/practical/drawing) and secure attendance of not less than 80% in every course as stipulated by Institute. I am fully aware that an attendance of less than 70% in more than three courses will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus/Hostel/Residence and attend all the tests to secure more than the minimum prescribed Class/Sessional Marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
8. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
9. If I absent myself continuously for 3 days, my parents will have to meet the HOD concerned/ Principal.
10. I hereby acknowledge that I have received a copy of IARE - R16 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number