B.Tech. FOUR YEAR DEGREE COURSE

ELECTRICAL & ELECTRONICS ENGINEERING

R20 Regulations

(Applicable for the batches admitted from 2020-2021)

VISHNU
UNIVERSAL LEARNING

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN :: BHIMAVARAM
(Autonomous)
Approved by AICTE & Affiliated to JNTUK, Kakinada
Accredited with 'A' Grade by NAAC & NBA
Vishnupur, Bhimavaram, West Godavari Dist., Andhra Pradesh, India. PIN - 534202

Email: info@svecw.edu.in, Website: www.svecw.edu.in

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN :: BHIMAVARAM
(Autonomous)

Vision

Transform the society through excellence in Education, Community empowerment and sustained Environmental protection.

Mission

- To achieve Academic excellence through innovative learning practices
- To instill self confidence among rural students by supplementing with co-curricular and extra-curricular activities
- To inculcate discipline and values among students
- To establish centers for Institute Industry partnership
- To extend financial assistance for the economically weaker sections
- To create self-employment opportunities and skill up gradation
- To support environment friendly Green Practices
- Creating innovation hubs

SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN:: BHIMAVARAM
(AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

"To establish a knowledge hub in the field of Electrical & Electronics Engineering to meet the needs of the society"

MISSION

- To produce quality Electrical and Electronics Engineers
- To inculcate discipline and ethical values among the students
- To empower students to succeed in higher education and research

ACADEMIC REGULATIONS

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(Applicable for the batches admitted from 2020-2021)

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THE DEGREE OF BACHELOR OF TECHNOLOGY – REGULAR/HONORS/MINOR
(With effect from 2020-21)

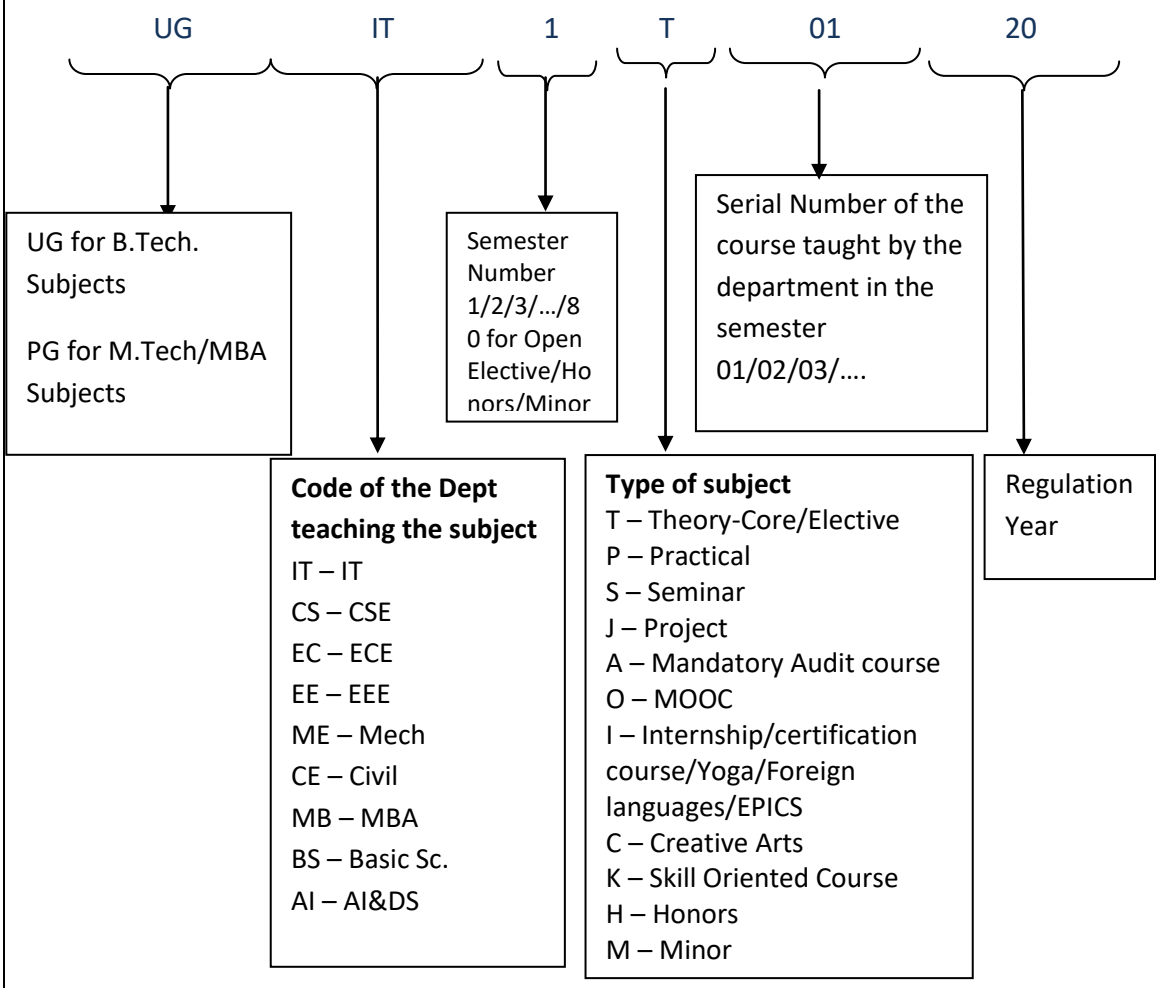
RB 0.0	**TITLE AND DURATION OF THE PROGRAM**
	The program shall be called the degree course in Bachelor of Technology, abbreviated as B.Tech.
	The program shall be of four academic years duration divided into eight semesters, each semester having duration of minimum 16 weeks.
	The calendar of events in respect of the program shall be fixed by the Institute from time to time.
	The external examination in all the subjects shall be conducted at the end of each semester for all the eight semesters.
	Students joining the B.Tech. programme shall have to complete the programme in a stipulated time frame of 8 years from the date of joining and students joining the B.Tech. Programme in the third semester directly through Lateral Entry Scheme (LES) shall have to complete the programme in a stipulated time frame of 6 years from the date of joining otherwise; they shall forfeit their seat in B.Tech. Programme and their admission shall stand cancelled. One year extension shall be given to the students who availed the GAP year facility.
	When a student is detained for lack of credits / shortage of attendance, she may be re-admitted into the same semester / year in which she has been detained. However, the academic regulations under which she was first admitted shall continue to be applicable to her.
RB 1.0	**ELIGIBILITY FOR ADMISSION**
RB 1.1	Admissions are done as per the norms prescribed by Government. The Government orders issued from time to time in this regard shall prevail.
RB 1.2	The Candidate shall be an Indian National.
RB 1.3	The Candidate should have passed the qualifying examination, Intermediate or equivalent on the date of admission.
RB 1.4	Seats in each programme in the college are classified into CATEGORY-A (70% of intake) and CATEGORY – B (30% of intake) besides lateral entry.
RB 1.5	Category 'A' Seats shall be filled by the Convener, EAMCET Admissions. Category 'B' Seats shall be filled by the College as per the guidelines of Andhra Pradesh State Council of Higher Education. 'Lateral Entry' candidates (10% of the intake) shall be admitted into the Third semester directly based on the rank secured by the candidate in Engineering Common Entrance Test (ECET) in accordance with the instructions received from the Convener, ECET and Government of Andhra Pradesh.
RB 2.0	**AWARD OF B.TECH. DEGREE**
RB 2.1	A Student shall be declared eligible for the award of the B.Tech. Degree, if she pursues a course of study in not less than four and not more than eight academic years (plus maximum of 1 year of GAP year). A Student admitted into III semester shall be declared eligible for the award of the B.Tech. degree, if she pursues a course of study in not less than three and not more than six academic years (plus maximum of 1 year of GAP year).
RB 2.2	Each discipline of the B.Tech. programme is designed to have a total of 160 credits and the

	student shall have to complete the courses and earn all credits as per the requirements for award of the degree. Students joining the B.Tech. programme in the third semester directly through Lateral Entry Scheme (LES) shall have to complete the courses, excluding first year courses and earn 121 credits as per the requirements for award of the degree.
RB 2.3	The B.Tech. Degree shall be conferred on a candidate who has satisfied the following requirements. A Regular student (four-year programme) should register herself for 160 credits. To become eligible for the award of B.Tech. Degree, the student must obtain all 160 credits. A Lateral Entry student should register herself for 121 credits and should obtain all the credits. However, it is mandatory for the students to complete the noncredit courses
RB 2.4	A student shall be eligible for the award of B.Tech degree with Honors or Minor if she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.
RB 3.0	**MINIMUM INSTRUCTION DAYS**
RB 3.1	The minimum instruction days for each semester shall be 90 working days.
RB 4.0	**COURSES OF STUDY**
RB 4.1	Branch Code - Branch Abbreviation 01-CE (Civil Engineering) 02-EEE (Electrical and Electronics Engineering) 03-ME (Mechanical Engineering) 04-ECE (Electronics and Communication Engineering) 05-CSE (Computer Science & Engineering) 12-IT (Information Technology) 54-AI&DS (Artificial Intelligence & Data Science) 61-AI&ML (Artificial Intelligence & Machine Learning)
RB 4.2	Groups of Courses: The Courses in the B.Tech. Programme are grouped as Core, Professional Elective, Open Elective, Skill oriented course, Mandatory Audit Course and Arts. Core Course: These are courses which are to be compulsorily studied by a student and it is the core requirement to complete the programme in a said branch. Professional Elective Course: A student can choose a course (subject) from a pool of courses of branch concerned, which add proficiency to the students. Open Elective Course: These are the courses offered by other branches. These courses are designed to lead to knowledge enhancement in multi-disciplinary domains. Skill Oriented Courses: These courses will be designed by keeping the interest of the students and requirement of specific industry or student interest. Mandatory Audit Course: These courses allow a student to attend classes without the benefit of a grade for a course. An undergraduate student who audits a course does so, for the purpose of self-enrichment and academic exploration.
RB 5.0	**DISTRIBUTION AND WEIGHTAGE OF MARKS**
RB 5.1	The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 75 marks for practical subject. The main project work shall be evaluated for 200 marks, Summer Internship/Skill oriented courses/Seminar shall be evaluated for 50 marks.
RB 5.2	For theory subjects, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End Examinations.
RB 5.3	Internal evaluation 30 marks shall be awarded as follows: 20 marks for MID Exam (15 marks for Descriptive and 5 marks for Quiz) and 10 marks for Course Activity like Technical quiz, Capstone project, Case studies, Short talk, etc. The

	Descriptive examination is for 90 minutes duration conducted for 30 marks. Each descriptive examination question paper consists of 3 questions (either – or type) from 3 units. Three questions are to be answered, one from each unit. The descriptive examination conducted for 30 Marks is to be brought down to total marks of 15. The quiz examination is for 10 minutes duration (conducted with 10 multiple choice questions with a weightage of ½ Mark each). After every 3 Units, one Course activity shall be conducted. Course Activity shall be evaluated by the Departmental Committee consisting of Head of the Department and Course Coordinator. For theory subjects, during the semester there shall be 2 MID Examinations. As the syllabus is framed for 6 units, the First MID examination (both descriptive and quiz) is conducted from first three units and Second MID examination(both descriptive and quiz) is conducted from last three units of each subject. Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam. Example: Mid-1 marks = Marks secured in(Descriptive examination-1 + Quiz examination-1 + Course Activity-1) Mid-2 marks = Marks secured in(Descriptive examination-2 + Quiz examination-2 + Course Activity-2) Final Internal Marks =Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2 If a student is absent for any one MID examination, she can appear for a Grand Test after MID-2. The Grand Test will be conducted with questions covering the entire syllabus. The marks in the grand test is reduced to 20 marks and to be considered for respective MID.
RB 5.4	The end semester examination is conducted for 70 marks by covering the topics of all units. Part-A contains mandatory short answer questions, 6 questions for total 10 marks covering all the units. Part-B contains 12 questions (two from each unit with either – or choice) of 10 marks each. 1 question has to be answered from each unit (6 x 10 = 60 marks).
RB 5.5	For practical subjects, there shall be continuous evaluation during the semester for 25 internal marks. Out of the 25 marks for internal, day-to-day work 10 marks, Record 5 marks and 10 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted for 50 marks by the internal examiner and external examiner.
RB 5.6	For the subject having design and/or drawing (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (10 marks for day–to–day work, and 20 marks for MID tests) and 70 marks for end examination. Mid marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam.
RB 5.7	For the seminar, the student shall collect the information on a specialized topic and prepare a technical report showing her understanding over the topic, and submit to the department, which shall be evaluated by the Departmental Committee consisting of Head of the Department, seminar supervisor and senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.
RB 5.8	Out of a total of 200 marks for the main project work, 100 marks shall be for Internal Evaluation and 100 marks for the End Semester Examination. The End Semester Examination (Viva – Voce) shall be conducted by the Committee. The Committee consists of an external examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the Eighth semester. The Internal Evaluation marks shall be on the basis of Two seminars given by each student on the topic of her project and evaluated by an Internal Committee, consisting of Head of the department, supervisor of the project and a senior faculty member.

<table>
<tr><td>RB 5.9</td><td>For Internship(2 Months Mandatory during summer vacation), 50 marks shall be for Internal Evaluation. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship.
The student shall submit the report to the department after completion of her Internship. A certificate from industry/skill development center shall be included in the report. Viva-Voce shall be conducted by the Departmental Committee consisting of Head of the Department, supervisor of the internship and a senior faculty member of the department. The Viva–Voce may be conducted along with respective semester lab external examinations. The report and the Viva-Voce shall carry 40% and 60% weightages respectively. There shall be no external examination for Internships.</td></tr>
<tr><td>RB 5.10</td><td>Laboratory marks and the internal marks awarded by the department are not final. The marks are subjected to be scrutinized and scaled by the Institute wherever it felt desirable. The internal and laboratory marks awarded by the department shall be referred to a Committee if required. The Committee shall arrive at a scaling factor and the marks shall be scaled as per the scaling factor. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved for two years after the final examinations of that semester in the respective departments as per the norms of the Institute and shall be produced to the Committees as and when they ask for.</td></tr>
<tr><td rowspan="10">RB 6.0</td><td colspan="2">PROGRAMME STRUCTURE</td></tr>
<tr><td>Basic Science Courses</td><td>18 to 21 credits</td></tr>
<tr><td>Engineering Science Courses</td><td>20 to 24 credits</td></tr>
<tr><td>Humanities and Social Science including Management Courses</td><td>10 to 11 credits</td></tr>
<tr><td>Professional Core Courses</td><td>50 to 54 credits</td></tr>
<tr><td>Professional Elective Courses</td><td>13 to 16 credits</td></tr>
<tr><td>Project/ Internships / Certification Courses/ Seminar</td><td>15 to 18 credits</td></tr>
<tr><td>Open Elective or Job Oriented Elective Courses</td><td>10 to 14 credits</td></tr>
<tr><td>Skill Oriented Courses</td><td>10 Credits</td></tr>
<tr><td>Mandatory Audit Courses – courses without credits</td><td>-</td></tr>
<tr><td>RB 7.0</td><td colspan="2">SCHEME OF INSTRUCTION FOR I, II, III AND IV YEARS</td></tr>
<tr><td>RB 7.1</td><td colspan="2">The Schemes of Instruction and syllabi of all B.Tech. programmes are given separately, which are approved by the BOS concerned and the Academic Council.</td></tr>
<tr><td>RB 8.0</td><td colspan="2">CONTACT HOURS AND CREDITS</td></tr>
<tr><td>RB 8.1</td><td colspan="2">One hour of Lecture/Tutorial is equivalent to 1 credit and one hour of practical work/field work is equivalent to 0.5 credit.</td></tr>
<tr><td>RB 8.2</td><td colspan="2">THEORY / TUTORIAL CLASSES
Each course is prescribed with fixed number of lecture periods per week. During lecture periods, the course instructor shall deal with the concepts of the course. For certain courses, tutorial periods are prescribed to give exercises to the students and to closely monitor their learning abilities and achievements.</td></tr>
<tr><td>RB 8.3</td><td colspan="2">LABORATORY / DRAWING COURSES
A minimum prescribed number of experiments/drawings/jobs/programmes have to be performed by students, who shall complete these in all aspects and get each experiment evaluated by teacher concerned and certified by the Head of the Department concerned at the end of the semester.</td></tr>
<tr><td>RB 9.0</td><td colspan="2">MEDIUM OF INSTRUCTION</td></tr>
<tr><td>RB 9.1</td><td colspan="2">The Medium of Instruction and examination is in English.</td></tr>
<tr><td>RB 10</td><td colspan="2">ATTENDANCE REQUIREMENTS</td></tr>
</table>

RB 10.1	In each semester the candidate has to put in a minimum attendance of 75% with a provision of condonation of 10% of the attendance by the Principal on the specific recommendation of the HOD, showing some reasonable cause such as medical grounds, participation in University level sports, cultural activities, seminars, workshops, paper presentation etc. A student is eligible to write the University examinations if she acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.
RB 10.2	Shortage of attendance below 65% in aggregate shall not be condoned.
RB 10.3	A stipulated fee of Rs. 500/- in the concerned semester shall be payable towards condonation of shortage of attendance. Students availing condonation on medical ground shall produce a medical certificate issued by the competitive authority.
RB 10.4	Students whose shortage of attendance is not condoned will be detained and the student has to re-register for that semester when it is offered by the department.
RB 10.5	Rules for calculation of attendance for the re-admitted candidates who were detained for want of attendance or who had break – in study for various reasons: a) No. of classes conducted shall be counted from the day one of the semester concerned, irrespective of the date of payment of tuition fee. b) They should submit a written request to the Principal, along with a challan paid towards tuition and other fee, for re-admission before the commencement of class-work. c) Student should come to know about the date of commencement of class-work of the semester into which she wishes to get re-admission. The information regarding date of commencement of class-work for each semester is available in the college notice boards/ website.
RB 11.0	**CONDITIONS FOR PASS AND AWARD OF CREDITS FOR A COURSE**
RB 11.1	A candidate shall be declared to have passed in individual theory/drawing course if she secures a minimum of 40% aggregate marks (40 marks out of 100, Internal and semester end examination marks put together), subject to a minimum of 35% marks (24 marks out of 70) in semester end examination. For successful completion of mandatory audit course the student must get a satisfactory(pass) grade from the department offering the course. If fails, she has to reappear whenever the course is offered.
RB 11.2	A candidate shall be declared to have passed in individual lab/project/seminar/ Internship/ Skill oriented course if she secures a minimum of 40% aggregate marks (Internal and semester end examination marks put together), subject to minimum of 35% marks in semester end examination.
RB 11.3	The student must pass the failed course by appearing the supplementary examination as per the requirement for the award of degree.
RB 11.4	On passing a course of a programme, the student shall earn assigned credits in that course.
RB 12.0	**TRANSITORY REGULATIONS**
RB 12.1	A candidate, who is detained or discontinued in the semester, on readmission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which she joins subsequently. However, exemption shall be given to those candidates who have already passed in such courses in the earlier semester(s) and substitute subject may be offered as approved by College Academic Committee and ratified by Academic Council.
RB 12.2	A student shall be eligible for promotion to next semester of B.Tech. programme, if she satisfies the conditions as stipulated in Regulation RB10.
RB 12.3	Further, a student shall be eligible for promotion to V / VII Semesters of B.Tech. programme, if she acquires the minimum number of credits as given below: A student shall be promoted from Semester - IV to Semester - V or from Semester - VI to Semester - VII only if she fulfills the academic requirements of 40% of the credits from the exams for which results are declared.

	For Lateral Entry Student: A student shall be promoted from Semester - VI to Semester - VII only if she fulfills the academic requirements of 40% credits from the exams for which results are declared.
RB 13.0	**COURSE CODE AND COURSE NUMBERING SCHEME:** The subject codes shall be given by the Department teaching the subject. Each subject code contains 10 characters. The 10 Characters for each subject shall be coded as per the following guidelines.
RB 13.1	
RB 13.2	While giving the subject codes the Departments can follow the below steps. i. Collect the requirements from various Departments.(subjects which they have to teach for other Departments) ii. Prepare a list of all the subjects the Departments have to teach in that semester (for their Department as well as other Departments based on the requirements, they have collected in point i.) iii. Give subject codes to all these subjects following the guidelines given. iv. Communicate these subject codes(identified in point i) to various Departments. v. Use the subject codes identified in point iii to the subjects in their course structure.
RB 14.0	**CONSOLIDATED GRADE CARD**
RB 14.1	A consolidated grade card containing credits and grades obtained by the candidate shall be issued after completion of the four years B.Tech. Programme.
RB 15.0	**METHOD OF AWARDING LETTER GRADES AND GRADE POINTS FOR A COURSE**
RB 15.1	A letter grade and grade point shall be awarded to the student in each course based on her performance as per the grading system given below.

	Percentage of Marks Range	Level	Letter Grade	Grade Point
	≥ 90	Outstanding	A+	10
	80-89	Excellent	A	9
	70-79	Very Good	B	8
	60-69	Good	C	7
	50-59	Fair	D	6
	40-49	Satisfactory	E	5
	< 40	Fail	F	0
	-	Absent	AB	0

RB 15.2	**Calculation of Semester Grade Points Average(SGPA) for semester:** The Performance of each student at the end of each semester is indicated in terms of SGPA. The SGPA is calculated as below: The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e. $SGPA = \Sigma (C_i \times G_i) / \Sigma C_i$ where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course
RB 15.3	**Calculation of Cumulative Grade Points Average (CGPA) :** The CGPA is calculated as below: The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e. $CGPA = \Sigma (C_i \times S_i) / \Sigma C_i$ where 'S_i' is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester. Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. While computing the SGPA/CGPA, the subjects in which the student is awarded Zero grade points will also be included. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters A+, A, B, C, D, E and F.
RB 15.4	As per AICTE regulations, conversion of CGPA into equivalent percentage is as follows: **Equivalent Percentage = (CGPA – 0.75) x 10**
RB 16.0	**REVALUATION** As per the notification issued by the Controller of Examination, the student can submit the application for revaluation, along with the fee receipt for revaluation of her answer script(s) of theory course(s), if she is not satisfied with the Grade obtained. The Controller of Examination shall arrange for revaluation of those answer script(s).
RB 16.1	For Revaluation a new external examiner, other than the first examiner, shall re-evaluate the answer script(s). If there is any change in marks (below 15% of the maximum External marks) the highest of the two marks will be considered and if there is any change in marks (Equal or above 15% of the maximum External marks), the script will be evaluated by the third valuator. The marks of all the three valuators are compared and the average of two nearer marks will be awarded to the student.
RB 17.0	**SUPPLEMENTARY EXAMINATIONS** Supplementary examinations shall be conducted twice in an academic year, along with regular semester end examinations.
RB 18.0	**READMISSION CRITERIA** A candidate, who is detained in a semester due to lack of attendance/ credits, has to

	obtain written permission from the Principal for readmission in the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of Rs.1,000/-
RB 19.0	**BREAK IN STUDY** Student, who discontinues her studies for whatsoever may be the reason, can get readmission into appropriate semester of B.Tech. programme after break-in study only with the prior permission of the Principal of the College provided, such candidate shall follow the transitory regulations applicable to such batch in which she joins. An administrative fee of Rs.1000/- per year of break in study in addition to the prescribed tuition fee and special fee has to be paid by the candidate to condone her break in study if this break in study is not covered under GAP year facility.
RB 20.0	**AWARD OF DIVISION**
RB 20.1	After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. degree, she shall be placed in one of the following:

CGPA secured from 160 credits (121 credits for Lateral Entry Students)	**Class Awarded**
≥ 7.75	First Class with Distinction
≥ 6.75 to < 7.75	First Class
≥ 5.75 to < 6.75	Second Class
≥ 5.0 to < 5.75	Pass Class

RB 21.0	**BETTERMENT / IMPROVEMENT OF CUMULATIVE GRADE POINT AVERAGE**
RB 21.1	A candidate, after becoming eligible for the award of the Degree, may reappear for the external Examination in any of the theory courses as and when conducted, for the purpose of improving the CGPA. But this reappearance shall be within a period of two academic years after becoming eligible for the award of the Degree, subject to fulfillment of Regulation RB 2.0.
RB 21.2	However, this facility shall not be availed by a candidate to reappear either for Internal Examination or for Semester End Examinations in Practical courses (including Project Viva-Voce) and also for Semester End Examinations evaluated internally for the purpose of improvement.
RB 21.3	Modified Grade Card and New Consolidated Grade Card shall be issued after incorporating new Grades and Credits.
RB 22.0	**ADVANCED SUPPLEMENTARY EXAMINATIONS** Candidate(s), who fails in Theory or Lab courses of 4th year second semester, can appear for advanced supplementary examinations conducted within one month after declaration of the revaluation results. However, those candidates who fail in this advanced supplementary examination of IV year second semester shall appear for subsequent examination along with regular candidates conducted at the end of the respective academic year.
RB 23.0	**MALPRACTICES** The Principal/chief superintendent shall refer the cases of malpractices in internal assessment tests and Semester End Examinations to a Malpractice Enquiry Committee, constituted by him/her for the purpose. The Principal shall take necessary action, against the erring students based on the recommendations of the Committee as per JNTUK Malpractice regulations.
RB 24.0	The physically challenged candidates who have availed additional examination time and a scribe during their Intermediate/EAMCET examinations shall be given similar concessions on production of relevant proof/documents.
RB 25.0	The students who are suffering from contagious diseases are not allowed to appear either internal or Semester end examinations with other students. A separate room will be allotted

	for such type of students.
RB 26.0	The students who participate in coaching/tournaments held at State/National/International levels through University / Indian Olympic Association during Semester end external examination period shall be promoted to subsequent semesters till the entire course is completed as per the guidelines of University Grants Commission Letter No. F. 1-5/88 (SPE/PES), dated 18-08-1994.
RB 27.0	The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of Regulation, approved in the Heads of the Departments meetings, shall be reported to the Academic Council for ratification.
RB 28.0	The Academic Council, from time to time, may revise or amend or change the Regulations, schemes of examination and/or syllabi.
RB 29.0	**GAP YEAR:** Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship can take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at College level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.
RB 30.0	As per the demand of the industry, a specific elective can be offered in the department with the permission of the Principal and that can be ratified in the college academic committee. Minimum 20% of intake of students is compulsory for offering regular electives.
RB 31.0	All undergraduate students shall register for NCC/NSS activities and Community Service Project as per the Government and University norms. A student will be required to participate in an activity for two hours in a week during second and third semesters. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance and behavior. If a student gets an unsatisfactory Grade, she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.
RB 32.0	Environmental Science, Indian Constitution, etc are offered as mandatory courses for all branches. A student has to secure 40% of the marks allotted in the internal evaluation(conducted for 50 marks) for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses. The students shall maintain the attendance similar to credit courses.
RB 33.0	All Open Electives are offered to students of all branches in general. However, a student shall choose an Open Elective from the list in such a manner that she has not studied the same course in any form during the Programme.
RB 34.0	A student shall be permitted to pursue upto a maximum of two elective courses under MOOCs during the Programme. Each of the courses must be of minimum 12 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to pursue and acquire a certificate for a MOOC course only from the organizations/agencies(like SWAYAM/NPTEL) approved by the BOS in order to earn the 3 credits. The Head of the department shall notify the list of such courses at the beginning of the semester. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL/etc portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL/etc. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the

	exam. The student shall be awarded the credits given in curriculum only by submission of the certificate. In case, if student does not pass subjects registered through SWAYAM/NPTEL/etc, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL/etc in the next semester with the recommendation of HOD.
RB 35.0	Students shall undergo mandatory summer internships for a minimum of six weeks duration at the end of second and third year of the Programme. There shall also be mandatory full internship in the final semester of the Programme along with the project work. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme.
RB 36.0	There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain courses and the remaining one shall be a soft skills course. Skill oriented courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the skills learned. If the student completes skill oriented course at an external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (Record/Report: 15 marks and Viva-Voce: 35 marks) along with laboratory end examinations. Viva-Voce shall be conducted by the Departmental Committee consisting of Head of the Department and senior faculty member. There shall be no external examination for Skill oriented courses.
RB 37.0	Undergraduate Degree with Honors/Minor shall be issued by the University to the students who fulfill all the academic eligibility requirements for the B.Tech program and Honors/Minor program. The objective is to provide additional learning opportunities to academically motivated students.
RB 38.0	**Curricular Framework for Skill Oriented Courses**
RB 38.1	For skill oriented/skill advanced course, one theory and 2 practical hours or two theory hours may be allotted as per the decision of concerned BOS.
RB 38.2	Out of the five skill courses two shall be skill-oriented courses from the same domain and shall be completed in second year. Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or Job oriented skill courses, which can be of inter disciplinary nature.
RB 38.3	A pool of interdisciplinary job-oriented skill courses shall be designed by a common Board of studies by the participating departments/disciplines and the syllabus along with the pre requisites shall be prepared for each of the laboratory infrastructure requirements. The list of such courses shall be included in the curriculum structure of each branch of Engineering, so as to enable the student to choose from the list.
RB 38.4	The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies/APSSDC or any other accredited bodies as approved by the concerned BoS.
RB 38.5	The Board of studies of the concerned discipline of Engineering shall review the skill advanced courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest courses based on industrial demand.
RB 38.6	If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency/professional bodies as approved by the Board of studies.
RB 38.7	If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding

	the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the concerned Board of Studies, the student is deemed to have fulfilled the attendance requirement of the course and acquire the credits assigned to the course.
RB 38.8	A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades. The recommended conversions and appropriate grades/marks are to be approved by the College/Academic Council.
RB 39.0	**Curricular Framework for Honors Programme**
RB 39.1	Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.
RB 39.2	A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 SGPA upto the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, her registration for Honors Programme stands cancelled and she shall continue with the regular Programme.
RB 39.3	Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, she will be awarded B.Tech. (Honors) in Mechanical Engineering.
RB 39.4	In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Regular B.Tech Degree (i.e. 160 credits).
RB 39.5	Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.
RB 39.6	It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
RB 39.7	The concerned BOS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BOS.
RB 39.8	Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BOS shall explore the possibility of introducing virtual labs for such courses with lab component.
RB 39.9	MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the College Academic Council.
RB 39.10	The concerned BOS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.
RB 39.11	If a student drops or is terminated from the Honors program, the additional credits so far

	earned cannot be converted into core or other electives; they will remain extra. These additional courses shall be mentioned in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as per the following: All the courses done under the dropped Honors will be shown in the transcript. None of the courses done under the dropped Honors will be shown in the transcript.
RB 39.12	In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, she will be dropped from the list of students eligible for Degree with Honors and she will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
RB 39.13	Honors must be completed simultaneously with the regular degree program. A student cannot earn Honors after she has already earned bachelor's degree.
RB 40.0	**Curricular Framework for Minor Programme:**
RB 40.1	a)Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, she will get Major degree in Mechanical Engineering with Minor degree in Civil Engineering. b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Science track, IOT track, Machine Learning track etc.
RB 40.2	The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE,CE,ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science(DS), Robotics, Electric vehicles, VLSI etc.
RB 40.3	The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BOS.
RB 40.4	There shall be no limit on the number of programs offered under Minor. The University/Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.
RB 40.5	The concerned BOS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BOS.
RB 40.6	A student shall be permitted to register for Minor program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) upto the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA upto 3rd semester or failed in any of the courses, her registration for Minor program shall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Minor registration active.
RB 40.7	A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
RB 40.8	Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BOS along with prerequisites. It is the responsibility of the student to

	acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that she has not studied in any form during the Programme.
RB 40.9	In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade will be assigned as decided by the university/academic council.
RB 40.10	Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BOS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.
RB 40.11	A committee should be formed at the level of College/ department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BOS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.
RB 40.12	If a student drops (is terminated) from the Minor program, the additional credits so far earned cannot be converted into core or other electives; they will remain extra. These additional courses shall be mentioned in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as per the following: All the courses done under the dropped Minor will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.
RB 40.13	In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, she will be dropped from the list of students eligible for degree with Minor and she will receive regular B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
RB 40.14	Minor must be completed simultaneously with the regular degree program. A student cannot earn the Minor after she has already earned bachelor’s degree.
RB 41.0	Withholding of Results If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

Guidelines for Community Service Project

Introduction

1. Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development.
2. Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
3. Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/

local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objectives

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

1. To sensitize the students to the living conditions of the people who are around them.
2. To help students to realize the stark realities of the society.
3. To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability.
4. To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
5. To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
6. To help students to initiate developmental activities in the community in coordination with public and government authorities.
7. To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

1. Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation.
2. Each class/section should be assigned with a mentor.
3. Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
4. A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
5. The log book has to be countersigned by the concerned mentor/faculty in charge.
6. Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
7. The final evaluation to be reflected in the grade memo of the student.
8. The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
9. Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
10. Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

1. A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
2. The Community Service Project is a twofold one –
    a. First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas.

A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.

b. Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
    - Agriculture
    - Health
    - Marketing and Cooperation
    - Animal Husbandry
    - Horticulture
    - Fisheries
    - Sericulture
    - Revenue and Survey
    - Natural Disaster Management
    - Irrigation
    - Law & Order
    - Excise and Prohibition
    - Mines and Geology
    - Energy
    - Internet
    - Free Electricity
    - Drinking Water

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

Learning Outcomes

1. Positive impact on students' academic learning
2. Improves students' ability to apply what they have learned in "the real world"
3. Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development
4. Improved ability to understand complexity and ambiguity

Personal Outcomes

1. Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
2. Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

1. Reduced stereotypes and greater inter-cultural understanding
2. Improved social responsibility and citizenship skills
3. Greater involvement in community service after graduation

Career Development

1. Connections with professionals and community members for learning and career opportunities
2. Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

1. Stronger relationships with faculty
2. Greater satisfaction with college
3. Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

1. Satisfaction with the quality of student learning
2. New avenues for research and publication via new relationships between faculty and community
3. Providing networking opportunities with engaged faculty in other disciplines or institutions

4. A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

1. Improved institutional commitment
2. Improved student retention
3. Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

1. Satisfaction with student participation
2. Valuable human resources needed to achieve community goals
3. New energy, enthusiasm and perspectives applied to community work
4. Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation

27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilization of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

Complementing the community service project, the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programmes is;

Programmes for School Children

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

Programmes for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Women's Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharat
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programmes on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programmes for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programmes

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programmes in consonance with the Govt. Departments like –
    i. Agriculture
    ii. Health
    iii. Marketing and Cooperation
    iv. Animal Husbandry
    v. Horticulture
    vi. Fisheries
    vii. Sericulture
    viii. Revenue and Survey
    ix. Natural Disaster Management
    x. Irrigation
    xi. Law & Order
    xii. Excise and Prohibition
    xiii. Mines and Geology
    xiv. Energy

Role of Students:

1. Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
2. For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
3. As and when required the College faculty themselves act as Resource Persons.
4. Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
5. And also, with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
6. An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. **Preliminary Survey (One Week)**
    a. A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
    b. A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.)
    c. The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.
2. ***Community Awareness Campaigns (Two Weeks)***
    Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. ***Community Immersion Programme (Four Weeks)***
   Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.
4. ***Community Exit Report (One Week)***
   During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.
   Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

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MALPRACTICES GUIDELINES

Disciplinary Action for Improper Conduct in Examinations

	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 she 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 examination hall in respect of any matter.	Expulsion of all the candidates involved from the examination hall and cancellation of the performance in that subject only. In case of an outsider, he will be handed over to the police and a case will be 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 will be seized and cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate/Person who has impersonated shall be expelled from examination hall. The candidate will also be debarred and forfeits the course. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course of such 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 Chief Superintendent / Asst. Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students, 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 examination 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 will also be 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 will also forfeit his/her course.
9.	If the 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 college shall be expelled 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 will also forfeit the course. 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/intoxicated 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	Reported to the Principal for further action to award suitable punishment.

Malpractices identified by squad or special invigilators

Punishments to the candidates as per the above guidelines.

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SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN:: BHIMAVARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Demonstrate employability skills and leadership qualities to serve the society
PEO2	Achieve personal and professional success with awareness and commitment to their ethical and social responsibilities
PEO3	Improve professional competence through life-long learning including higher education and research

PROGRAM OUTCOMES (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions:** 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
PO4	**Conduct investigations of complex problems:** 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
PO5	**Modern tool usage:** 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
PO6	**The engineer and society:** 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
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	**Communication**: 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.
PO11	**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
PO12	**Life-long learning:** 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

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Ability to enhance living standards of disabled people by designing appropriate products with the help of technology.
PSO2	Competence to explore, analyze and solve problems related to power electronic systems.

MIND MAP

Electrical & Electronics Engineering

Skill Advanced Courses

- Real Time Implementation of Electrical Systems
- Arduino & Raspberry Pi Prog.
- Internet of Things IOT
- Scientific Computing
- Drone Technology
- Control of Robots

Basic Sciences & Humanities

- Engineering Mathematics & Applications to Electrical Engineering
- Applied Physics
- Engineering Chemistry
- English Communication skills

Advanced Topics in Electrical Engineering

- Artificial Intelligence in Electrical Engineering
- Robotics & Control
- Advanced Power Electronics & Electric Drives Drives
- Energy Storage Technologies
- Green Electronics
- Renewable Energy Sources
- Smart Grid
- HVDC & FACTS
- High Voltage Engineering

Engineering Sciences

- Circuits & Measurements
- Electromagneticfields
- Engineering Drawing
- Computations with 'C'. PYTHON & JAVA

Signal Processing

- Signals & Systems
- Micro Processor & Micro Controllers
- Digital Signal Processing
- Sensor Applications & Data Acquisition

Electronics

- Analog Electronic Circuits
- Digital Logic Circuits
- IC Applications

Control Engineering

- Control Theory
- Digital Control Systems
- Control System Design
- Intelligent Control Systems
- PLC & Automation

Electrical Machines

- DC & AC Machines
- Special Machines
- Intelligent Control of Machines
- Electrical Machines fir Electric Vehicles

Power Systems

- Power Generation, Transmission & Distribution
- Power Systems Protection & Control
- Utilization of Electrical Energy
- Power System Reforms
- Energy Conservation & Audit
- Power Quality

Power Electronics

- Power Electronics & Drives
- Applications to Power Systems & Drives
- Simulation tools and Analysis

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I Year – I Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	BS	UGBS1T0220	Mathematics – I	3	-	-	3	30	70	100
2	BS	UGBS1T0420	Engineering Chemistry	3	-	-	3	30	70	100
3	HSS	UGBS1T0120	English – I	3	-	-	3	30	70	100
4	ES	UGME1T0120	Engineering Drawing	1	-	4	3	30	70	100
5	ES	UGCS1T0120	Computational Thinking with 'C'	3	-	-	3	30	70	100
6	HSS LAB	UGBS1P0620	English Communication Skills Lab-I	-	-	3	1.5	25	50	75
7	BS LAB	UGBS1P0820	Engineering Chemistry Lab	-	-	3	1.5	25	50	75
8	ES LAB	UGCS1P0220	Computational Thinking with 'C' Lab	-	-	3	1.5	25	50	75
			Total	13	0	13	19.5	225	500	725

I Year – II Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	BS	UGBS2T0120	Mathematics–II	3	-	-	3	30	70	100
2	BS	UGBS2T0220	Applied Physics	3	-	-	3	30	70	100
3	ES	UGEE2T0220	Electrical Circuit Analysis-I	3	-	-	3	30	70	100
4	ES	UGCS2T0120	Python Programming	3	-	-	3	30	70	100
5	ES	UGEE2T0320	Analog Electronics	2	-	2	3	30	70	100
6	ES LAB	UGCS2P0320	Python Programming Lab	-	-	3	1.5	25	50	75
7	BS LAB	UGBS2P0520	Applied Physics Lab	-	-	3	1.5	25	50	75
8	ES LAB	UGEE2P0420	Electrical Circuits Lab	-	-	3	1.5	25	50	75
9	MC	UGBS2A0920	Environmental Science	2	-	-	-	-	-	-
			Total	16	0	11	19.5	225	500	725

II Year – I Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	BS	UGBS3T0520	Numerical Methods and Complex Variables	3	-	-	3	30	70	100
2	PC	UGEE3T0120	Electrical Circuit Analysis - II	3	-	-	3	30	70	100
3	PC	UGEE3T0220	Analog Integrated Circuits	3	-	-	3	30	70	100
4	PC	UGEE3T0320	Digital Logic Circuits	3	-	-	3	30	70	100
5	PC	UGEE3T0420	Electrical Machines -I	3	-	-	3	30	70	100
6	PC Lab	UGEE3P0520	Electrical Machines – I Lab	-	-	3	1.5	25	50	75
7	PC Lab	UGEE3P0620	Digital Logic Circuits Lab	-	-	3	1.5	25	50	75
8	PC Lab	UGEE3P0720	Analog Circuits Lab	-	-	3	1.5	25	50	75
9	SOC	UGBS3C0120	Arts	1	-	2	2	50	-	50
10	MC	UGBS3A0220	Indian Constitution	2	-	-	-	-	-	-
			Total	18	0	11	21.5	275	500	775

II Year – II Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	ES	UGEE4T0120	Electromagnetic fields	3	-	-	3	30	70	100
2	PC	UGEE4T0220	Electrical Machines -II	3	-	-	3	30	70	100
3	PC	UGEE4T0320	Control Systems	3	-	-	3	30	70	100
4	PC / BS	UGBS4T0320	Probability and Statistics	3	-	-	3	30	70	100
5	HSS	UGBS4T0120	English-II	2	-	2	3	30	70	100
6	ES / PC Interdisciplinary Lab	UGEE4P0420	JAVA Programming Lab	-	-	3	1.5	25	50	75
7	PC Lab	UGEE4P0520	Control Systems Lab	-	-	3	1.5	25	50	75
8	PC Lab	UGEE4P0620	Electrical Machine -II Lab	-	-	3	1.5	25	50	75
9	SOC	UGEE4K0720	Arduino / Raspberry Pi Programming (proj.)	1	-	2	2	50	-	50
			Total	15	0	13	21.5	275	500	775
Honors / Minor Course										
				4	0	0	4			
Internship 2 Months (Mandatory) during Summer Vacation										

III Year – I Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGEE5T0120	Power System Generation & Transmission	3	-	-	3	30	70	100
2	PC	UGEE5T0220	Electrical Measurements and Instrumentation	3	-	-	3	30	70	100
3	PC	UGEE5T0320	Power Electronics & Drives	3	-	-	3	30	70	100
4	OE / JOE-I	UGBS5O0120	Soft Skills (English, Aptitude & Logical Reasoning)	2	-	2	3	30	70	100
5	PE-I	UGEE5T0420	Digital IC Applications	3	-	-	3	30	70	100
		UGEE5T0520	Special Electrical Machines							
		UGEE5T0620	Advanced Control Systems							
		UGEE5T0720	Electrical Systems in Vehicular Applications							
		UGEE5T0820	Signals & Systems							
6	PC Lab	UGEE5P0920	Electrical Measurements and Instrumentation Lab	-	-	3	1.5	25	50	75
7	PC Lab	UGEE5P1020	Power Electronics & **Drives** Lab	-	-	3	1.5	25	50	75
8	SKC	UGEE5K1120	Scientific Computing (lab)	1	-	2	2	50	-	50
9	MC	UGEE5A1220	Professional Ethics	2	-	-	-	-	-	-
10	Internship	UGEE5I1320	Summer Internship after second year	-	-	-	1.5	50	-	50
Total				17	0	10	21.5	300	450	750
Honors / Minor Course										
				4	0	0	4			

III Year – II Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PC	UGEE6T0120	Power System Analysis	3	-	-	3	30	70	100
2	PC	UGEE6T0220	Power System Protection	3	-	-	3	30	70	100
3	PC	UGEE6T0320	Microprocessors & Microcontrollers	3	-	-	3	30	70	100
4	PE-II	UGEE6T0420	Advanced Power Electronics	3	-	-	3	30	70	100
		UGEE6T0520	Digital Control Systems							
		UGEE6T0620	Digital Signal Processing							
		UGEE6T0720	Electrical Distribution Systems							
		UGEE6T0820	VLSI Design							
5	OE / JOC	**Open Elective –II/ Job Oriented Elective-II**		2	-	2	3	30	70	100
6	PC Lab	UGEE6P1020	Dynamics & Control Lab	-	-	3	1.5	25	50	75
7	PC Lab	UGEE6P1120	Microprocessor & Microcontroller Lab	-	-	3	1.5	25	50	75
8	PC Lab	UGEE6P1220	Power Systems Lab	-	-	3	1.5	25	50	75
9	SAC	UGEE6K1320	IoT / Control of Robotics (proj.)	1	-	2	2	50	-	50
10	MC	UGEE6A1420	IPR & Patents	2	-	-	-	-	-	-
Total				17	0	13	21.5	275	500	775
Honors / Minors Course										
				4	0	0	4			
Internship 2 Months (Mandatory) during Summer Vacation										

IV Year – I Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1	PE-III	UGEE7T0120	Power System Operation Control	3	-	-	3	30	70	100
		UGEE7T0220	High Voltage Engineering							
		UGEE7T0320	Advanced Electric Drives							
		UGEE7T0420	Utilization of Electrical Energy							
		UGEE7T0520	Control System Design							
2	PE-IV	UGEE7T0620	Programmable Logic Controllers & Applications	3	-	-	3	30	70	100
		UGEE7T0720	Green Electronics							
		UGEE7T0820	HVDC & FACTS							
		UGEE7T0920	Energy Audit, Conservation & Management							
		UGEE7T1020	Artificial Intelligence in Electrical Engineering							
3	PE-V	UGEE7T1120	Energy Storage Technologies	3	-	-	3	30	70	100
		UGEE7T1220	Robotics & Control							
		UGEE7T1320	Power Quality							
		UGEE7T1420	Smart Grid							
		UGEE7T1520	Sensor Applications & Data Acquisitions							
4	OE/JOC	**Open Elective - III**		2	-	2	3	30	70	100
5	OE/JOC	**Open Elective - IV**		2	-	2	3	30	70	100
6	HSS	UGEE7T1720	Management Science	3	-	-	3	30	70	100
7	SAC	UGEE7K1820	Digital Controller Programming for Power Electronic Systems (lab)	1	-	2	2	50	-	50
8	Internship	UGEE5I1920	Summer Internship after Third year	-	-	-	3	50	-	50
Total				17	0	6	23	280	420	700
Honors / Minor Course										
				4	0	0	4			

IV Year – II Semester

S. No.	Category	Course Code	Course Title	L	T	P	C	IM	EM	TM
1.	Major Project	UGEE8J0120	Major Project / Internship in industry (6 Months)	-	-	20	10	100	100	200
2.	Seminar	UGEE8S0220	Seminar	-	2	-	2	50	-	50
			Total	0	2	20	12	150	100	250

L – Lectures, T – Tutorials, P – Practicals, C – Credits, IM – Internal Marks, EM – External Marks, TM – Total Marks

BS - Basic Science, HSS - Humanities & Social Science, ES - Engineering Science, MC - Mandatory Course, PC - Professional Core, SOC - Skill Oriented Course, OE/JOE - Open Elective/Job Oriented Elective, PE - Professional Elective, HSSE - Humanities & Social Science Elective

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Open Electives

The following courses are offered to the students of other departments.

S. No.	Course Code	Course Title
1	UGEE0T0120	Energy Studies
2	UGEE0T0220	Solar Energy Appliances
3	UGEE0T0320	Energy Audit and Conservation
4	UGEE0T0420	Battery Management Systems
5	UGEE0T0520	Industrial Electronics
6	UGEE0T0620	Electrical Machines for EV's
7	UGEE0T0720	Sensors & Data Acquisition
8	UGEE0T0820	PLC & Applications
9	UGEE0T0920	Programming in MATLAB
10	UGEE0T1020	AI Techniques

Note: Each department will notify the list of Open Electives to be offered at the time of Course registration.

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HONORS (for EEE Students)

S.No.	Course Code	Course Title	L	T	P	C	Pre Requisite
Track 1 (Electrical Machines)							
1	UGEE4H0120	Advanced Network Analysis	3	1	0	4	M-I, M-II, ECA
2	UGEE5H0120	Electrical Machine Design	3	0	2	4	EM-I, EM-II
3	UGEE6H0120	Modelling and Analysis of Electric Machines	3	1	0	4	EM-I,EM-II
4	UGEE7H0120	Electrical Machines for Electric Vehicles	3	1	0	4	SEM
Track 2 (Power Electronics)							
1	UGEE4H0220	Renewable Energy Sources	3	1	0	4	Engineering Physics
2	UGEE5H0220	Power Semiconductor Devices	3	1	0	4	Analog Electronics
3	UGEE6H0220	Control Strategies for Power Electronic Converters	3	1	0	4	CS, ACS
4	UGEE7H0220	Electric Drives for Electric Vehicles	3	1	0	4	CS, ACS, DCS
Track 3 (Power Systems)							
1	UGEE4H0320	Energy Audit Demand Side Management	4	0	0	4	---
2	UGEE5H0320	Power System Reforms	4	0	0	4	PSGT, EA&DM
3	UGEE6H0320	Distribution Automation	4	0	0	4	PSGT
4	UGEE7H0320	Advanced Power System Protection	3	1	0	4	PSP
Track 4 (Control Systems)							
1	UGEE4H0420	Principles of Signals & Systems	3	0	2	4	M-I
2	UGEE5H0420	Linear Systems Theory	4	0	0	4	CS
3	UGEE6H0420	Optimal Control Systems	3	1	0	4	CS
4	UGEE7H0420	Process Dynamics & Control	3	1	0	4	CS
MOOCs							
1	UGEE0H3520	MOOC1	2	-	-	2	-
2	UGEE0H3620	MOOC2	2	-	-	2	-

Note: Students can choose any 4 courses in the interested track in addition to the 2 MOOC courses to get the Honors degree.

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Minor (For other Departments)

S.No.	Course Code	Course Title	L	T	P	C	Pre Requisite
TRACK-1							
1	UGEE4M0120	Fundamentals of Electrical Engineering	3	1	0	4	-
2	UGEE5M0220	Power Engineering	3	1	0	4	-
3	UGEE6M0320	Control System Engineering	4	0	0	4	-
4	UGEE7M0420	Power Electronics					-
TRACK-2							
1	UGEE4M0120	Power Electronics for Electric Vehicles	3	1	0	4	BEEE
2	UGEE5M0220	Electric Drives for Electric Vehicles	3	1	0	4	BEEE
3	UGEE6M0320	Energy Storage and Battery Management Systems	4	0	0	4	---
4	UGEE7M0420	Electric & Hybrid Vehicles	3	1	0	4	PECEV, EDEV & ESBMS
TRACK-3							
1	UGEE4M0120	Signal Systems & Circuits	3	1	0	4	-
2	UGEE5M0220	Linear Control systems	3	1	0	4	SS&C
3	UGEE6M0320	Advanced Control Theory	3	1	0	4	CS
4	UGEE7M0420	Digital Control Systems	3	1	0	4	CS, SS&C
TRACK-4							
1	UGEE4M0120	Renewable Sources of Energy	3	1	0	4	-
2	UGEE5M0220	Energy Conservation & Audit	3	1	0	4	-
3	UGEE6M0320	Utilization of Electrical Energy	3	1	0	4	BEE / BEEE
4	UGEE7M0420	Power Quality	3	1	0	4	BEE / BEEE
MOOCs							
1	UGEE0M3520	MOOC1	2	-	-	2	-
2	UGEE0M3620	MOOC2	2	-	-	2	-

Note: Non EEE Students can choose any 4 courses in the above list in addition to the 2 MOOC courses to get the Minor degree in EEE.

I YEAR
I SEMESTER

MATHEMATICS-I
(Common to All Branches)

Subject Code : UGBS1T0220	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basics of Matrices, Differentiation and Integration

Course Objectives:

- Prepare students to learn the concepts of Rank of a matrix, Eigen values, Eigen vectors.
- Familiarize students with analytical methods to solve ordinary differential equations.
- Assist the students to learn the concepts of partial differentiation.
- Gain knowledge of infinite series expansions of various real valued functions.

Syllabus:

Unit-I:
Linear Systems of Equations (10 Hours)
Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations - solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method.
Application: Finding the current in an Electrical Circuit by Gauss elimination method

Unit-II:
Eigen Values and Eigen Vectors (10 Hours)
Linear Transformation and Orthogonal Transformations, Eigen values and Eigen vectors and their properties.
Diagonalization of matrices by Similarity and Orthogonal transformations, Cayley-Hamilton Theorem (without proof).
Application : Finding inverse and powers of a matrix by Cayley-Hamilton Theorem

Unit-III:
Ordinary Differential Equations of First Order And First Degree (8 Hours)
Exact, Reducible to exact equations, Linear and Bernoulli's equations.
Applications: Orthogonal Trajectories, Newton's Law of Cooling, Law of Natural Growth and Decay.

Unit –IV:

Ordinary Differential Equations of Higher Order (10 Hours)

Second and Higher order linear differential equations with constant coefficients, Non-Homogeneous terms of the type $\sin ax, \cos ax, e^{ax}$, polynomials in x, $e^{ax}V(x)$ and $xV(x)$. Linear Differential equations with variable coefficients: Cauchy-Euler and Legendre's Equations.

UNIT -V:

PARTIAL DIFFERENTIATION (8 Hours)

Partial Differentiation, Total derivative; Jacobian, Functional dependence, Maxima, minima of functions of two and three variables, Lagrange method of undetermined multiplier.

Unit-VI:

MEAN VALUE THEOREMS (8 Hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders (Without Proof), Taylor's and Maclaurin's series.

Course Outcomes:

CO1: Determine the rank, inverse and powers of a matrix (L4)

CO2: Apply matrix techniques to model and solve system of linear equations (L3)

CO3: Illustrate Eigen values, Eigen vectors, properties and diagonalization of a given matrix (L2)

CO4: Apply appropriate analytical technique to model and solve a given differential equation (L3)

CO5: Apply the concepts of Partial differentiation to Jacobians and Extrema of several variable functions (L3)

CO6: Examine Mean value theorems for a given function (L4)

CO7: Construct the Taylor's and Maclaurin's series from generalized mean value theorem (L3)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	3
CO2	3	3	3	2	-	-	-	-	-	-	-	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3
CO6	3	3	3	2	-	-	-	-	-	-	-	3
CO7	3	3	3	2	-	-	-	-	-	-	-	3

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint.

REFERENCE BOOKS:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India.
3. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson.
6. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.

ENGINEERING CHEMISTRY
(EEE & ECE Branches)

Subject Code: UGBS1T0420	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic knowledge on Chemistry.

Course objectives:

- To introduce the basic principles of batteries, fuel cell construction and the importance of advanced polymers.
- To provide basic building blocks of engineering by coverage of advanced chemistry topics.
- To make the students learn about importance of Nano and advanced materials.

Syllabus:

UNIT-1:
COMPUTATIONAL CHEMISTRY (8 Hours)
Introduction, Ab Initio studies, Molecular switches: characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes, an acid-base controlled molecular shuttle, a molecular elevator, an autonomous light-powered molecular motor.

UNIT-2:
CHEMINFORMATICS (6 Hours)
Docking-Kinds and Types, Key stages and applications, Schrödinger wave equation, drug and receptor interaction, polarity of the molecule.

UNIT-3:
CHEMIELECTRONICS (10 Hours)
Battery technology – Introduction, primary and secondary batteries- Mercury cell, NiMH, Li –ion batteries. Fuel cells- H_2- O_2 fuel cells, methanol – oxygen fuel cells.
Storage devices – working of floppy, CD, Hard disk, Pen drive.
Liquid crystals- Introduction, types, structure, and applications.

UNIT-4:
PCB'S & PHOTO AND LIGHT RESPONSIVE COMPOUNDS (8 Hours)
Manufacturing of printed circuit boards by Electroless plating, sensors-chemical, electrochemical sensors, biosensors (Glucose monitoring in blood)

UNIT-5:

NON CONVENTIONAL ENERGY RESOURCES (8 Hours)

Solar cells – Introduction –harnessing of solar energy –solar heat collectors, PV cells. Hydropower, Geothermal energy, Tidal power and wave power ocean thermal energy conversion.

UNIT-6:

MATERIAL CHEMISTRY (10 Hours)

Composite materials -Constituents of composites, classification & its applications.

Nano materials- Classification, preparation, &applications.

Advanced polymers – Biodegradable polymers, conducting polymers, biomedical polymers.

Superconductors-Introduction, preparation of the 1-2-3-super conducting pellet ($YBa_2Cu_3O_7$-x)

Course Outcomes:

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

CO1: Explain the important principles for quantum chemical and molecular mechanical methods.(L2)

CO2: Evaluate applicability of computational chemistry in Engineering. (L5)

CO3: Make use of the concepts in quantum chemistry and molecular mechanics for drug modeling. (L3)

CO4: Apply the working principles of batteries, fuel cells and solar cells in Engineering.(L3)

CO5: Distinguish types of sensors based on the working principle.(L4)

CO6: Analyze various types of conventional and non-conventional energy resources.(L4)

CO7: Identify properties and applications of industrially important advanced polymers.(L3)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	3	-	-	-	-	-	-	3
CO2	3	3	-	-	3	-	-	-	-	-	-	-
CO3	3	3	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	3	-	-	-	-	3
CO5	-	-	-	-	-	3	3	-	-	-	-	3
CO6	-	-	-	-	3	3	3	-	-	-	-	-
CO7	-	-	-	-	-	3	3	-	-	-	-	3

TEXT BOOKS:

1. Text book of Engineering Chemistry by Jain & Jain. Dhanpat Rai Publishing Company, 16th edition.
2. A Text book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publications, 3rd edition.
3. A text book of Organic Chemistry by Morrison and Boyd, 7th edition, Pearson publications.
4. Computational Chemistry by Dr. Parashurammishra, Jagadamba publications.

REFERENCE BOOKS:

1. A Text book of Engineering Chemistry by S.S.Dara. S.Chand& Company Ltd., 12thedition.
2. A Text book of Engineering Chemistry Shika Agarwal, Cambridge.
3. A text book of Engineering Chemistry by Rath, Rama Devi, Reddy, Cengage Learning Indian pvt Ltd.
4. A Text book of Chemistry, principles and applications by M.J.sienko and R.A.Plane.
5. Fundamentals of molecular spectroscopy by C.N.Banwell.
6. A Text book of Physical chemistry by P.W. Atkins.
7. A Text book of Organic Chemistry: structure and function by K.P.C.Volhardt and N.E. Schore,5th edition.
8. A text book of Inorganic Chemistry by Dr.Wahid U.Malik, S.Chand publication, Revised edition.
9. Computational Chemistry by Errol G.Lewis 2ndedition, Springer publications.
10. Essentials of Computational Chemistry Christopher J Cramer 2ndedition, Wiley.

ENGLISH –I
(Common to All Branches)

Subject Code: UGBS1T0120	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic knowledge in grammar as well as prose and poetry.

Course Objectives:

- To develop English language skills in listening, speaking, reading and writing by having learners engage in a range of communicative tasks.
- To expand the learner's use of grammatically correct and situationally and culturally appropriate language in speaking and writing for effective communication in a variety of interpersonal and academic situations.

SYLLABUS:

UNIT-I:
STAY HUNGRY – STAY FOOLISH – STEVE JOBS (10 Hours)
Grammar : Concord : Subject-verb agreement ; Tenses
Speaking : Describing oneself and others, objects, places, processes and narrating events and stories.
Listening : Listening to narratives, talks and conversations and answering questions on them.

UNIT-II:
GIVE US A ROLE MODEL – A P J ABDUL KALAM (10 Hours)
Grammar : Articles
Speaking : Framing appropriate questions and giving answers: exercises

UNIT-III:
DO NOT ASK YOUR CHILDREN TO STRIVE – WILLIAM MARTIN (8 Hours)
Vocabulary: Selected Etymological roots and word formation; prefixes and suffixes derived from foreign languages to form derivatives in English.

Speaking **:** Speaking spontaneously on ideas using idiomatic expressions.

UNIT-IV:

THE PATH OF CULTIVATING YOURSELF - RYUHO OKAWA (**8 Hours)**

(An Excerpt From " The Rebirth Of Buddha - Buddha's Wisdom To Transform Your Life**)**

Vocabulary: Synonyms and antonyms

Grammar : Passive Voice

UNIT-V:

TSUNAMI RELIGION –ANJALI PRASHAR (8 Hours)

Grammar : Uses of Phrases and Clauses in Sentences; Simple, Compound and Complex Sentences

UNIT-VI:

A REVIEW ON THE MOVIE 'THE MAN FROM THE EARTH'(2007 release)(**8 Hours)**

Composition : Paragraph writing

Listening **:** Listening comprehension

Course Outcomes:

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

CO1: Infer the life lessons of Steve Jobs and apply wherever possible in life and use tense correctly. (L2)

CO2: Discover the meaning from A.P.J. Abdul kalam's interaction and apply in life (L4)

CO3: Make use of 'Articles' in communication appropriately. (L3)

CO4: Outline the essential features of parenting and build vocabulary quickly through various techniques. (L2)

CO5: Examine and later apply in life the essence of philosophy of Buddha.(L4)

CO6: Discover that 'Passive Voice' and 'synonyms & antonyms' have an important role so as to apply in communication. (L3)

CO7: Find and learn to understand 'Tsunami religion' and apply different types of sentences using phrases and clauses.(L1)

CO8: Explain effectively various aspects of the movie and learn to write 'paragraphs'.(L2)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	3
CO2	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	-	-	-	-	-	-	-	-	3	-	3
CO4	-	-	-	-	-	-	-	-	-	3	-	3
CO5	-	-	-	-	-	-	3	-	-	3	-	3
CO6	-	-	-	-	-	-	-	-	-	3	-	3
CO7	-	-	-	-	-	-	3	-	-	3	-	3
CO8	-	-	-	-	-	-	-	-	-	3	-	3

TEXT BOOKS:

1. Ignited Minds – A P J Abdul Kalam
2. Life, Language and Culture – Explorations –1 & 2 Cengage publishers
3. The Parent's Tao Te Ching – William Martin
4. The Rebirth Of Buddha - Buddha's Wisdom To Transform Your Life - Ryuho Okawa

REFERENCE BOOKS:

1. The Oxford Guide to Writing & Speaking – John Seely
2. The students' Companion – Wilfred D Best (New Edition) – Harper, Collins Publishers.
3. Col-Locate Your World, a store house of words & word-relations, their similarities & dissimilarities – Ajay Singh, Arihant Publications (I) Pvt. Ltd., Meerut
4. Situational Grammar – M I Dubrovin (Visalandra Publishers)
5. Wren & Martin English Grammar and Composition – N.D.V. Prasada Rao

INTERNET SOURCES:

1. https://news.stanford.edu/2005/06/14/jobs-061505/ (Steve Jobs' Speech)
2. https://www.imdb.com/title/tt0756683/ (The Man from the Earth)

ENGINEERING DRAWING
(Common for ME, CE & EEE Branches)

Subject Code: UGME1T0120	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic knowledge on Coordinate Geometry.

Course Objectives:

- To acquire basic skills in technical graphic communication and also get thorough knowledge of various geometrical elements used in Engineering practice.
- Impart and inculcate proper understanding of the theory of projection and projection of one-dimensional objects on 2D planes.
- To impart knowledge on projecting two dimensional figures and to visualize the different positions of planes.
- To visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling.
- To visualize and represent the pictorial views of two- & three-dimensional objects with proper dimensioning and scaling.
- Interpret and represent both two & three dimensional of objects

SYLLABUS:

UNIT-I: (10 Hours)

INTRODUCTION TO THE ENGINEERING DRAWING: Polygons, Conic sections: construction of ellipse, parabola and hyperbola by general method.

INTRODUCTION TO ORTHOGRAPHIC PROJECTIONS: projections of points

UNIT-II: (10 Hours)

PROJECTIONS OF STRAIGHT LINES: Perpendicular to one and parallel to other, parallel to both the planes, parallel to one plane and inclined to the other plane, inclined to both the planes, determination of true lengths.

UNIT-III: (10 Hours)

PROJECTIONS OF PLANES: Regular planes perpendicular/parallel to one plane and inclined to the other reference plane; inclined to both the reference planes

UNIT-IV: (10 Hours)

PROJECTIONS OF SOLIDS: Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the reference planes**.**

UNIT-V: **(10 Hours)**

ISOMETRIC PROJECTIONS

Isometric drawing of prisms and pyramids, Isometric drawing of cone, cylinder and sphere.

UNIT-VI: **(10 Hours)**

Conversion of isometric views to orthographic views
Conversion of orthographic views to isometric views

Course Outcomes:

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

CO1: Familiarize how industry communicates, practices for accuracy in presenting the technical information through drawing.

CO2: Develop the engineering perspective essential for representing orthographic projections.

CO3: Develop the engineering perspective essential for representing isometric projections.

CO4: Improve their visualization skills to develop new designs.

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	-	-	-	3	-	3
CO3	3	3	-	-	-	-	-	-	-	3	-	3
CO4	3	3	-	-	-	-	-	-	-	3	-	3

TEXT BOOKS:

T1: Engineering Drawing by N.D. Butt, Chariot Publications

T2: Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers.

T3: Engineering Graphics by PI Varghese, McGrawHill Publishers

T4: Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

REFERENCE BOOKS:

R1: Engineering Graphics for Degree by K.C. John, PHI Publishers

R2: Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

R3: Engineering Drawing by M.B.Shah&B.C.Rana, Pearson Publications

COMPUTATIONAL THINKING WITH C
(Common to CSE, ECE, EEE, ME and CE Branches)

Subject Code: UGCS1T0120	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic knowledge on Mathematics and problem solving skills.

Course Objectives: This course is designed to let the student explore computational thinking and C programming.

Syllabus:

UNIT I: (8 Hours)
What is Computational Thinking: What is computational thinking, How is computational thinking used
Logical and Algorithmic Thinking: Approach, Logical thinking, Algorithmic thinking
Problem Solving and Decomposition: Defining the problem, Devising a solution, Decomposition, Other effective strategies, Patterns and generalization **[T1]**

UNIT II: (8 Hours)
Abstraction and Modeling: Abstraction, Modeling
Anticipating and Dealing with Errors: Understanding bugs and errors, Designing out the bugs, Mitigating errors, Testing, Debugging, Deciding which errors to fix
Evaluating a Solution: Aspects of a quality solution: Correctness, Efficiency, Elegance, Usability **[T1]**

UNIT III: (8 Hours)
Basics of C: Structure of a C program, Data Types, Constants, Variables, Input/ Output Statements, Creating and running programs, operators, precedence and order of evaluation **[T2]**

UNIT IV: (8 Hours)
Selection Statements: Simple If, If-else, Nested if else, else-if, switch statements.
Loop Statements: while, do-while, for, continue, break statements.
Arrays: Arrays declaration, definition, accessing elements, 1-D arrays, 2-D arrays. **[T2]**

UNIT V: **(8 Hours)**

Strings: Declaration of string, String Manipulation Functions.

Functions: Categories of functions, Parameter passing mechanism, Passing an Array to a Function, Scope rules, Storage Classes.

Recursion: Recursion versus Iterations, Recursive solutions for factorial, Fibonacci series, GCD. **[T2]**

UNIT VI: **(8 Hours)**

Pointers: Notations, Pointer Arithmetic, Pointer to array, Dynamic Memory Allocation Functions.

Structures: Declaration, Definition and initialization of structures, Accessing structures, Arrays of structures, Unions. **[T2]**

Course Outcomes:

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

CO 1 Formulate a problem with its solution in such a way that a computer can effectively carry it out. [L2]

CO 2 Apply the Computational thinking approach to develop algorithms for a given scenario. [L4]

CO 3 Develop the applications using basic constructs of C, selection statements, Loops, arrays, User defined Data types. [L5]

CO 4 Make use of Modular approach and Recursion to develop solutions for complex problems. [L3]

CO 5 Apply the concepts of Pointers, Dynamic memory allocation to write memory efficient programs. [L3]

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Computational Thinking: A beginner's guide to problem-solving and programming, by Karl Beecher, BCS-The chartered Institute of India
2. Let us C, Yashawant Kanitkar, BPB publications
3. Programming in C, Reema Thareja, OXFORD.
4. The C programming Language by Dennis Richie and Brian Kernighan, Prentice hall

REFERENCE BOOKS:

1. C: The Complete Reference, Herbert Schildt, 4th Edition, McGraw Hill.
2. Computer Science: A Structured Programming Approach using C, B. A. Fouruzan and R. F. Gilberg, 3rd Edition, Thomson Publications, New Delhi.

ENGLISH COMMUNICATION SKILLS LAB
(Common to All Branches)

Subject Code: UGBS1P0620	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Basic knowledge in speech sounds as well as formal and informal communication.

Course Objectives:

- To enable learners to use the correct pronunciation of English sounds.
- To prepare students to use different functions of English Language.

Syllabus:

Week1: Greeting, Introducing and Taking leave

Week2: Pure Vowels

Week3: Giving information and Asking for information

Week4: Diphthongs

Week5: Inviting, Accepting and Declining Invitations

Week6: Consonants

Week7: Commands, Instructions and Requests

Week8: Accent and Rhythm

Week9: Suggestions and Opinions

Week10: Intonation

Course Outcomes:

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

CO1: Develop correct pronunciation of 44 English sounds for better communication**.**(L3)
CO2: Demonstrate the ability to use language functions through adequate grammar.(L2)
CO3: Find and practice correct accent, rhythm and intonation and use it in communication.(L1)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	3
CO2	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	-	-	-	-	-	-	-	-	3	-	3

TEXT BOOKS:

1. Interact – English Lab Manual for Undergraduate Students – Orient BlackSwan
2. Strengthen Your Steps – Maruthi Publications (the latest edition)

REFERENCE BOOKS:

1. English Conversation Practice – Grant Taylor, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
2. A series of 'ROBIN READERS' published by Orient Black Swan

INTERNET SOURCES:

1. www.talkenglish.com
2. https://learnenglish.britishcouncil.org/ (Learn English – British Council)

ENGINEERING CHEMISTRY LAB
(EEE & ECE Branches)

Subject Code: UGBS1P0820	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Basic knowledge on Chemistry.

Course Objectives:

- To provide the students with a solid foundation in Chemistry laboratory required to solve engineering problems.
- To understand the principles of engineering chemistry associated with basics of Engineering.

Syllabus:

Experiment 1:
Construction of electrochemical cell

Experiment 2:
Thin layer chromatography.

Experiment 3:
Determination of cell constant and conductance.

Experiment 4:
Potentiometric determination of EMF and reduction potentials.

Experiment 5:
Determination of K^+ ion by ion exchange chromatography.

Experiment 6:
Determination of pH content in soft drinks.

Experiment 7:
Estimation of vitamin-C.

Experiment 8:
Determination of Ferrous ion by colorimetric method.

Experiment 9:
Molecular Modeling-1.

Experiment 10:
Molecular Modeling-2.

Course Outcomes:
Upon completion of the course, students will be able to:
CO1: Illustrate the basic knowledge on volumetric and electrochemical analysis. (L3)
CO2: Interpret cell constant and reduction potentials of electrolytes. (L3)
CO3: Evaluate the Physical and chemical properties of solutions used in Engineering.(L5)
CO4: Illustrate the computational chemistry to design a drug/molecule. (L2)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	3	-	-	3	-	-	-	-	3
CO3	3	-	-	3	-	-	3	-	-	-	-	-
CO4	-	-	3	-	3	3	-	-	-	-	-	-

TEXT BOOK:

Computational Chemistry: A Practical Guide for Applying Techniques to Real World Problems by David Young (Author), Wiley publications.

COMPUTATIONAL THINKING WITH C LAB
(Common to CSE, ECE, EEE, ME and CE Branches)

Subject Code: UGCS1P0220	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Basic knowledge on Mathematics and problem solving skills.

Course Objectives:

1. The students will learn to develop the programs for solving the basic problems using operators, control statements and Loops.
2. The Students will be able to write programs using concepts like Arrays, Strings, pointers and functions.

Experiments:

EXP1:

Case study on Computational Thinking: Discuss a problem scenario and use the Computational Thinking approach to design a solution for the problem.

EXP2:

a. Write a program that will output your name and address using a separate printf() statement for each line of output.
b. Modify your solution for the previous program so that it produces all the output using only one printf() statement.
c. Write a program to output the following text exactly as it appears here:
"C is just like sea……" she said.
d. Write a program that prompts the user to enter a distance in inches and then outputs that distance in yards and feet.
e. Write a program to convert the temperature from degree centigrade to Fahrenheit and vice versa.

EXP3:

a. Write a C program to find the largest of three numbers using nested if-else.
b. Write a C Program to swap two numbers without using a temporary variable.
c. Write a simple program based on operators (pre, post increment, bitwise and, or, etc.).
d. Write a simple program based on type conversions (from int to float & float to int)

EXP4:

a. Write a program that displays all the numbers from X to Y, that are divisible by a and b. (X, Y, a and b should be read from the keyboard)
b. Write a program that reads an unspecified number of integers, determines how many positive and negative values have been read, and computes the total and average of the input values, not counting zeros. Your program ends with the input 0. Display the average as a floating-point number. (For example, if you entered 1, 2, and 0, the average should be 1.5.)
c. Write a C program for finding student Grade by reading marks as input.

EXP5:

a. The total distance travelled by vehicle in 't' seconds is given by distance $s = ut+1/2at^2$ where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec^2). Write a C program to find the distance travelled at regular intervals of time given the values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.
b. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
c. Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number.

EXP6:

a. Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.
b. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1, Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first 'n' terms of the sequence.
c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

EXP7:

a. Write a C Program to check whether the given number is Armstrong number or not.
b. Write C programs for the following series:

$$1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n}$$

$$\frac{1}{3}+\frac{3}{5}+\frac{5}{7}+\frac{7}{9}+\frac{9}{11}+\frac{11}{13}+\cdots+\frac{95}{97}+\frac{97}{99}$$

c. Write a C program to find the roots of a Quadratic equation.

EXP8:

a. Write C programs that use both recursive and non-recursive functions
   i. To find the factorial of a given integer.
   ii. To find the GCD (greatest common divisor) of two given integers.
b. Write C programs for implementing Storage classes: (Auto, register, static, extern)

EXP9:

a. Write a C program to find the minimum and maximum integer of an Array.
b. Write a C program that uses functions to perform the following:
   i. Addition of Two Matrices
   ii. Multiplication of Two Matrices

EXP10:

a. Write a C program to construct the following pyramid of numbers.

1 1 2 1 2 3	* * * * * *	1 2 3 4 5 6	A B B C C C D D D D E E E E E

EXP11:

a. Write a C program to swap two numbers using call by reference method.
b. Write a C program that uses a pointer to read and display Array elements.
c. Write a C program to create an array with calloc(), store the values into it and find their sum.

EXP12:

a. Write a C program to find length of the given string without using strlen().
b. Write a C program that uses functions to perform the following operations:
   i. To insert a sub-string into a given main string from a given position.
   ii. To delete n Characters from a given position in a given string.
c. Write a C program to determine if the given string is a palindrome or not

EXP13:

a. Write a C program to implement Linear Search.
b. Write a C program to implement sorting of an array using bubble sort.

EXP14:

Examples which explore the use of structures and union.

Course Outcomes:

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

CO 1 Understand the program flow to resolve the syntax and logical errors. [L2]
CO 2 Develop programs for the basic mathematical and general problems. [L3]
CO 3 Analyze complex problems and break them into logical modules and interpret the results. [L4]

Mapping of COs to POs :

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Programming with C (Schaum's Outlines Series), Byron Gottfried, Jitender Chhabra, Mc Graw Hill Publishers.
2. Let us C, Yashawanth Kanethkar, 8th Edition, Jones & Bartlett Publishers, India.

REFERENCE BOOKS:

1. C: The Complete Reference, Herbert Schildt, 4th Edition, Mc Graw Hill.
2. Computer Science: A Structured Programming Approach using C, B. A. Fouruzan and R. F. Gilberg, 3rd Edition, Thomson Publications, New Delhi.

I YEAR
II SEMESTER

MATHEMATICS-II
(Common to All Branches)

Subject Code: UGBS2T0120	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Basics of Differentiation and Integration.

Course Objectives:

- To assist the students in learning Fourier series expansions of various periodic functions and the corresponding Fourier Transform
- To train the students to deal with multiple integrals and improper integrals
- To prepare the students to learn the concepts of Vector calculus

Syllabus:

UNIT-I:

FOURIER SERIES (**8 Hours)**

Introduction, Determination of Fourier coefficients, Even and Odd functions, Change of Interval, Half range Sine and Cosine Series

UNIT-II:

FOURIER TRANSFORMS **(10 Hours)**

Fourier Integral Theorem (Without proof) Fourier Sine and Cosine Integrals, Sine and Cosine Transforms, Properties, Inverse Transforms

UNIT-III:

MULTIPLE INTEGRALS **(12 Hours)**

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form). Change of variables (Cartesian to polar) for double integrals.

Evaluation of Triple Integrals: Change of variables for triple integrals, (spherical polar coordinates, cylindrical coordinates)

UNIT-IV:

BETA AND GAMMA FUNCTIONS **(8 Hours)**

Definition of Improper integrals, Beta and Gamma functions and their properties.

UNIT-V:

VECTOR DIFFERENTIATION (10 Hours)

Vector point functions and scalar point functions. Gradient, Divergence and Curl, Solenoidal and Irrotational Vectors. Directional derivative, Vector identities (without proof).

Application: Scalar potential function

UNIT-VI:

VECTOR INTEGRATION (10 Hours)

Line, Surface and Volume Integrals. Green's, Gauss and Stoke's Theorems (without proofs) and their applications involving cubes, sphere and rectangular parallelepipeds.

Application: Work done by force as a line integral

Course Outcomes:

CO1: Find Fourier series expansion of various periodic functions (L2)

CO2: Represent a continuous function in Fourier integral form and hence find its Fourier Transform (L3)

CO3: Evaluate double and triple integrals in Cartesian and Polar coordinates over given regions (L3).

CO4: Evaluate various kinds of improper integrals using Beta and Gamma functions(L3)

CO5: Determine the Gradient, Divergence and Curl of a vector field using vector differentiation and Prove identities relating to them (L4)

CO6: Evaluate vector integrals (Line, surface, volume) and justify the relation between them by integral theorems (L3)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	3
CO2	3	3	3	2	-	-	-	-	-	-	-	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3
CO4	3	3	3	2	-	-	-	-	-	-	-	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3
CO6	3	3	3	2	-	-	-	-	-	-	-	3

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Ed.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint.

REFERENCE BOOKS:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India.
3. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson.
6. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.

APPLIED PHYSICS
(ECE & EEE Branches)

Subject Code: UGBS2T0220	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Ray optics, Basics of mechanics and Properties of materials.

Course Objectives:

1. Impart the knowledge of optical phenomena like interference and diffraction required to design instruments with higher resolution.
2. Understand the physics of semiconductors and their working mechanisms to use in electronic circuits and devices.
3. Impart knowledge of materials with characteristics utility in appliances.

Syllabus:

UNIT–I:

WAVE OPTICS (8 Hours)

Interference: Superposition principle, Young's double slit experiment, Intensity distribution, Conditions for sustained Interference - Interference in thin films (reflected geometry) - Newton's Rings (reflected geometry).

Diffraction: Fraunhoffer Diffraction - Diffraction due to Single slit (quantitative), Double slit, N -slits (qualitative) – Intensity distribution curves - Diffraction Grating – Grating spectrum – missing order – Rayleigh's criterion (qualitative)-resolving power.

UNIT–II:

COHERENT OPTICS (9 Hours)

Lasers: Characteristics–Spontaneous and Stimulated emission of radiation – population inversion - Einstein's coefficients & Relation between them and their significance - Pumping Mechanisms –Optical Resonator-Threshold condition for Lasing Action-Ruby laser – Helium-Neon laser – Applications.

Fiber Optics: Construction and working of optical fiber - acceptance angle & numerical aperture – types of fibers based on refractive index profile – attenuation in optical fiber-optical fiber communication system, Applications

UNIT–III:

QUANTUM MECHANICS (8 Hours)

Introduction- Matter waves – de-Broglie's hypothesis – Davisson-Germer experiment – Heisenberg's Uncertainty Principle –physical significance of wave function – Schrödinger Time Independent and Time Dependent wave equations – Particle in infinite potential well.

UNIT–IV:

FREE ELECTRON THEORY OF SOLIDS (8 Hours)

Free electron theory: Classical free electron theory (merits and demerits only) - Quantum Free electron theory – electrical conductivity based on quantum free electron theory – Fermi - Dirac distribution function – Temperature dependence of Fermi-Dirac distribution function.

Band theory: Bloch's theorem (qualitative) – Kronig-Penney model (qualitative) – E Vs. K diagram -formation of energy bands in crystalline solids –– classification of crystalline solids

UNIT–V :

SEMICONDUCTOR PHYSICS (8 Hours)

Introduction – Intrinsic semiconductors - density of charge carriers - Electrical conductivity – Fermi level – extrinsic semiconductors - p-type & n-type - Density of charge carriers- Hall effect- Applications of Hall effect - Drift and Diffusion currents – Einstein's equation – p-n junction diode –Zener diode- Semiconductor laser

UNIT–VI:

MAGNETISM & DIELECTRICS (8 Hours)

Magnetism: Magnetic dipole moment – Magnetization – Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr magnetron – Classification of magnetic materials: Dia, Para & Ferro – Hysteresis – Soft and Hard magnetic materials – Applications of Ferromagnetic material.

Dielectrics: Dielectric polarization **–** Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic and Ionic (Quantitative), Orientational polarizations (qualitative) – Lorentz Internal field – Claussius-Mossotti equation - Applications of dielectrics.

Course Outcomes:

At the end of this course students will be able to

CO1: Analyze the differences between interference and diffraction with applications(L4)

CO2: Identify the engineering applications of Laser and Optical fiber (L2)

CO3: Apply Schrödinger's wave equation for energy values of free particle (L3)
CO4: Illustrate various electron theories to understand behavior of electron (L2)
CO5: Outline the properties and applications of different types of semiconductors (L3)
CO6: Classify magnetic materials based on susceptibility and their temperature dependence (L2)
CO7: Summarize various types of polarization of dielectrics (L2)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	-	-	2	-	-	-	-	-	-	2
CO3	-	3	-	-	-	-	-	-	-	-	-	2
CO4	-	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	2	-	-	-	-	-	-	-	-
CO7	3	-	-	2	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. "A Text book of Engineering Physics" by M.N. Avadhanulu, P.G. Kshirsagar - S. Chand Publications.
2. "Engineering Physics" by D. Bhattacharya and Poonam Tandon, Oxford press.
3. "Engineering Physics" by R.K Gaur and S.L Gupta., - Dhanpat Rai publishers.

REFERENCE BOOKS:

1. "Engineering Physics" by M. R. Srinivasan, New Age international publishers.
2. "Optics" by AjoyGhatak, 6th Edition McGraw Hill Education.
3. "Solid State Physics" by A. J. Dekker, McMillan Publishers.
4. "Physics Volume –II", 5^{th} edition, Resnick Halliday, Krane, by Wiley India
5. "Engineering Physics" by Dr. Armugam, Anuradha agencies

ELECTRICAL CIRCUIT ANALYSIS-I

Subject Code: UGEE2T0220	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Engineering Physics, Mathematics

Course Objective: This course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits, and network topology.

Syllabus:

UNIT –I: Introduction to Electrical Circuits (8 Hours)

Passive components and their V-I relations. Sources (dependent and independent) - Kirchhoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta- to-star transformation). Source transformation technique, nodal analysis and mesh analysis.

UNIT –II: A. C Fundamentals (8 Hours)

Periodic waveforms (determination of rms, average value, peak factor, and form factor). Concept of phase angle and phase difference – Waveforms and phasor diagrams for lagging, leading networks. Complex and polar forms of representations.

UNIT –III: Analysis of AC Networks (9 Hours)

Steady state analysis of R, L and C circuits. Power Factor and its significance, real, reactive power and apparent power, waveform of instantaneous power and complex power, Extension of node and mesh analysis to AC networks, Numerical problems on sinusoidal steady state analysis.

UNIT –IV: Resonance (8 Hours)

Series and parallel resonance, Selectively band width and Quality factor, Numerical Problems, Introduction to locus diagram.

UNIT- V: Network Theorems –I (8 Hours)

Superposition theorem, Thevenin's theorem, Norton's theorem- Application of network theorems on AC and DC circuits (Numerical problems)

UNIT –VI: Network Theorems –II (8 Hours)

Maximum Power Transfer theorem, Reciprocity theorem, Milliman's theorem, compensation theorem and Tellegen's theorem. Application of network theorems on AC and DC circuits (Numerical problems)

Course Outcomes: At the end of this course, students will be able to

CO1: Apply the basic concepts of Electrical circuits to solve various electrical networks

CO2: Apply AC fundamentals to analyze single-phase AC circuits of different configurations

CO3: Compute the resonance, bandwidth, and quality factors for series and parallel

CO4: Simplify electrical networks using network theorems

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	3

TEXTBOOKS:

1. "Engineering Circuit Analysis" by William Hayt and Jack E. Kemmerley, 6th edition, McGraw Hill Company,

2. "Network Analysis" by Van Valkenburg, 3rd edition, PHI Learning, 2006.

3. "Fundamentals of Electric circuits" by C. K. Alexander and M. N. O. Sadiku, 5th edition, Mc Graw hill Publishers, 2013.

REFERENCE BOOKS:

1. "Circuit Theory (Analysis and Synthesis) by A. Chakrabarthi, 7th edition, Dhanpat Rai & Co. 2015.

2. "Introductory circuit analysis" by Robert L Boylestad, 12th edition, Pearson Education, 2013.

3. "Network analysis & synthesis" by Ravish. R. Singh, 1st edition, Mc-Graw Hill Education, 2016.

PYTHON PROGRAMMING

Subject Code: UGCS2T0120	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic knowledge on C programming.

Course Objectives:
Python is a modern language useful for writing compact codes to solve problems. The course is intended to provide the foundations of Python Programming. The students should be able to create python programs that leverage the object oriented features.

Syllabus:

UNIT I: (8 Hours)
Basics of Python Programming: Features of Python, Comparison with C, Python Virtual Machine, comments, indentation, literals, variables and identifiers, data types, operators, Input and Output Statements, type conversion, command Line Arguments.

Decision Control Statements: selection/conditional branching statements, basic loop structures, nested loops, break, continue and pass statements, else statement used with loops.

UNIT II: (9 Hours)
Functions: Declaration and definition, calling a function, returning values from function, pass by object reference, Formal and actual arguments, Local and Global variables, recursive functions, lambda functions.

Data Structures: Strings and its operations, Lists: accessing and updating values in list, basic list operations and list methods, nested and cloning lists, list comprehensions, looping in lists. Tuples, Sets, Dictionaries and their operations.

UNIT III: (9 Hours)
Classes and Objects: Introduction to Object Oriented Programming, classes and objects, Class method and self argument, __init__() method, class variables and object variables, __del__() method, other special method, public and private data members, built-in class functions and attributes, garbage collection, class and static methods.

UNIT IV: (8 Hours)
Inheritance: Introduction, inheriting classes, types of inheritance, overriding methods, abstract classes and interfaces.

Modules: What are Modules, Modules and Files, Namespaces, Importing Modules, Module Built-in Functions, Packages.

UNIT V: (8 Hours)

Error and Exception Handing: Types of Errors, Exceptions, Handling Exceptions, types of exceptions, except block, assert statement, user defined exceptions.

UNIT VI: (8 Hours)

NumPy Arrays: Creation, Processing Arrays, Types of Arrays, Arrays using NumPy, Operations on Arrays, attributes of arrays, multi-dimensional arrays, matrices in NumPy.

Course Outcomes:

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

- **CO 1** Understand the Python syntax, semantics, basic programming constructs to be used to write the programs.[L2]
- **CO 2** Utilize the methods of various data structures to manipulate the data. [L3]
- **CO 3** Apply the appropriate Object-Oriented Programming principle for a given scenario.[L3]
- **CO 4** Develop bug free applications by handling different types of exceptions. [L4]

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Reema thareja, Python Programming using problem solving approach, Oxford University Press.

REFERENCE BOOKS:

1. Dietel and Dietel, Python How to Program.
2. Kenneth A. lambert, B.L. Juneja, Fundamentals of Python, Cengage Learning
3. Dr. R. Nageswara Rao, Core Python Programming , Dreamtech Press

ANALOG ELECTRONICS

Subject Code: UGEE2T0320	**L**	**T**	**P**	**C**
I Year / II Semester	**2**	**0**	**2**	**3**

Prerequisites: Semiconductor Physics

Course Objective: The objective of this course is to introduce the students about the fundamentals concepts of semiconductor diodes, Transistor and their applications. It also introduces wave shaping concepts of both linear and non-linear circuits and design of multivibrators. At the end of the course, the students are expected to know about the applications of the semiconductor devices.

Syllabus:

UNIT I: Linear Wave Shaping (10 Hours)

Response of High pass and low pass RC circuits to different signals (sinusoidal, step, pulse, square and ramp), high pass RC circuit as a differentiator, low pass RC circuit as an integrator, attenuator, its application in CRO probe.

UNIT II: Diode Circuits (10 Hours)

P-N junction diode, diode current equation, I-V characteristics of a diode, diode resistance and capacitance, Diode Equivalent Circuits(models),Zener diode and its characteristics, LED, Photo diode, Tunnel diode.

UNIT-III: Diode Applications (12 Hours)

Diode Clippers: Shunt Clippers, Series clippers, clipping at two independent levels, transfer characteristics of clippers, Design of clippers

Diode Clampers: Positive clampers, negative clampers, Design of clampers

Rectifiers and Voltage regulator: Zener diode as a voltage regulator

UNIT IV: Transistor Circuits (10 Hours)

BJT: Structure and configuration of BJT with input and output characteristics, Operating point and load line analysis

MOSFET: Structure, Characteristics, Operating point and load line analysis

UNIT V: Transistor Biasing and Applications (12 Hours)

BJT Biasing: Need for Biasing, different methods. MOSFET biasing: different methods. Generalized analysis of transistor amplifier model using h-parameters (frequency response)

Applications: BJT as a switch, BJT as an amplifier (Single stage), MOSFET as a switch, MOSFET as an amplifier.

UNIT VI: Design of Multivibrators (10Hours)

Bistable multivibrators: Analysis and Design of fixed and self-bias transistor binary. Monostable: Analysis and Design of collector coupled mono-stable multivibrators, waveforms at bases and collectors,

Astable Multivibrator: Analysis and Design of Collector coupled Astable multivibrator, Astable multivibrator as a voltage to frequency converter

List of Experiments

PART A: ELECTRONIC WORKSHOP PRACTICE

1. Identification, Specifications, Testing of R, L, C Components (Color Codes), Potentiometers, Switches (SPDT, DPDT, and DIP), Coils, Gang Condensers, Relays, Bread Boards.
2. Identification, Specifications and Testing of Active Devices, Diodes, BJTs, JFETs, MOSFETs, Power Transistors, LEDs, LCDs, Optoelectronic Devices.
3. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeters, Function Generator, Regulated Power Supplies and CRO.

PART B: (all 6 Experiments from Section B are Compulsory (only internal choice in each experiment number))

Experiment 1: (i) Linear wave shaping (Diff. Time Constants, Integrator)

(or)

(ii)Linear wave shaping (Diff. Time Constants, Differentiator)

Experiment 2: (i) PN Junction diode characteristics (Static Resistance and Cut-in Voltage)

(or)

(ii) Zener Diode as a Voltage regulator

Experiment 3: (i) Diode applications: Clippers, clampers

(or)

(ii)Bridge Rectifier (with & without filters)

Experiment 4: (i) Load line and operating of CE circuit

(or)

(ii) Transistor CE characteristics (Input and Output characteristics)

Experiment 5: (i) Transistor application: Transistor as a Switch

(or)

(ii) Design of Voltage divider biasing Circuit for given operating point and Transistor

Experiment 6:(i) Design of Astable Multivibrator (Voltage – Frequency Converter)

(or)

(ii) Design of monostable Multivibrator

Course Outcomes: At the end of this course students will be able to

CO1: Analyze various linear wave shaping circuits and its responses
CO2: Explain working, characteristics and properties of different types of semiconductor diodes and Transistors.
CO3: Analyze the biasing of transistor circuits and develop various applications using the diodes and transistors
CO4: Explain and design multivibrator circuits for the given set of specifications.
CO5: Develop technical writing skills important for effective communication and acquire teamwork skills for working effectively in groups.

Mapping of COs to POs:

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	-	-	-	-	-	-	-	2	2	2	-	-	-	-

TEXT BOOKS:

1. "Electronic Devices and Circuits", J Millman, Chritophas C Halkias, and Satyabratajit Vol 1, 4th Edition, McGraw Hill Edition, 2015.
2. "Pulse, Digital and Switching Waveforms", Jacob Millman and Herbert Taub, Vol 1, 3rd Edition, McGraw Hill Edition, 2011.
3. "Electronic Devices and Circuit theory", R L Boylestad and Louis Nashelsky, Vol 1, 11th Edition, Pearson Education, 2006.
4. "Pulse and Digital Circuits", Venkata Rao K, Rama Sudha K and Manmadha Rao G, Vol 1, 1st Edition, 2010

REFERENCE BOOKS:

1. "ELECTRONIC PRINCIPLES", Albert Malvino and David J Bates, Vol 1, 8th Edition, MC Graw Hill Edition, 2015
2. "Electronic Devices", Thomas L Floyd, Vol 1, 9th Edition, Pearson Education, 1996
3. "Electronic Devices and Circuits", David A Bell, Vol 1, 5 Edition, Oxford University Press,2008.
4. "Electronic Devices &Circuits", J B Gupta, Vol 1, 6th Edition, S K Kataria & Sons, 2016

PYTHON PROGRAMMING LAB

Subject Code: UGCS2P0320	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Basic understanding of Computer Programming terminologies.

Course Objectives:

- To be able to implement the basic programming constructs
- To understand the features of Object-Oriented Programming

Experiments:

1. Write a program to demonstrate different representations of numbers in Python.
2. Write a program to perform different complex Arithmetic Operations on numbers in Python.
3. Develop programs to demonstrate decision making and looping structures in python.
4. Write a program to demonstrate working with lists in python.
5. Write a program to demonstrate working with tuples in python.
6. Write a program to demonstrate working with dictionaries in python.
7. Write a program to create a module by adding a method and import the module in the application.
8. Write a program to create user defined exception and handle the exception in the application.
9. Write a program to demonstrate how to create classes and objects in the application.
10. Demonstrate the use of NumPy arrays in python.

Case Studies:

1. Case study on Loops:

   A perfect number is a number for which the sum of its proper divisors is exactly equal to the number. For example, the sum of the proper divisors of 28 would be 1 + 2 + 4 + 7 + 14 = 28, which means that 28 is a perfect number. A number *n* is called deficient if the sum of its proper divisors is less than *n* and it is called abundant if this sum exceeds *n*. Write a program for the given large n, find the sum of all perfect numbers, sum of all deficient numbers and sum of abundant numbers separately. Print all perfect numbers along with its sum, deficient numbers along with its sum and abundant numbers along with its sum.

2. Case studies on Functions:
   a) Write a function "remove_duplicates" which takes a string argument and returns a string which is the same as the argument except only the first occurrence of each letter is present. Make your function case sensitive.
   b) Write a function mult_lists(a, b) that takes two lists of numbers of the same length, and returns the sum of the products of the corresponding elements of each.
   c) Write a function called flatten_list that takes as input a list which may be nested, and returns a non-nested list with all the elements of the input list.

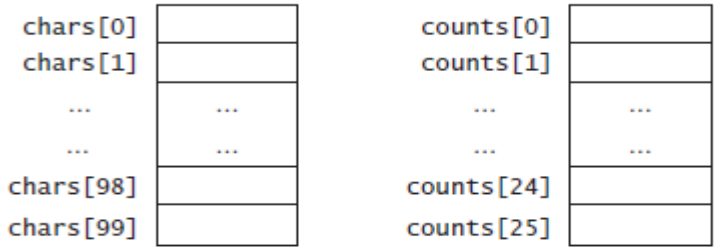
3. Case study on modules:
   Create a module "Prime" to include the following functions.
   a) isPrime(number) : returns Boolean whether the given number is prime number or not.
   b) isPalindromePrime(number) : returns Boolean whether the given number is prime with palindromic. Example 131 is a palindromic prime.
   c) isEmirp(number) : returns Boolean whether the given number and its reversal number are also prime numbers. Example 17 and 71 are both Emirps.
   d) mersennePrime(p): returns $\mathbf{2^p - 1}$ value for given integer p if it is prime number.
   e) printTwinPrimes(range) : prints all twin prime numbers below given range.

   Write a test program to import the Prime module and perform the following operations using the functions of Prime module.

   - Prints first 100 prime numbers.
   - Prints first 100 Palindrome prime numbers.
   - Prints first 100 Emirp numbers.
   - Prints all Mersenne prime numbers for the p value below 32.
   - Prints all twin prime numbers below 1000.

4. Case study on Lists:
   Counting the occurrence of each letter.
   The program counts the occurrence of each letter among 100 letters.
   Procedure
   - Generates 100 lowercase letters randomly and assigns them to a list of characters, named **chars**. You can obtain a random letter by using the **getRandomLowerCaseLetter()** function in the **RandomCharacter** module. (Import RandomCharacter module into your program)
   - Counts the occurrences of each letter in the list. To do so, it creates a list named **counts** that has 26 **int** values, each of which counts the occurrences of a letter.

That is, **counts[0]** counts the number of times **a** appears in the list, **counts[1]** counts the number of time **b** appears, and so on.



5. Case study on Classes
   Design a class named QuadraticEquation for a quadratic equation $ax^2+bx+c=0$. The class contains:
   - The private data fields a, b, c that represents three coefficients.
   - A constructor for the arguments for a, b and c
   - Three get methods for a, b and c
   - A method named getDiscriminant() that returns the discriminant, which is b^2-4ac.
   - The methods named getRoot1() and getRoot2() for returning the two roots of the equation using the formulas:
     $R1 = -b + (\sqrt{b^2-4ac})/2a$ and $R2 = -b - (\sqrt{b^2-4ac})/2a$.
   - These methods are useful only if the discriminant is non-negative. Let these methods return 0 if the discriminant is negative.
   - Write a test program that prompts the user to enter values for a, b, c and displays the result based on discriminant.

Course Outcomes:

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

- **CO 1.** Understand python programming structure for solving basic programming problems.[L2]
- **CO 2.** Use primitive data types, selection statements, loops, function, and classes to write programs. [L3]
- **CO 3.** Develop programs for a given scenario. [L3]
- **CO 4.** Analyze different data structures and choose suitable one for a given problem. [L4]

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Python Programming using problem solving approach, Reema tharaja, Oxford University Press, 1st Edition.
2. Fundamentals of Python, Kenneth a. lambert, B.L. Juneja, Cengage Learning, 1st Edition.
3. Chun, J Wesley, Core Python Programming, 2nd Edition, Pearson.

REFERENCE BOOKS:

1. Python How to Program, Dietel and Dietel, 1st Edition.
2. Barry, Paul, Head First Python, 2nd Edition, O Rielly.
3. Lutz, Mark, Learning Python, 4th Edition, O Rielly.

APPLIED PHYSICS LAB
(ECE & EEE Branches)

Subject Code: UGBS2P0520	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Knowledge on measuring instruments, electricity and magnetism.

Course Objectives:

- Gain knowledge in various areas of physics to apply real time applications
- Use fundamental techniques and skills of physics in modern engineering
- Enhance analytical thinking and to improve problem solving techniques

Syllabus:

(Any 8 of the following 15 experiments can be done)

Experiment 1:
Determination of thickness of a spacer using wedge film and parallel interference fringes

Experiment 2:
Newton's rings – Radius of Curvature of Plano - Convex Lens

Experiment 3:
Determination of wavelength of a source-Diffraction Grating-Normal incidence

Experiment 4:
Determination of width of a slit using Laser diffraction

Experiment 5:
Determination of the bending losses in optical fiber

Experiment 6:
Determination of Planck's constant using photo cell

Experiment 7:
Energy Band gap of a Semiconductor p - n junction

Experiment 8:
Characteristics of Thermistor – Temperature Coefficients

Experiment 9:
Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall effect

Experiment 10:
Study the V-I characteristics of p-n junction diode

Experiment 11:
Study the V-I characteristics of Zener diode

Experiment 12:
Variation of dielectric constant with temperature

Experiment 13:
Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus

Experiment 14:
Measurement of magnetic susceptibility by Gouy's method

Experiment 15:
Study the variation of Magnetic induction (B) versus Magnetic field strength (H) by magnetizing the magnetic material (B-H curve)

Course Outcomes:

At the end of this course students will be able to

CO1: Apply the scientific knowledge to understand optical concepts(L3)

CO2: Experiment with basic electronic circuits to understand their function(L2)

CO3: Study the magnetic behaviour of materials (L2)

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	2

TEXT BOOKS:

1. "A Text book of Engineering Physics" by M.N. Avadhanulu, P.G. Kshirsagar - S. Chand Publications.
2. "Engineering Physics" by R.K Gaur and S.L Gupta., - Dhanpat Rai publishers.

ELECTRICAL CIRCUTS LAB

Subject Code: UGEE2P0420	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Any 10 of the following experiments are to be conducted

1. Verification of KCL and KVL with DC excitation
2. Verification of DC nodal analysis
3. Verification of DC mesh analysis.
4. Determination of average value, R.M.S value, form factor, peak factor of Sinusoidal wave.
5. Determination of self, mutual Inductances and coefficient of coupling
6. Series and parallel resonance
7. Verification of thevenin's theorem
8. Verification of Norton's theorem
9. Verification of superposition theorem
10. Verification of maximum power transfer theorem
11. Verification of compensation theorem.
12. Verification of Milliman's theorem.

Course Outcomes: At the end of this course students will be able to

CO1: verify circuit Laws and nodal and mesh analysis

CO2: Determine parameters of a given sinusoidal waveform

CO3: Interpret the response of series and parallel RLC circuits under resonance

CO4: Determination of self and mutual inductance and coefficient of coupling

CO5: Verify various Theorems.

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	-	-

References: https://nptel.ac.in/courses/108/106/108106172/

https://sabotin.ung.si/~mv0029/pdf/Alexander_2.pdf

ENVIRONMENTAL SCIENCE
(Common to ECE, EEE, ME and CE)

Subject Code: UGBS2A0920	**L**	**T**	**P**	**C**
I Year / II Semester	**2**	**0**	**0**	**0**

Prerequisites: Basic knowledge on Eco systems, bio diversity and environmental pollution.

Course Objectives:

The course emphasized a basic understanding of the ecosystem and its diversity. Introduces different environmental technologies to mitigate the adverse impacts of environmental pollution. It creates awareness of global treaties with a broader context. Further, familiarizes the basic concepts of disaster management.

Syllabus:

UNIT-1: **(4 Hours)**
Ecosystem and Biodiversity
Nature of Ecosystem, scope, concept of ecosystem, biodiversity, importance, conservation of natural resources-renewable and non-renewable resources.

UNIT-2: **(4 Hours)**
Environmental Pollution
Air, water, soil, noise, plastic pollution- sources, effects, Environmental carcinogens-types, sources of ionizing radiation, global climatic challenges.

UNIT-3: **(5 Hours)**
Environmental Technology
Water pollution management-Waste water treatment, air pollution-control measures, solid waste management, methods to hazardous waste collection and treatment of hazardous waste, bio-medical waste management, and technical solutions for plastic waste.

UNIT-4: **(5 Hours)**
Environmental Management and Sustainable Development
Environmental standards in India, Environmental legislation acts, Environmental assessment (EA), Environmental management plan, Carbon credits under KYOTO, IPCC, UNFCC, National and international plans for climatic change.

UNIT-5: **(4 Hours)**
Disaster Management
Disaster Management, identification of disaster prone areas, disaster warning programs.

UNIT-6: **(4 Hours)**

Field Visit

Eco tourism-Student should go field visit and have to submit a report for evaluation.

Course Outcomes:

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

CO1: Explain different types of ecosystem services and provide examples of ultimate and proximate threats to biodiversity and ecosystem integrity.

CO2: Recognize the different aspects of environmental contamination, which have adverse effects on human health.

CO3: Evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the restoration of degraded environments.

CO4: Identify and justify key stakeholders in humanities and social sciences that need to be a part of sustainable solutions.

CO5: Describe the findings and critically analyze various aspects that are relevant to environmental studies during a field trip.

CO6: Asses impact of disasters and environmental hazards with emphasis on disaster preparedness, response and recovery.

Mapping of COs to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	-	-	-	-	2
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	-	-	-	-	2
CO4	-	-	-	-	-	-	3	-	-	-	-	2
CO5	-	-	-	-	-	3	-	-	-	3	-	2
CO6	-	-	-	-	-	3	3	-	-	-	-	-

Text Books:

1. Environmental Studies by R. Rajagopalan, 2nd Edition, Oxford University Press.
2. A Textbook of Environmental Studies by Shashi Chawla, TMH.
3. Environmental Studies by P.N. Palaniswamy, P. Manikandan, A. GeethEnviroa, and K. Manjula Rani; Pearson Education.

Reference Books:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers.
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co.
4. Environmental Studies by Piyush Malaviya, Pratibha Singh, Anoopsingh: Acme Learning.

II Year-I Semester

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

(Common to ME and CE)

Subject Code: UGEE2T0120	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Engineering Physics, Mathematics

Course Objectives:

The basic input to all engineering is the electric energy. A basic course on Electrical Engineering is almost essential for all engineering students. This course will offer various features of Electrical & Electronics Engineering starting from simple DC circuits, Transformers, various DC & AC machines, and Electronic devices.

Syllabus

UNIT –I	**DC Circuits**	**Hours: 09**
Electrical circuit parameters (R, L and C), ohms law, Kirchhoff current and voltage laws, voltage and current sources, series and parallel circuits, voltage and current division rule, analysis of simple circuits with dc excitation (independent sources only), Star to delta transformation.		
UNIT –II	**DC Machines**	**Hours: 09**
Construction of dc machine, principle and working of DC Generator, EMF Equation, types of dc generators. Principle and working of DC motor, Torque Equation of dc Motor, types of DC Motors and speed control of DC motor, simple problems.		
UNIT –III	**Transformers**	**Hours: 08**
Principle and working of single – phase transformer, construction: types of single-phase transformer, EMF Equation of a Transformer, OC test and SC test, efficiency and regulation, simple problems.		
UNIT – IV	**AC Machines**	**Hours: 08**
Principle and working of three-phase Induction motor, Constructional details, types of Induction Motor, Slip, Torque slip characteristics. Single-phase Induction Motor - Construction and working principle, Spilt-phase and capacitor type Induction motors. Alternators: Principle and working, constructional details, EMF equation		
UNIT –V	**Electronic Devices**	**Hours: 09**
PN junction diodes, types, V-I characteristics. Transistor configurations, characteristics. Principle of operation of Half-wave, Full-wave rectifier and bridge rectifier. Introduction to OP-AMPs.		
UNIT –VI	**Amplifiers and Oscillators**	**Hours: 08**
Biasing Methods, Classification of Amplifiers, Feedback Amplifiers, Transistor as an Amplifier, frequency response of CE Amplifier. Operations of Oscillators: – RC Phase Shift and Wien Bridge.		

Course Outcomes: At the end of this course students will be able to
CO1: To Interpret and analyze basic electric circuits with DC excitation.
CO2: To demonstrate the working principles of DC machines.
CO3: To analyze the constructional features of Transformers and to study of its working principle.
CO4: To explain the constructional features and study of AC machines.
CO5: To summarize the working principles of Diodes, Transistors and analyze their characteristics.
CO6: To classify the working principles of the different types of Amplifiers & Oscillators.

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												

TextBooks:

1. Basic Electrical & Electronics Engineering, D. P. Kothari and I. J. Nagrath, 1st edition, Tata McGraw Hill, 2020.
2. Basic Electrical & Electronics Engineering, S. K. Bhattacharya, 1st edition, Pearson education India, 2011.
3. Basic Electrical & Electronics Engineering, B. R. Patil, 1st edition, Oxford University press, 2012.

ReferenceBooks:

1. Fundamentals of Electrical & Electronics Engineering, by S. K. Sahadev, Dhanpat rai publications, 2010.
2. Basic Electrical Engineering, by D. C. Kulshreshtha, 2nd edition, McGraw Hill, 2009.
3. Basic Electrical Engineering, by Nagsarkar,Sukhija, 2nd edition, Oxford University Press, 2005

ELECTRICAL CIRCUIT ANALYSIS-I

Subject Code: UGEE2T0220	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Engineering Physics, Mathematics

Course Objective: This course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits, and network topology.

Syllabus

UNIT –I Introduction to Electrical Circuits Hours: 09

Passive components and their V-I relations. Sources (dependent and independent) -Kirchhoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta- to-star transformation). source transformation technique, nodal analysis and mesh analysis.

UNIT –II A. C Fundamentals Hours: 08

Periodic waveforms (determination of rms, average value, peak factor, and form factor). Concept of phase angle and phase difference – Waveforms and phasor diagrams for lagging, leading networks. Complex and polar forms of representations.

UNIT –III Analysis of AC Networks Hours: 09

Steady state analysis of R, L and C circuits. Power Factor and its significance, real, reactive power and apparent power, waveform of instantaneous power and complex power, Extension of node and mesh analysis to AC networks, Numerical problems on sinusoidal steady state analysis.

UNIT –IV Resonance Hours: 08

Series and parallel resonance, Selectively band width and Quality factor, Numerical Problems, Introduction to locus diagram.

UNIT- V Network Theorems –I Hours: 08

Superposition theorem, Thevenin's theorem, Norton's theorem- Application of network theorems on AC and DC circuits (Numerical problems)

UNIT –VI Network Theorems –II Hours: 08

Maximum Power Transfer theorem, Reciprocity theorem, Milliman's theorem, compensation theorem and Tellegen's theorem. Application of network theorems on AC and DC circuits (Numerical problems)

Course Outcomes: At the end of this course, students will be able to

CO1: Apply the basic concepts of Electrical circuits to solve various electrical networks

CO2: Apply AC fundamentals to analyze single-phase AC circuits of different configurations

CO3: Compute the resonance, bandwidth, and quality factors for series and parallel resonance circuits

CO4: Simplify electrical networks using network theorems

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO5	3	3	-	-	-	-	-	-	-	-	-	-	-	3

Textbooks:

1. "Engineering Circuit Analysis" by William Hayt and Jack E. Kemmerley, 6th edition, McGraw Hill Company,

2. "Network Analysis" by Van Valkenburg, 3rd edition, PHI Learning, 2006.

3. "Fundamentals of Electric circuits" by C. K. Alexander and M. N. O. Sadiku, 5th edition, Mc Graw hill Publishers, 2013.

Reference Books:

1. "Circuit Theory (Analysis and Synthesis) by A. Chakrabarthi, 7th edition, Dhanpat Rai & Co. 2015.

2. "Introductory circuit analysis" by Robert L Boylestad, 12th edition, Pearson Education, 2013.

ANALOG ELECTRONICS

Subject Code: UGEE2T0320	**L**	**T**	**P**	**C**
I Year / II Semester	**2**	**0**	**2**	**3**

Prerequisites: Semiconductor Physics

Course Objective: The objective of this course is to introduce the students about the fundamentals concepts of semiconductor diodes, Transistor and their applications. It also introduces wave shaping concepts of both linear and non-linear circuits and design of multivibrators. At the end of the course, the students are expected to know about the applications of the semiconductor devices.

Unit I: LINEAR WAVE SHAPING (10Hours)

Response of High pass and low pass RC circuits to different signals (sinusoidal, step, pulse,square and ramp), high pass RC circuit as adifferentiator, low pass RC circuit asan integrator, attenuator, its application in CRO probe.

UNIT II: DIODE CIRCUITS (10Hours)

P-N junction diode, diode current equation, I-V characteristics of a diode, diode resistance and capacitance, Diode Equivalent Circuits(models),Zener diode and its characteristics, LED, Photo diode, Tunnel diode.

Unit-III: DIODE APPLICATIONS (12Hours)

Diode Clippers: Shunt Clippers, Series clippers, clipping at two independent levels, transfer characteristics of clippers, Design of clippers

Diode Clampers: Positive clampers, negative clampers, Design of clampers

Rectifiers and Voltage regulator: Zener diode as a voltage regulator

Unit IV: TRANSISTOR CIRCUITS (10Hours)

BJT: Structure and configuration of BJT with input and output characteristics, Operating point and load line analysis

MOSFET: Structure, Characteristics, Operating point and load line analysis

UNIT V: TRANSISTOR BIASING AND APPLICATIONS (12Hours)

BJT Biasing: Need for Biasing, different methods. MOSFET biasing: different methods.

Generalized analysis of transistor amplifier model using h-parameters (frequency response)

Applications: BJT as a switch, BJT as an amplifier (Single stage), MOSFET as a switch, MOSFET as an amplifier.

UNIT VI: DESIGN OF MULTIVIBRATORS (10Hours)

Bistablemultivibrators: Analysis and Design of fixed and self-bias transistor binary. Monostable: Analysis and Design of collector coupled mono-stable multivibrators, waveforms at bases and collectors,

AstableMultivibrator: Analysis and Design of Collector coupled Astablemultivibrator, Astablemultivibrator as a voltage to frequency converter

List of Experiments

PART A: ELECTRONIC WORKSHOP PRACTICE

1. Identification, Specifications, Testing of R, L, C Components (Color Codes), Potentiometers, Switches (SPDT, DPDT, and DIP), Coils, Gang Condensers, Relays, Bread Boards.

2. Identification, Specifications and Testing of Active Devices, Diodes, BJTs, JFETs, MOSFETs, Power Transistors, LEDs, LCDs, Optoelectronic Devices.

3. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeters, Function Generator, Regulated Power Supplies and CRO.

PART B: (all 6 Experiments from Section B are Compulsory (only internal choice in each experiment number))

Experiment 1: (i) Linear wave shaping (Diff. Time Constants, Integrator)

(or)

(ii)Linear wave shaping (Diff. Time Constants, Differentiator)

Experiment 2: (i) PN Junction diode characteristics (Static Resistance and Cut-in Voltage)

(or)

(ii) Zener Diode as a Voltage regulator

Experiment 3: (i) Diode applications: Clippers, clampers

(or)

(ii)Bridge Rectifier (with & without filters)

Experiment 4: (i) Load line and operating of CE circuit

(or)

(ii) Transistor CE characteristics (Input and Output characteristics)

Experiment 5: (i) Transistor application: Transistor as a Switch

(or)

(ii) Design of Voltage divider biasing Circuit for given operating point and Transistor

Experiment 6:(i) Design of AstableMultivibrator (Voltage – Frequency Converter)

(or)

(ii) Design of monostableMultivibrator

Course Outcomes: At the end of this course students will be able to

CO1: Analyze various linear wave shaping circuits and its responses
CO2: Explain working, characteristics and properties of different types of semiconductor diodes and Transistors.
CO3: Analyze the biasing of transistor circuits and develop various applications using the diodes and transistors
CO4: Explain and design multivibrator circuits for the given set of specifications.
C05: Develop technical writing skills important for effective communication and acquire teamwork skills for working effectively in groups.

CO-PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	-	-	-	-	-	-	-	2	2	2	-	-	-	-

TEXT BOOKS:

1. "Electronic Devices and Circuits", J Millman, Chritophas C Halkias, and Satyabratajit Vol 1, 4th Edition, McGraw Hill Edition, 2015.
2. "Pulse, Digital and Switching Waveforms", Jacob Millman and Herbert Taub, Vol 1, 3rd Edition, McGraw Hill Edition, 2011.
3. "Electronic Devices and Circuit theory", R L Boylestad and Louis Nashelsky, Vol 1, 11th Edition, Pearson Education, 2006.
4. "Pulse and Digital Circuits", Venkata Rao K, Rama Sudha K and Manmadha Rao G, Vol 1, 1st Edition, 2010

REFERENCE BOOKS:

1. "ELECTRONIC PRINCIPLES", Albert Malvino and David J Bates, Vol 1, 8th Edition, MC Graw Hill Edition, 2015
2. "Electronic Devices", Thomas L Floyd, Vol 1, 9th Edition, Pearson Education, 1996
3. "Electronic Devices and Circuits", David A Bell, Vol 1, 5 Edition, Oxford University Press,2008.
4. "Electronic Devices &Circuits", J B Gupta, Vol 1, 6st Edition, S K Kataria& Sons, 2016

ELECTRICAL CIRCUTS LAB

Subject Code: UGEE2P0420	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Any 10 of the following experiments are to be conducted

1. Verification of KCL and KVL with DC excitation
2. Verification of DC Nodal analysis
3. Verification of DC Mesh analysis.
4. Determination of average value, R.M.S value, form factor, peak factor of Sinusoidal wave.
5. Series and Parallel Resonance
6. Verification of Thevenin's theorem
7. Verification of Norton's theorem
8. Verification of Superposition theorem
9. Verification of Maximum power transfer theorem
10. Verification of Compensation theorem
11. Verification of Milliman's theorem.

Course Outcomes: At the end of this course students will be able to

CO1: verify circuit Laws and nodal and mesh analysis

CO2: Determine parameters of a given sinusoidal waveform

CO3: Interpret the response of series and parallel RLC circuits under resonance

CO4: Determination of self and mutual inductance and coefficient of coupling

CO5: Verify various Theorems.

CO-PO MAPPING:

Pos	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												

References: https://nptel.ac.in/courses/108/106/108106172/

https://sabotin.ung.si/~mv0029/pdf/Alexander_2.pdf

ELECTRICAL CIRCUIT ANALYSIS-II

Subject Code: UGEE3T0120	**L**	**T**	**P**	**C**
II Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Laplace Transforms, Vectors, Complex numbers, Electrical circuits Analysis-I

Course Objective: This course aims at study of coupled circuits, three phase systems, transient analysis and two port networks for the future study and analysis of power systems.

Syllabus

UNIT I Analysis of Coupled Circuits Hours: 08

Basic definitions of Magnetic circuits, Faraday's laws of electromagnetic induction, Self, mutual Inductance, coupling coefficient, Self, Mutual Inductance and their relation, Dot Convention, Series, and parallel aiding and opposing.

UNIT –II Balanced Three phase circuits Hours: 09

Phase sequence- star and delta connection - relation between line and phase voltages and currents - analysis of balanced three phase circuits - measurement of active and reactive power.

UNIT –III Unbalanced Three phase circuits Hours: 08

Analysis of three phase three wire unbalanced circuits - Loop method, Star-Delta transformation technique, Applications of Milliman's theorem, Two wattmeter method for measurement of three phase power.

UNIT –IV Time Domain Analysis of Electrical Circuits Hours: 09

Time-domain analysis of first and second order differential equations for Series and parallel R-L, R-C, RLC circuits for DC and AC excitations, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT –V Electrical Circuit Analysis Using Laplace Transforms Hours: 08

Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros, Frequency response (magnitude and phase plots).

UNIT –VI Two Port Networks Hours: 08

Z parameters, Y parameters, ABCD parameters and hybrid parameters and their relations. Relationships between parameter sets simplification of cascaded and parallel networks

Course Outcomes: At the end of this course students will be able to

CO1: analyze coupled circuits under different connections

CO2: Analyze balanced and unbalanced three phase circuits and to determine three-phase power.

CO3: Extend the knowledge ofmathematics to analyze transient and steady state response of electrical circuits in time domain and s-domain.

CO4: Deduce and relate two-port parameters for a given two-port network.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	3

Textbooks:

1. "Engineering Circuit Analysis" by William Hayt and Jack E. Kemmerley, 6th edition, McGraw Hill Company

2. "Network Analysis" by Van Valkenburg, 3rd edition, PHI Learning, 2006.

3. "Fundamentals of Electric circuits" by C. K. Alexander and M. N. O. Sadiku, 5th edition, Mc Graw hill Publishers, 2013.

Reference Books

1. "Circuit Theory (Analysis and Synthesis) by A. Chakrabarthi, 7th edition, Dhanpat Rai & co. 2015.

2. "Introductory circuit analysis" by Robert L Boylestad, 12th edition, Pearson Eductaion, 2013.

ANALOG INTEGRATED CICRUTS

Subject Code: UGEE3T0220	**L**	**T**	**P**	**C**
II Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Electrical circuits, Analog Electronics - I

Course Objective: The objective of this course is to introduce the basic building blocks of the Linear Integrated circuits, and applications on Linear & Non-linear Op-amps. To study the specials functions of PLL, Linear IC's and Digital IC's and theory about the ADC and DAC.

Syllabus

UNIT –I	**INTRODUCTION TO OPERATIONAL AMPLIFIER**	**10 Hours**

Introduction to Operational Amplifier-Block diagram of Typical Op-Amp With Various Stages-circuit symbol- BJT Differential Amplifier -Different input/output configurations of BJT differential amplifier-DC and AC Analysis of BJT Differential Amplifier With R_E - AC analysis with r-parameters-BJT differential amplifier Analysis with constant current source-Current repeater circuit-Current mirror circuit-Level translator-Cascaded BJT differential amplifier-FET differential amplifier

UNIT –II	**OPERATIONAL AMPLIFIER CHARACTRISTICS**	**10Hours**

Ideal operational amplifier properties–Ideal assumptions-equivalent circuit-virtual ground-OPAMP Parameter; Input bias current -Input offset Current-Input OffsetVoltage-Differential input resistance-CMRR-PSRR-Slew ratio–Large signal voltage gain–Output voltage swing transient's response. OPAMP with open loop and closed loop configurations Basic circuits such as differential, inverting and non-inverting.

UNIT –III	**OPERATIONAL AMPLIFIER APPLICATIONS**	**12Hours**

OPAMP as voltage follower-summing Amplifier-Non-inverting summing amplifier-subtractor-Differentiator-Integrator-Scalechanger-Instrumentation Amplifier-V to I and I to V Convertors-Log and Antilog amplifiers–non-inverting type comparator–Inverting type Comparator-Zero crossing detector–Schmitt-trigger sample and hold circuit-peak Detector-Precision Diode-Half-wave and full-wave rectifiers. Non-ideal operational amplifier non–inverting amplifier-inverting amplifier.

UNIT – IV	**ACTIVE FILTERS DESIGN & IC VOLTAGE REGULATORS**	**12Hours**

ACTIVE FILTERS: Active filters(Butter-Worth) Introduction-Merits and demerits of active filters Over PassiveFilters-First order low passfilter Design and frequency Response-Second order LPF design and frequency Response-First order HPF design and frequency Response-Second order HPF design and frequency Response-Higher-order filters-BPF wide band-pass and narrow band–pass Filter-Wide band reject Filter-Notch Filter-All-pass filter.

IC VOLTAGE REGULATORS: Basic Voltage Regulators-IC voltage regulators using 78XX-79XX -Dual power supplying using 78XX and 79XX series.

UNIT –V	**WAVEFORM GENERATORS USING OP-AMP,TIMERS & PLL**	**10 Hours**

OPAMPS: Wave form generators using op–amps: square wave & triangular wave, Design of Astable multi vibrator -Monostablemulti vibrator using signal op-amp

555 TIMERS: Introduction-Pin diagram-Functional diagram for 8pin DIP-Design of Astable and monostablemultivibrators-Astable application as voltage controlled oscillator-Monostable application as pulse width modulation

PLL: Introduction, block diagram-Function of each block 565 PLL-PLL Applications as Frequency divider and frequency multiplier

UNIT –VI	D TO A AND A TO D CONVERTERS	10 Hours
D to A and A to D Convertors; Digital to Analog Convertors(D to A)-Introduction-Specifications-Basic DAC techniques-Weighted resistor DAC R–2R ladder DAC-Invested R-2R Output expression for each type. Analog to Digital Convertors Introduction-Specifications-Parallel comparator type-Counter type-Dual slope-Successive approximation type ADCs-Merits and demerits of each type, Comparison of different types.		

Course Outcomes: At the end of this course students will be able to

CO1: Explain internal operation and characteristics of different configurations of operational amplifier

CO2: Acquaint with a wide variety of op-amps to develop linear and digital IC applications

CO3: Develop and distinguish various analog filter configurations based on frequency response using an Op-Amp.

CO4: Classify and develop wave form generators using op-amp, 555 timer and PLL with their applications

CO5: Construct and compare different A to D and D to A conversion operation

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	2											2	
CO2	1	2									3		2	
CO3	1	2			3						3		1	
CO4	1	2			3						3		1	
CO5	1	2			3						3		2	

TextBooks:

1. "Op-Amps and Linear Integrated Circuits", Ramakanth A Gayakwad, Vol 1, 4th Edition, Pearson Education, 2000,

2. "Linear Integrated Circuits", D Roy Chowdary, Vol 1, 2nd Edition, New Age International, 2003.

3. "Microelectronics", Arvin Gabriel & Jacob Millman, Vol 1, 2nd Edition, Tata McGraw Hill Education Pvt Ltd, 2001.

ReferenceBooks:

1. "Op-Amps and Linear Integrated Circuits", Dr Sanjay Sharma, Vol 1, 4th Edition, S K Kataria& Son's, 2017

2. "Analog Electronics", L K Maheswari& M M S Anand, Vol 1, 1st Edition, Prentice Hall India Pvt Ltd, 2006

3. "Linear Integrated Circuits", S Salivahan& V S KanhanaBhasskaran, Vol 1, 1st Edition, Tata McGraw Hill Publishing Company Ltd, 2008

4. "Electronic Principles", Albert Malvino and David J Bates, Vol 1, 8th Edition, Mc Graw Hill Edition, 2015

DIGITAL LOGIC CIRCUITS

Subject Code: UGEE3T0320	**L**	**T**	**P**	**C**
II Year / I Semester	**3**	**0**	**0**	**3**

Course Objective:

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits
- To illustrate the concept of synchronous sequential circuits
- To introduce the concept of memories and programmable logic devices.

Syllabus

UNIT –I DIGITAL FUNDAMENTALS **Hours: 08**

Number Systems and Conversions – Decimal, Binary, Octal, Hexadecimal, 1's &2's complements and its methods of subtraction, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Error detection and correction codes, parity checking, Hamming code.

UNIT-II MINIMIZATION TECHNIQUES **Hours :08**

Logic gates, Boolean theorems, Minimization of logic functions using Boolean theorems, Sum of products and Product of sums, Minterms and Maxterms, Karnaugh map (up to Four variables) and Quine-McCluskey method.

UNIT –III COMBINATIONAL CIRCUIT DESIGN **Hours: 08**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Decoder, Encoder, Priority Encoder, Magnitude Comparator

UNIT –IV PROGRAMMABLE LOGIC DEVICES **Hours: 06**

Basic memory structure – ROM -PROM – EPROM, EEPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL

UNIT –V SEQUENTIAL CIRCUITS - I **Hours: 06**

Latches, Flip flop, Triggering of Flip-flops, Flip-flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, conversion of FF to another FF.

UNIT –VI SEQUENTIAL CIRCUITS -II **Hours: 06**

Circuit implementation – Counters: Design of Counters- Ripple Counters, Ring Counters, Jonson Counter.
Registers: Shift registers, Universal Shift Register, Bidirectional Shift register.
Analysis and design of clocked sequential circuits : Moore/Mealy models, state minimization, state assignment.

Course Outcomes: At the end of this course students will be able to

CO1: Understand the fundamentals of Digital logic circuits
CO2: Analyze different methods used for simplification of Boolean expressions
CO3: Design and implement Combinational circuits
CO4: Apply the memory devices in different types of digital circuits
CO5: Develop skillto design sequential circuits

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													
CO2	3	3	3											
CO3	3	3	3											
CO4	3	3	3											
CO5	3	2	2											

TextBooks:

1. Raj Kamal, 'Digital Systems-Principles and Design', Pearson education 2nd edition, 2007
2. M. Morris Mano, 'Digital Design', Pearson Education, 2006.
3. John M.Yarbrough, 'Digital Logic, Application & Design', Thomson, 2002.
4. Digital Electronics and Logic Design, Dr. Sanjay Sarma, Katson Books, Fourth Edition, 2016.

ReferenceBooks:

1. Charles H.Roth, 'Fundamentals Logic Design', Jaico Publishing, IV edition, 2002.
2. Floyd and Jain, 'Digital Fundamentals', 8th edition, Pearson Education, 2003.
3. John F.Wakerly, 'Digital Design Principles and Practice', 3rd edition, Pearson Education, 2002.
4. Tocci, "Digital Systems : Principles and applications, 8th Edition" Pearson Education.

ELECTRICAL MACHINES-I

Subject Code: UGEE3T0420	**L**	**T**	**P**	**C**
II Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Fundamental Laws in Electromagnetism, Basic Electrical Engineering

Course Objective: To understand the concepts of Magnetic circuits, DC Machines and Transformers.

UNIT I: DC GENERATORS **10hrs**

Principles of Electromechanical Energy conversion, construction features of conventional DC machines.
D.C. Generators – Principle of operation –E.M.F Equation – armature windings – lap and wave windings,Armature reaction – Cross magnetizing and de-magnetizing AT/pole –commutation Process – methods of improving commutation, Classification– applications of DC Generators,Losses and Efficiency.

UNIT II: DC MOTORS **10hrs**

D.C Motors – Principle of operation – Back E.M.F. - Torque equation – Losses and Efficiency. Classification – applications of dc motors. Starting by 3 point and 4 point starters,Speed control of d.c. shunt Motors: Armature voltage and field flux control methods, Speed control of series motor.

UNIT – III: PERFORMANCECHARACTERISTICS OF D.C. MACHINES **8hrs**

Open circuit characteristic of separately excited DC generator, voltage build-up in a shunt generator, critical field resistance and critical speed, causes for failure to self-excited and remedial measures. Load characteristics of DC generators, Performance characteristics of DC Motors

UNIT-IV: PARALLEL OPERATION AND TESTING OF D.C. MACHINES **7hrs**

Parallel operation of dc shunt, series and compound generators, Direct Testing - brake test on DC Motors, load test on DC generators, Indirect testing: Swinburne‘s test – Hopkinson‘s test – Field’s test - Retardation test - problems.

UNIT V: SINGLE PHASE TRANSFORMER AND AUTO TRANSFORMER **10hrs**

Operation of single-phase transformers at different loads with phasor diagrams –Equivalent Circuit, testing - open circuit and short circuit tests, separation of hysteresis and eddy current losses, Efficiency and Regulation calculations. Autotransformers - construction, principle, applications and comparison with two winding transformer, Parallel operation of single-phase transformers

UNIT VI: POLY-PHASE TRANSFORMER **10hrs**

Three-phase transformer - construction, types of connection and their comparative features, Phase conversion – Scott connection, Tap-changing transformers - No-load and ON-load tap changing of transformers, Three-winding transformers – Determination of Zp, Zs and Zt.

Course Outcomes: At the end of this course students will be able to
CO 1: Apply and analyze the energy conversion principles to rotating machines.
CO2: Sketch and explain the constructional details and analyze the operation of Transformers and DC Machines
CO3: Analyze the testing methods of DC Machines, transformers and performance of transformers using phasor diagrams

CO-PO MAPPING:

PO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3	3											

TEXT BOOKS:
1. "Electric Machinery", A. E. Fitzgerald, C. Kingsley and S. D. Umans, 6th Edition, McGraw-Hill, 2003.
2. "Performance and Design of Direct Current machines", A. E. Clayton and N. N. Hancock, 1st Edition, CBS Publishers, 2004.
3. "Electric Machines", I. J. Nagrath and D. P. Kothari, 5th Edition, McGraw Hill Education, 2010.
REFERENCE BOOKS:
1. "A Text Book of Electrical Machines", R. K. Rajput, 4th Edition, Laxmi Publications, 2006.
2. "Electrical Machinery", P. S. Bimbhra, 7th Edition, Khanna Publishers, 2011.
3. "Electrical Machines", Smarajit Ghosh, 2nd Edition, Pearson, 2012.

ELECTRICAL MACHINES- I LAB

Subject Code: UGEE3P0520	**L**	**T**	**P**	**C**
II Year / I Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Any ten of the experiments from the following are to be conducted.

1. Magnetization characteristics of DC Shunt Generator. Determination of critical field resistance and critical speed.
2. Load test on DC Shunt Generator. Determination of Characteristics.
3. Load test on DC Series Generator. Determination of Characteristics.
4. Load test on DC compound Generator. Determination of Characteristics.
5. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
6. Field's test on DC series machines. Determination of efficiency.
7. Swinburne's Test. Predetermination of DC Generator and DC Motor Efficiency.
8. Brake Test on DC compound motor. Determination of performance curves.
9. Brake Test on DC shunt motor. Determination of Performance curves.
10. Separation of losses in DC shunt motor.
11. Speed Control of DC shunt Motor by Field and Armature Control Methods.
12. Retardation Test on DC shunt machine.

Course Outcomes: At the end of this course students will be able to

CO1: Examine the performance characteristics of various DC Generators

CO2: Determine the efficiency and losses of DC machines by conducting suitable tests

CO3: Examine the performance curves of various DC Motors

CO4: Analyze the behaviour of dc shunt motor by separating losses and test for speed control

CO-PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1			3	3								2		
CO2			3	3								2		
CO3			3	3								2		
CO4			3	3								2		

DIGITAL LOGIC CIRCUITS LAB

Subject Code: UGEE3P0620	**L**	**T**	**P**	**C**
II Year / I Semester	**0**	**0**	**3**	**1.5**

Course Objective:

To provide hand-on experience in designing and implementing digital/logic circuits. The laboratory exercises are designed to give students ability to design, build, and implement digital circuits and systems. Laboratory exercise progress from investigation of the properties of basic logic gates and flip-flops to the design of combinational and sequential circuits.

Syllabus

List of Experiments

Any Ten of the below Experiments can be conducted

1. (a) Study of Logic gates

   (b) Verify DE Morgan's Theorem for 2 variables.
2. Simplification of K-Maps
3. Design and Implementation of Code Converters using logic gates
4. Design and Implementation Arithmetic circuits
5. Design and Implementation of Decoders and Encoders
6. Design and Implementation of MUX and DE-MUX
7. Design and Implementation of Magnitude comparator
8. Verify State tables of Flip Flops
9. Design and Implementation of Registers
10. Design and Implementation of Counters

Course Outcomes: At the end of this course students will be able to

CO1: Verify De Morgan's Theorem and K-Maps using various logic gates

CO2: Design and implementation of code converters using logic gates

CO3: Design and implementation of combinational and sequential logic circuits

CO4: Develop technical writing skills and effective communication

CO5: Acquire teamwork skills for working in groups

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1				3										
CO2				3										
CO3				3										
CO4										3				
CO5									3					

ANALOG CIRCUITS LAB

Subject Code: UGEE3P0720	**L**	**T**	**P**	**C**
II Year / I Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Linear IC Applications (Any 10 Experiments)

1. Op-Amp Applications
    a. Adder
    b. Subtractor
2. Integrator Circuit using IC741
3. Differentiator Circuits using IC741.
4. Active Filter Applications: LPF (first order)
5. Active Filter Applications: HPF (first order)
6. IC741 Oscillator Circuit: RC Phase Shift Oscillator
7. IC741 Oscillator Circuit: Wein Bridge Oscillator
8. IC 555 Timer: Monostable Operation Circuit
9. IC 555 Timer: Astable Operation Circuit
10. Monostable Operation Circuit using Op-Amp
11. Astable Operation of Circuit using Op-Amp
12. 4 bit DAC using OP-AMP

Course Outcomes:

CO1: Having knowledge to design and analyze OP-AMP circuits, Pulse and Digital circuits, A-D conversion & D-A conversion

CO2: Develop technical writing skills important for effective communication.

CO3: Acquire teamwork skills for working effectively in groups

CO-PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	2	1										1	1
CO2								2	1					
CO3									2	1				

II Year II-Semester

ELECTROMAGNETIC FIELDS

Subject Code: UGEE4T0120	**L**	**T**	**P**	**C**
II Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Engineering Physics, Mathematics -II

Course Objective: Electromagnetic fields are the foremost pre-requisite course for most of the subjects in Electrical Engineering. Either in the enunciation of basics of electrical elements R, L and C that are the building blocks of any electrical device or in the illustration of Energy transfer from mechanical to electrical and vice versa its role is crucial. This course also includes the famous works of Coulomb, Ampere, Faraday, Maxwell etc. to the field of Electrical Engineering.

Syllabus

UNIT –I Static Electric fields **Hours: 09**

Electrostatics: Electrostatic Fields – Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge – Work done in moving a point charge in an electrostatic field – Electric Potential – Properties of potential function – Potential gradient – Guass's law –– Maxwell's first law, div(D)= ρ_v , Laplace's and Poison's equations and Solution of Laplace's equation in one variable.

UNIT –II Conductors, Dielectrics and Capacitance **Hours: 09**

Conductors – Dielectrics and Capacitance: Electric dipole – Dipole moment – potential and EFI due to an electric dipole – Torque on an Electric dipole in an electric field – Behaviour of conductors in an electric field – Conductors and Insulators Polarization – Boundary conditions between conduction to Dielectric and dielectric to dielectrics capacitance – capacitance of parallel plates, spherical and coaxial cables with composite dielectrics –Energy stored and energy density in a static electric field – Current density – conduction and Convection current densities – Ohm's law in point form – Equation of continuity

UNIT –III Steady Magnetic Fields **Hours: 08**

Magneto statics and Ampere's Law: Static magnetic fields – Biot-Savart's law – Oesterd's experiment - Magnetic field intensity (MFI) – MFI due to a straight current carrying filament – MFI due to circular, square and solenoid current – Carrying wire – Relation between magnetic flux, magnetic flux density and MFI – Maxwell's second Equation, div(B)=0 –Ampere's circuital law and its applications viz. MFI due to an infinite sheet of current and a long filament carrying conductor – Point form of Ampere's circuital law –Field due to a circular loop, rectangular and square loops, Maxwell's third equation, Curl (H)=J.

UNIT – IV Magnetic Force and Torque **Hours: 08**

Force in Magnetic fields: Magnetic force - Moving charges in a Magnetic field – Lorentz force equation – force on a current element in a magnetic field – Force on a straight and a long current carrying conductor in a magnetic field – Force between two straight long and parallel current carrying conductors – Magnetic dipole and dipole moment – a differential current loop as a magnetic dipole – Torque on a current loop placed in a magnetic field.

UNIT –V Inductance **Hours: 08**

Self and Mutual inductance: Self and Mutual inductance – determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magnetic field.

UNIT –VI Time-Varying Fields **Hours: 08**

Time Varying Fields: Time varying fields – Faraday's laws of electromagnetic induction – Its integral and point forms – Maxwell's fourth equation, Curl (E) = $-\frac{\partial B}{\partial t}$ - Statically and Dynamically induced EMFs – Simple problems -Modification of Maxwell's equations for time varying fields – Displacement current – Poynting Theorem and Poynting vector.

Course Outcomes: At the end of this course students will be able to

CO1: Solve electric filed problems of various configurations by using Coulombs law, Gauss's theorem and by solving Laplace's and Poisson's equations

CO2: Solve magnetic field problems of various configurations by using Biot-Savart's law, Ampere's law by different techniques.

CO3: Apply Faradays law of electromagnetic induction to solve and analyze problems of Performance and behavior of electromechanical devices such as Motors, Generators and Transformers.

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												

TextBooks:

1. "Engineering Electromagnetics", by William H. Hayt& John. A. Buck, 7thEditon, Mc. Graw-Hill Companies, 2006.

2. "Elements of electromagnetics", by Matthew N. O. Sadiku, 4th Edition, Oxford University Press, 2007.

3. "Introduction to Electro Dynamics" by D J Griffiths, 2nd edition, Prentice-Hall of India Pvt. Ltd, 2014.

ReferenceBooks:

1. "Electromagnetism - Theory and applications", A. Pramanik, 2nd edition, PHI Learning Pvt. Ltd, 2009.

2. "Engineering Electromagnetics", by J. P. Tewari, 2nd edition, Khanna publishers, 2013.

3. "Electromagnetics" by J. D Kraus 4th edition, McGraw-Hill Inc. 1992.

ELECTRICAL MACHINES-II

Subject Code: UGEE4T0220	**L**	**T**	**P**	**C**
II Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Fundamental Laws in Electromagnetism, Electrical Machines-I

Course Objective: To understand the concepts of Induction and Synchronous Machines.

Syllabus

UNIT I: Design of AC Machine Windings and Revolving Magnetic Field 10hrs
Armature windings- Distributed and concentrated windings - distribution - pitch and winding factor, E.M.F equation of alternator, Harmonics and its suppression. Three windings spatially shifted by 120 degrees and Concept of revolving magnetic field. Windings spatially shifted by 90 degrees and pulsating magnetic field.

UNIT II: Three phase Induction Machines 10hrs
Induction motor- Principle and operation, Types (squirrel cage and slip-ring), EMF equation, slip, rotor current, starting torque, running torque, maximum torque, relationship between rotor input, rotor copper loss, and mechanical power developed. Equivalent circuit, Phasor Diagram, Effect of parameter variation on torque speed characteristics (variation of Rotor resistance, stator voltage, frequency), Power stages, losses and efficiency, Induction Generator operation.

UNIT III: Circle Diagram and speed control of Induction Motor 8hrs
No load and blocked rotor tests - Circle diagram – predetermination of performance. Methodsof starting - DOL, Resistance Control, Star-Delta & Auto-transformer and Speed Control – slip control techniques and synchronous speed control techniques.

UNIT-IV: Single-phase induction motors 8hrs
Single phase induction motors- Double revolving field theory, and Cross field theory, Torque speed characteristics, Split-phase starting methods and applications equivalent circuit, and determination of parameters.

UNIT V: Synchronous Generators 10hrs
Synchronous generator- construction , armature reaction, equivalent circuit and phasor diagram , characteristics of synchronous machines, voltage regulation methods by EMF, MMF and ZPF , Salient pole machine - Two Reaction Theory, phasor diagram, slip test-determination of Xd and Xq. Parallel operation of alternators - synchronization and load sharing, Power stages, losses and efficiency

UNIT VI: Synchronous Motors 8hrs
Principle of operation - methods of starting - phasor diagram, V and inverted V curves, mathematical analysis for power developed - excitation and power circles – hunting and its suppression, Power stages, losses and efficiency.

Course Outcomes: At the end of this course students will be able to
CO1: Explain the arrangement of armature windings and the concept of revolving magnetic field.
CO2: Describe the constructional details, operation of Single Phase & Three Phase Induction Motors.
CO3: Analyze the performance of Induction Machine using Phasor diagrams and circuit model.
CO4: Examine synchronous machine model and analyze the performance of synchronous Machines.

CO-PO MAPPING:

PO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3		3										
CO2	3	3												
CO3	3	3	3											
CO4	3	3		3										

TEXT BOOKS:
1. "Electric Machinery", A. E. Fitzgerald, C. Kingsley and S. D. Umans, 6th Edition, McGraw-Hill, 2003.
2. "Performance and Design of Alternating Current Machines", M. G. Say, 3rdEdition, CBS Publishers, 2002.
3. "Electrical Machinery", P. S. Bimbhra, 7thEdition, Khanna Publishers, 2011.

REFERENCE BOOKS:
1. "Electric Machines", I. J. Nagrath and D. P. Kothari, 5th Edition, McGraw Hill Education, 2010.
2. "Theory of Alternating Current Machinery", A. S. Langsdorf, 2ndEdition Tata-McGraw-Hill Education, 1990.
3. "Principles of Electric Machines and Power Electronics", P. C. Sen, 3rd Edition, John Wiley & Sons, 2014.

CONTROL SYSTEMS

Subject Code:UGEE4T0320	**L**	**T**	**P**	**C**
II Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Electrical circuits, Laplace transforms, Basic laws of physics

Course Objective: This course introduces the elements of linear control systems and their analysis. Classical methods of design using frequency response are included. The state space approach for modeling and analysis is the added feature of this course.

Syllabus

UNIT –I Introduction to control problem **Hours: 10**

Concepts of control systems: open loop and closed loop control systems, Classification of control systems and Feedback characteristics, effects of feedback. Industrial Control examples.

Models of linear time-invariant systems: Mathematical models- differential equations, Impulse response and transfer functions -Translational and rotational systems- Block Diagram Algebra- Signal flow graph reduction using mason's gain Formula-Control hardware and their models.

UNIT –II Time Response Analysis **Hours: 08**

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response - Steady-state Errors-Effect of Proportional, Integral and Derivative Controllers

UNIT –III Stability Analysis and Root Locus Technique **Hours: 09**

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root Locus technique. Construction of Root-loci

UNIT – IV Frequency Response Analysis **Hours: 08**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT –V Introduction to design of compensators in the frequency domain **Hours: 09**

Design specifications in frequency-domain. Design of Lag compensators, Lead compensators and Lag –Lead compensators using Bode plots.

UNIT –VI State variable Analysis **Hours: 08**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Concept of controllability and observability.

Course Outcomes: At the end of this course students will be able to

CO1: Explain the concepts of feedback control systems

CO2: Summarize the models of different control system components

CO3: Develop transfer function and state-space models for linear dynamical systems

CO4: Analyze the response and stability of the control system in time-domain and frequency domain

CO5: Identify appropriate compensator/ controller for the given control problem and apply the design procedure for

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3												2	
CO2	3												2	
CO3	3													3
CO4	3	3												3
CO5	3		3										2	3
CO6	3												2	

Text Books:

1. "Control Systems Engineering", I. J. Nagrath and M. Gopal, 2nd Edition, New Age International Ltd., Publishers, 2006.
2. "Modern Control Engineering", Katsuhiko Ogata, 3rdedition, Prentice Hall of India Pvt. Ltd., 1998.
3. "Control Systems: Principles and Design", M. Gopal, 4th Edition, Mcgraw Higher Ed, 2012

REFERENCE BOOKS:

1. "Control Systems Engineering", S Palani, 2nd Edition, McGraw Hill Education, 2009.
2. "Automatic Control Systems", Benjamin C. Kuo, FaridGolnaraghi Prentice Hall of India, 9th Edition, Wiley, 2014.

CONTROL SYSTEMS LAB

Subject Code: UGEE4P0520	**L**	**T**	**P**	**C**
II Year / II Semester	**0**	**0**	**3**	**1.5**

Course Objective: To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, and A.C. Servo motors and to understand time and frequency responses of control system with and without controllers and compensators.

Syllabus

List of Experiments

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions
4. Effect of feedback on DC servo motor
5. Effect of P, PD, PI, PID Controller on a second order systems
6. Lag and lead compensation – Magnitude and phase plot
7. Transfer function of DC motor
8. Characteristics of magnetic amplifiers
9. Characteristics of AC servo motor
10. Characteristics of DC servo motor
11. Transfer function of DC generator

Course Outcomes: At the end of this course students will be able to
CO1:examine the characteristics of various control system components
CO2:interpret the effects of P, PI, PID controllers
CO3:verify compensator characteristics and logic gates function through PLC
CO4:analyze the response of a second order system

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3			3									

ELECTRICAL MACHINES- II LAB

Subject Code: UGEE4P0620	**L**	**T**	**P**	**C**
II Year / II Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Any ten of the experiments from the following are to be conducted.

1. O.C. & S.C. Tests on Single Phase Transformer
2. Sumpner's test on single phase Transformers
3. Scott connection of Transformers
4. No–load & Blocked rotor tests on three phase Induction motor
5. Regulation of a three-phase alternator by synchronous impedance method
6. **V** and Λ curves of a three-phase synchronous motor.
7. Equivalent Circuit of a single phase induction motor
8. Determination of $\mathbf{X_d}$ and $\mathbf{X_q}$ of a salient pole synchronous machine
9. Parallel operation of Single phase Transformers
10. Separation of core losses of a single phase transformer
11. Brake test on three-phase Induction Motor
12. Efficiency of a three-phase alternator
13. Heat run test on a bank of 3 Nos. of single phase Delta connected transformers
14. Measurement of sequence impedance of a three-phase alternator.
15. Study of Induction Generator.

Course Outcomes: At the end of this course students will be able to

CO1: Examine the performances of single-phase transformer by conducting suitable test
CO2: Understand the separation of core-losses in transformer
CO3: Analyze the behaviour of Induction Machines
CO4: Experiment with synchronous machines for deliberate its performance

CO-PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1			3	3								2		
CO2			3	3								2		
CO3			3	3								2		
CO4			3	3								2		

ARDUINO / RASPBERRY PI PROGRAMMING

Subject Code: UGEE4K0720	**L**	**T**	**P**	**C**
II Year / II Semester	**1**	**0**	**2**	**2**

Prerequisites: C Programming, Electronic devices

Course Objective: To understand and acquire knowledge on various Electronic devices and sensors with the help of Arduino or Raspberry Pi programming.

Syllabus

Arduino Platform: Prototyping environment, Electronic component overview, Arduino development environment, setting up with arduino boards, creating sketches, using libraries, using example codes, debugging with serial monitor, loops, functions, sensor interfacing, interfacing with LCD display and control of different motors.

Raspberry Pi Platform: Basic functionality of a Raspberry Pi boards, setting up and configuring the boards, Component overview, Programming with Python and C++, Communication facilities with Pi (I2C, SPI, UART), Working with GPIO library and interfacing with sensors and actuators.

Course Outcomes: At the end of this course students will be able to

CO1: Creating sketches with the help of libraries and example codes in different programming languages.

CO2: Measure various physical parameters with the help of sensors.

CO3: Interfacing with different actuator for required operations.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1														
CO2														
CO3														

Reference Books:

1. Arduino Cookbook by Michael Margolis, O'Reilly Media, Inc. 1st edition.
2. Arduino for Beginners: Essential Skills Every Maker Needs, John Baichta, Pearson Education, Inc. (https://ptgmedia.pearsoncmg.com/images/9780789748836/samplepages/0789748835.pdf).
3. Raspberry pi 3! An Introduction to Using with Python, Scratch, JavaScript and More, Gary Mitnick, Createspace Independent Publishing Platform, 2017
4. Raspberry Pi Cookbook for Python Programmers, Tim Cox, Packt publishing Ltd., 2nd revised edition, 2016.

III Year I-Semester

POWER SYSTEM GENERATION AND TRANSMISSION

Subject Code: UGEE5T0120	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Electrical circuits, Electromagnetic Fields, Properties of materials

Course Objective: Electrical Power plays significant role in day to day life of entire mankind. The aim of this course is to allow the students to understand the concepts of the generation and transmission of power along with economic aspects. It also deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are also discussed in detail.

Syllabus

UNIT –I	**Conventional and Non-Conventional Energy Sources**	**Hours: 09**
Coal fired steam thermal power plant– layout, working principle- Gas turbine power plant - Nuclear power plants, Types of Renewable Energy Sources –Solar and Wind Energy systems-working Principle		
UNIT –II	**Economics in Power Generation**	**Hours: 09**
Load curve, load duration and integrated load duration curves – load factor, demand factor, diversity factor, capacity factor, utilization factor, plant use factors and operating reserve. Costs of Generation and their division into fixed, Semi-fixed and running Cost. Desirable Characteristics of a Tariff Method – Tariff Methods – Numerical Problems.		
UNIT –III	**Transmission Line Parameters and Corona**	**Hours: 09**
Resistance, inductance and capacitance of single and three phase transmission lines-symmetrical and unsymmetrical spacing–transposition-single and double circuits-stranded and bundled conductors-application of self and mutual GMD–Skin and Proximity effect - Inductive interference – Corona – characteristics-factors affecting corona, critical voltages and power loss		
UNIT – IV	**Performance of Transmission Lines**	**Hours: 09**
Development of equivalent circuits for short, medium and long lines–efficiency and Regulation-Attenuation constant and phase constant- surge impedance loading		
UNIT –V	**Power System Transients**	**Hours: 09**
Incident, Reflected and Refracted Waves, Wave Length and Velocity of Propagation of Waves, Types of System Transients - Travelling or Propagation of Surges - Attenuation, Distortion, Reflection and Refraction Coefficients - Termination of lines with different types of conditions - Open Circuited Line, Short-circuited Line, T-Junction, and Lumped Reactive Junctions. - Description and effect on Resistance of Solid Conductors.		

UNIT –VI	Mechanical design of transmission line and Cables	Hours: 09

Insulators–types and comparison–voltage distribution in string insulator–string efficiency–Methods of improving string efficiency–Stress and sag calculations–effect of wind and ice–supports at different levels–stinging chart.

Cables – types–capacitance of cables–insulation resistance - dielectric stress and grading- dielectric loss-thermal characteristics- capacitance of three core cables.

Course Outcomes: At the end of this course students will be able to
CO1:explain types of power generation and evaluate economic aspects of power generation and tariff
CO2:determine the parameters of various types of transmission lines
CO3:analyze the performance of short, medium and long transmission lines
CO4:analyze the power system transients and various factors governing the performance of transmission
CO5:classify and compare different type of insulators and underground cables

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												

TextBooks:

1. Electrical Power Systems by C. L. Wadhawa New Age International (P) Limited, Publishers, 1997
2. Modern Power System Analysis by I. J. Nagarath and D. P. Kothari, Tata McGraw Hill, 2nd Edition
3. Electrical Power Systems by P.S.R. Murthy, B.S. Publications
4. Electrical Power Systems by D. Das, New age International
5. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.

ReferenceBooks:

1. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U.S. Bhatnagar, A. Chakrabarthy, Dhanpat Rai & Co Pvt. Ltd
2. Power System Analysis and Design by B. R. Gupta, Wheeler Publishing.
3. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4thedition

ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Subject Code: UGEE5T0220	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**1**	**0**	**3**

Prerequisites: Basic knowledge on electrical & electronic measuring instruments, Electrical Circuits, Vector Algebra.

Course Objective: This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

Syllabus

UNIT –I	**MEASURING INSTRUMENTS**	**Hours: 09**
Classification of Measuring Instruments-Deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, Moving Iron type, dynamometer- Expression for the deflecting torque and control torque –Extension of range using shunts and series resistance –Instrument Transformers-Ratio and phase angle errors – Numerical problems.		
UNIT –II	**MEASUREMENT OF POWER & ENERGY**	**Hours: 09**
Construction and working of Single-phase and three-phase dynamometer type wattmeter–Expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems – Numerical problems. Construction and working of Single-phase Induction type watt-hour meters-Expression for driving and braking torques – errors and compensations – Three phase energy meter – Numerical problems.		
UNIT –III	**POTENTIOMETERS**	**Hours: 09**
DC Potentiometer: Principle and operation– Standardization –Applications. AC Potentiometers: Working of polar and coordinate types-Applications.		
UNIT – IV	**MEASUREMENTS OF PARAMETERS (R-L-C)**	**Hours: 09**
Measurement of resistance(R):Methods of measurement of low, medium and high resistances –Wheat stone's bridge – Carey Foster's bridge– Kelvin's double bridge – Loss of charge method– Megger. Measurement of inductance(L): Maxwell's bridge–Hay's bridge – Anderson's bridge–Owen's bridge. Measurement of capacitance(C): Desauty Bridge – Schering Bridge- Numerical problems.		
UNIT –V	**DIGITAL METERS**	**Hours: 09**
Digital voltmeter – Successive approximation DVM, Ramp type DVM and Integrating type DVM – Digital frequency meter, Digital multimeter, Digital tachometer, Digital Energy Meter, LCR Q meter, Power Analyzer-Measurement of phase difference, Frequency, hysteresis loop using lissajious patterns in CRO-Numerical Problems.		
UNIT –VI	**TRANSDUCERS**	**Hours: 09**
Definition, Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers, Digital shaft encoders, Hall effect sensors-Numerical Problems.		

Course Outcomes: At the end of this course students will be able to:
CO1: Categorize electrical instruments for measuring various electrical parameters and analyze their performances.
CO2: Explain the working of different measuring instruments for power and energy measurement with an emphasis on extension and testing.
CO3: Understand the principle of operation and working of DC & AC Potentiometers
CO4: Understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
CO5: Understand the principle of operation and working of Digital meters &transducers.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3											1	1
CO3	3	3											1	1
CO4	3	3											1	1
CO5	3	3											1	1

TextBooks:

1."Electrical & Electronic Measurement & Instruments" by A. K. Sawhney, Dhanpat Rai & Co. Publications, 2015.

2. "Electrical Measurements and measuring Instruments" by E. W. Golding and F. C. Widdis, 5thEdition, Wheeler Publishing. 1998

3. "Modern Electronic Instrumentation and Measurement Techniques" A.D. Helfrick and W.D. Cooper, 5th Edition, PHI Learning Private Ltd., 2002.

ReferenceBooks:

1. "Electrical and Electronic Measurements" by Banerjee, Gopal Krishna, 2nd edition, PHI Learning Private Ltd., 2016.

2. "Electrical Measurements: Fundamentals, Concepts, Applications" by Reissland, M.U, New Age International (P) Limited, 2006.

3. A Course on "Electrical and Electronic Measurements & Instrumentation" by J.B.Gupta, Fourteenth Edition, S.K.Kataria& Sons publisher of Engineering and Computer Books,July 10,2014.

4. Electronic Instrumentation and Measurements 4th Edition by H S Kalsi, TMH 2019.

POWER ELECTRONICS& DRIVES

Subject Code: UGEE5T0320	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Electrical circuits, Electronic devices

Course Objective: To understand and acquire knowledge on various power semiconductor devices, and also to analyze and design different power converter circuits with R, RL and Drive loads.

Syllabus

UNIT –I	**Power Semi-Conductor Devices**	**Hours: 10**
Basic theory of operation and characteristics of power Diode, power MOSFET and power IGBT – Thyristor family description – Basic theory of operation of SCR – Static characteristics – Turn on and turn off methods – Dynamic characteristics of SCR – Snubber circuit design – Numerical Problems-Firing circuits for SCR.		
UNIT –II	**Single and Three Phase AC–DC Bridge Converters**	**Hours: 10**
Single Phase:Diode bridge rectifier with R-load -Line commutation principle using fully controlled and semi controlled converter operations with R, RL loads–Derivation of average voltage and current – Effect of source Inductance. ***Three Phase:***Full converter with R and RL loads– Derivation of load voltage. Dual converters with non–circulating and circulating currents.		
UNIT –III	**AC–AC Converters**	**Hours: 08**
Principles of ON-OFF Control, Single phase AC voltage controller with R and RL load, derivation of RMS output voltage– Numerical problems–Operation of three phase AC voltage controller		
UNIT – IV	**DC–DC Converters**	**Hours: 08**
Buck Converter operation–Voltage and current waveforms–Derivation of output voltage Boost converter operation–Voltage and current waveforms– Derivation of output voltage Buck-Boost converter operation –Voltage and current waveforms–Derivation of output voltage.		
UNIT –V	**DC–AC Inverters**	**Hours: 08**
Single phase half bridge and full bridge inverters –Three phase Inverters (120^0 and 180^0 modes of operation) –PWM techniques– single pulse, multi-pulse and sinusoidal PWM.		
UNIT –VI	**Fundamentals of Electric Drives**	**Hours: 10**
Electric drive – Fundamental torque equation – Load torque components – Four quadrant operation of drive (hoist control) – Brakingmethods: Dynamic – Plugging – Regenerative methods. Speed-torque expressions & Speed-torque characteristics for - Three phase converter controlled DC motors. - Four quadrant operation using dual converters - Single, two and four quadrant chopper fed separately excited and series excited motors. - Variable Voltage Variable Frequency control of induction motor by voltage source inverter.		

Course Outcomes: At the end of this course students will be able to
CO1: Infer the characteristics of various power semiconductor devices
CO2: Apply knowledge to build firing and Snubber circuits for SCR
CO3: Analyze the performance of single and three phase AC-DC converters
CO4: Examine the performance of AC-AC, DC-DC and DC-AC converters
CO5: Outline the electric drives and its characteristics.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		3											3
CO2	3		3											3
CO3	3		3											3
CO4	3		3											3
CO5	3			3										3

TextBooks:

1. "Power Electronics: Circuits, Devices and Applications '"– by M. H. Rashid, 2nd edition,Prentice Hall of India, 1998
2. "Power Electronics: converters, applications & design -by Ned Mohan", Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
3. "Power Converter Circuits" -by William Shepherd, Li Zhang, CRC Taylor & Francis Group.
4. Fundamentals of Electric Drives – by G K DubeyNarosa Publications.

ReferenceBooks:

1. "Elements of Power Electronics"–Philip T.Krein. Oxford publications.
2. "Power Electronics" – by P.S.Bhimbra, Khanna Publishers.
3. "Thyristorised Power Controllers" – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.
5. Thyristor Control of Electric drives – VedamSubramanyam TataMcGraw Hill Publications.

DIGITAL IC APPLICATIONS
(Professional Elective-I)

Subject Code : UGEE5T0420	**L**	**T**	**P**	**C**
III Year/ I Semester	**3**	**0**	**0**	**3**

Prerequisites

- Electronics Devices and Circuits
- Digital Logic Design.

Course Objectives

1. To get familiarized with Digital Logic families
2. To use computer-aided design tool (Verilog HDL) for development of complex digital logic circuits.
3. To design and prototype with standard cell technology and programmable logic

SYLLABUS

UNIT-I **[10 Hrs]**

Bipolar Logic Families: RTL, DTL, I^2L, Transistor Inverter, Basic TTL, Schottky TTL, TTL Families, Emitter coupled logic, ECL Families,

CMOS Logic Families: Introduction to logic families, CMOS logic, CMOS electrical properties, Steady state and dynamic electrical behavior of CMOS circuit, CMOS logic families, Tristate CMOS buffer, CMOS/TTL interfacing.

UNIT-II **[8 Hrs]**

Introduction to HDL (Verilog): Levels of Design Description, Module, Test Bench, Compiler Directives, Simulation and Synthesis Tools, Language Constructs and conventions.

Types of Modeling: Switch Level Modeling, Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vectors, Operators Illustration of above modeling examples.

UNIT-III **[10 Hrs]**

Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Delays, Strengths and Construction Resolution, Net Types

Behavioral Modeling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Assignments with Delays, wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non- Blocking Assignments, case statement, if, Assign, Repeat, for loop, While loop

UNIT-IV **[10 Hrs]**

Combinational circuit design using Verilog HDL: Parallel Adder cum Subtractors circuit, Carry looks ahead Adder, Decoders, Encoders, Multiplexers, Demultiplexers, comparators, code converters, Priority Encoder, Dual Priority Encoder, Floating Point encoder, Barrel shifter, one-bit counter. Parity circuits, Verilog HDL program for the above combinational logic circuits with relevant ICs

UNIT-V **[10 Hrs]**

Sequential logic circuit design using Verilog HDL: SSI latches and Flip-flops, Counters, Design of Counters using Digital ICs, Ring Counter, Johnson counter, Modulus N Synchronous counters, MSI Registers, Shift Registers, Modes of operation of shift registers, Universal Shift registers. Verilog HDL program for the sequential logic circuits with relevant ICs.

UNIT-VI **[8 Hrs]**

MEMORIES: ROMs - Internal structure, 2D-decoding commercial types, timing and applications.

Static RAM: Internal structure, SRAM timing, standard SRAMS, synchronous SRAMS. Dynamic RAM: Internal structure, timing, synchronous DRAMs

Course Outcomes:

Upon completion of the course, students will be able to

COs	Description
CO 1	Illustrate characteristics of Bipolar and CMOS logic families.
CO 2	Demonstrate different design constraints in Verilog HDL
CO 3	Categorize different modeling styles
CO 4	Design combinational circuits using digital ICs in Verilog HDL
CO 5	Design sequential circuits using digital ICs in Verilog HDL
CO 6	Illustrate the different memories in digital ICs

Mapping of Cos to POs:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3													
CO 2	3		3		3									
CO 3	3				3									
CO 4	3		3											
CO 5	3		3											
CO 6	3													

Text Books

T1. John F. Wakerly, "Digital Design Principles & Practices", PHI Education, 3rd Ed., 2005.
T2. Zainalabdien Navabi, "Verilog Digital System Design", TMH, 2nd Edition.

Reference Books

R1. Samir Palnitkar, "Verilog HDL" Pearson Education, 2nd Edition, 2009.
R2. J. Bhasker, "A Verilog HDL Primer", Star Galaxy Publishing, 3rd Edition

SPECIAL ELECTRICAL MACHINES
(Professional Elective-I)

Subject Code: UGEE5T0520	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Electrical Machines

Course Objective: To understand the construction details, working principle and operationof special machines.

Syllabus

UNIT –I	**STEPPER MOTORS**	**Hours: 09**
Construction – Principle of operation – Theory of torque production – Hybrid stepping motor – Variable reluctance stepping motor – Open loop and closed loop control.		
UNIT –II	**SWITCHED RELUCTANCE MOTOR**	**Hours: 09**
Principle of operation – Design of stator and rotor pole arc – Power converter for switched reluctance motor – Control of switched reluctance motor.		
UNIT –III	**PERMANENT MAGNET BRUSHLESS DC MOTOR**	**Hours: 08**
Construction – Principle of operation – Theory of brushless DC motor as variable speed synchronous motor – Sensorless and sensor based control of BLDC motors.		
UNIT – IV	**PERMANENT MAGNET SYNCHRONOUS MOTOR**	**Hours: 10**
Principles of operation–Constructional features– Phasor diagram – EMF and Torque equations– Torque/Speed characteristics – Power controllers–applications.		
UNIT –V	**LINEAR MOTORS**	**Hours: 07**
Linear induction motor: Construction– principle of operation– applications. Linear synchronous motor: Construction– principle of operation– applications.		
UNIT –VI	**OTHER SPECIAL MACHINES**	**Hours: 07**
Constructional features – Principle of operation and Characteristics of Hysteresis motor– Synchronous Reluctance Motor –Repulsion motor– applications.		

Course Outcomes: At the end of this course students will be able to

CO1: To explore the students to the construction, principle of operation and performance of special electrical machines as an extension to the study of basic electrical machines.
CO2: To impart knowledge on constructions, working and performance of steppers motors and switched reluctance motor.
CO3: To analyze the performance of PMBLDC Motor and PMSM.
CO4: To understand the Linear motor and other special machines.

CO-PO MAPPING:

PO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3		3										
CO2	3	3												
CO3	3	3	3											
CO4	3	3		3										

TextBooks:

1. "Special Electrical Machines", K. Venkata Ratnam, University press, New Delhi, 5th Edition, 2016
2. "Special Electrical Machines", E.G. Janardanan, PHI, 1st Edition, 2014.

ReferenceBooks:

1. "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Applications", R. Krishnan, CRC Press, 1st Edition, 2001.
2. "Permanent Magnet and Brushless DC Motors", T. Kenjo and S. Nagamori, Oxford University press, Oxford, UK, 1988.

ADVANCED CONTROL SYSTEMS
(Professional Elective-I)

Subject Code:UGEE5T0620	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Control systems

Course Objective: This subject aims to study state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

Syllabus

UNIT –I State space analysis

State Space Representation – Solution of state equation – State transition matrix, –Canonical forms – Controllable canonical form – Observable canonical form, Jordan Canonical Form.

UNIT –II Controllability, observability and design of pole placement

Tests for controllability and observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

UNIT –III Describing function analysis

Introduction to nonlinear systems, Types of nonlinearities, describing functions, Introduction to phase–plane analysis.

UNIT – IV Stability analysis

Stability in the sense of Lyapunov – Lyapunov's stability and Lyapunov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

UNIT –V Calculus of variations

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler–Lagrange equation.

UNIT –VI Optimal control

Linear Quadratic Optimal Regulator (LQR) problem formulation – Optimal regulator design by parameter adjustment (Lyapunov method) – Optimal regulator design by Continuous Time Algebraic Riccatti equation (CARE) - Optimal controller design using LQG framework.

Course Outcomes:
CO1: Summarize the various ways to model a dynamic in state space form
CO2: Analyze the controllability and observability of continuous-time systems and design an appropriate state-feedback controller of using the pole placement technique
CO3: Analyze of nonlinear system using the describing function technique and phase plane analysis.
CO4: Analyze the stability analysis using Lypunov method
CO5: Minimize of functionals using calculus of variation studied.
CO6: Formulate and solve the LQR problem and riccatti equation.

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3												2	
CO2	3												2	
CO3	3													3
CO4	3	3												3
CO5	3		3										2	3
CO6	3												2	

TextBooks:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998

2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

REFERENCE BOOKS:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw– Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

ELECTRICAL SYSTEMS IN VEHICULAR APPLICATIONS
(Professional Elective-I)

Subject Code: UGEE5T0720	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**-**	**-**	**3**

Course Objective:

This course introduces a comprehensive overview of Electric Vehicles.

Syllabus

UNIT –I	**CONVENTIONAL VEHICLES**	**Hours: 08**
Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.		
UNIT –II	**ELECTRIC DRIVE-TRAINS**	**Hours: 08**
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies.		
UNIT –III	**ELECTRIC PROPULSION UNIT**	**Hours: 06**
Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.		
UNIT – IV	**ENERGY STORAGE**	**Hours: 06**
Introduction to Energy Storage Requirements in Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis.		
UNIT –V	**SIZING THE DRIVE SYSTEM**	**Hours: 08**
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems		
UNIT –VI	**ENERGY MANAGEMENT STRATEGIES**	**Hours: 10**
Introduction to energy management strategies used electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.		

Course Outcomes: At the end of this course students will be able to
CO1: Explore basic concepts of conventional electric vehicle.
CO2: Analyze the performance of basic traction and related power flow.
CO3: Evaluate the performance of different motors for electric vehicle propulsion.
CO4: Analyze the energy storage systems.
CO5: Demonstrate the sizing and alignment of components in EV.
CO6: Acquire the knowledge on EV energy management system.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		2											1
CO2	3		2											1
CO3	3		2											3
CO4	3		2											3
CO5	3		2											3
CO6	3	3	2											3

Text Books:

1. "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 1st Edition, 2011.
2. "Hybrid Electric Vehicles: Energy Management Strategies", S. Onori, L. Serrao and G. Rizzoni, Springer, 1st Edition, 2015.
3. "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", M. Ehsani, Y.Gao, S. E. Gay and A. Emadi, CRC Press, 1st Edition, 2004.

Reference Books:

1. "Electric and Hybrid Vehicles", T. Denton, Routledge, 1st Edition, 2016.

SIGNALS AND SYSTEMS
(Professional Elective-I)

Subject Code: UGEE5T0820	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Transform calculus & complex variables

Course Objective: To introduce about signals and systems, Fourier series and transform, sampling theorem, linear systems, Laplace transform and Z transform.

Syllabus

UNIT –I	**INTRODUCTION**	**Hours: 08**
Definition of Signals and Systems, Basic signals, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling Classification of Signals, Problems on classification and characteristics of Signals.		
UNIT –II	**FOURIER SERIES**	**Hours: 10**
Orthogonality in signals, approximation of signals,Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum.		
UNIT –III	**ANALYSIS OF LINEAR SYSTEMS**	**Hours: 08**
Classification of Systems, Response of a system, Filter characteristics of linear systems and characteristics of low-pass, band-pass and band-stop, Concept of convolution		
UNIT – IV	**FOURIER TRANSFORMS ANDSAMPLING**	**Hours: 08**
Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms. Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing,		
UNIT –V	**LAPLACE TRANSFORMS**	**Hours: 10**
Introduction to Laplace transforms, Relation between L. T's, and F.T. of a signal,Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L. T's, inverse Laplace transforms. Laplace transform of certain signals using waveform synthesis		
UNIT –VI	**Z–TRANSFORMS**	**Hours: 10**
Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals,properties of Z-transforms and Inverse Z-transform.Solving difference-equations.		

Course Outcomes: At the end of this course students will be able to
CO1: Explain the fundamental characteristics of signals and systems.
CO2: Recall the concepts of Fourier series and Fourier transform and apply the same for different continuous time signals and systems
CO3: Interpret the practical relevance of sampling process and explain the effects of under sampling**.**
CO4: Analyze different systems and examine its response
CO5: Apply the relevant transform techniques for the analysis of continuous and discrete time systems

CO – PO Mapping														
POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO**	**PSO**
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												

TextBooks:
1. "Signals, Systems & Communications", B.P. Lathi,, BS Publications, 2003. 2. "Signals and Systems", A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn 3. "Signals& Systems", Narayan Iyer and K Satya Prasad, Cenage Pub. circuits" by C. K. Alexander and M. N. O. Sadiku, 5th edition, McGraw hill Publishers, 2013
ReferenceBooks:
1. "Signals & Systems", Simon Haykin and Van Veen, Wiley, 2nd Edition 2. "Principles of Linear Systems and Signals", BP Lathi, Oxford University Press, 2015 3. "Signals and Systems", K Raja Rajeswari, B VisweswaraRao, PHI, 2009

Open Elective-I

ELECTRICAL MEASUREMENTS & INSTRUMENTATION LAB

Subject Code: UGEE5P0920	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Any 10 Experiments from the following:

1. Calibration and Testing of Single-phase Energy Meter.
2. Crompton D.C. Potentiometer – Calibration of PMMC Ammeter and PMMC Voltmeter.
3. Kelvin's Double Bridge – Measurement of Resistance – Determination of Tolerance.
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Measurement of 3 phase Reactive Power with single–phase wattmeter for balanced loading.
7. Calibration of LPF wattmeter – by Direct loading.
8. Parameters of Choke coil.
9. C.T. testing using mutual Inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
10. Measurement of Power by 3 Voltmeter and 3 Ammeter methods.
11. Measurement of 3-Φ power with single wattmeter and 2 No's of C.T.
12. Measurement of phase difference, frequency using Lissajous patterns in CRO.
13. LVDT characteristics and calibration
14. Study of Angular measurement using Resistive Trainer
15. Measurement of current using Hall effect transducer.
16. Microcontroller based Load cell calibration and Measurementof weight.
17. Measurement of Light Intensity using Photo Resistor.

Course Outcomes: At the end of this course students will be able to

CO1: Calibrate single phase energy meter, PMMC voltmeter and Ammeter, LPF wattmeter and Load Cell Sensor.
CO2: Measure the electrical parameters - voltage, current, power, energy, frequency and phase differenceusing various meters.
CO3: Determine resistance, inductance and capacitance through various bridges.
CO4: Measure the Non-Electrical quantities - light intensity and displacement

CO-PO MAPPING:

Pos	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												

POWER ELECTRONICS AND DRIVES LAB

Subject Code: UGEE5P1020	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Course Objectives: To train students on the analysis of the power semiconductors devices, power electronic converters and Drives.

Syllabus

EXPERIMENTS:

1. Gate firing circuits for SCR's
2. Single - Phase Half controlled converter with R and RL load
3. Single - Phase fully controlled bridge converter with R and RL loads
4. Single - Phase AC Voltage Controller with R and RL Loads
5. Single - Phase dual converter with RL loads
6. Three - Phase full converter with RL–load.
7. Single - Phase PWM inverter.
8. Single -Phase diode bridge rectifier with R load and capacitance filter.
9. Single Phase Inverter fed Induction Machine Drive.
10. Arduino code-based Gate pulse generation for Single Phase Bridge Rectifier.

Additional Experiments:

1. Four Quadrant chopper fed DC Drive.
2. Arduino code-based Gate pulse generation for Three Phase Inverter.

Course Outcomes: At the end of this course students will be able to,

CO1: Analyze the operation of firing circuits for SCR
CO2: Classify and analyze control of different power electronic converters
CO3: Analyze the operation of power electronic converter fed drives
CO4: Analyze the program / Code to generate the gating pulses for converters

CO – PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3			2										3
CO2	3			3										3
CO3	3			3										3
CO4	3		3	2	2									3

SCIENTIFIC COMPUTING

Subject Code: UGEE5K1120	**L**	**T**	**P**	**C**
III Year / I Semester	**1**	**0**	**2**	**2**

List of Topics

1. Basics of MATLAB:Creating and working with arrays of numbers-Creating and printing simple plots- saving and executing a script file- creating and executing a function file
2. Arrays and Matrices-I: Matrices and vectors-input, indexing, matrix manipulation, creating vectors-arithmetic operations
3. Arrays and Matrices-II:relational operations, logical operations-elementary math functions, matrix functions
4. Programming: Relational and logical operators- Control structures- for Loop- Nested for Loops- WhileLoops
5. Scripts and functions: User defined functions- functions that returnmore than one value-subfunction- Menu driven programming
6. Graphics & GUI:Basic 2-D plots- 3-D plots- GUI

Course Outcomes: At the end of this course students will be able to

CO1: Explain the basics of MATLAB

CO2: Interpret the given problem and write an appropriate programs using MATLAB m-file

CO3: Choose appropriate mathematical and logical operations for the given problem-solving scenario

CO4: Solve engineering problem by using appropriate user-defined functions

CO5: Identify suitable plotting functions and develop Graphical user interface for visualizing and communicating the results

CO-PO MAPPING:

Pos	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3		3	3									
CO2	3	3		3	3									
CO3	3	3		3	3									
CO4	3	3		3	3									

References:

1. https://in.mathworks.com/academia/courseware.html

PROFESSIONAL ETHICS

(Mandatory Course)

Subject Code: UGEE5A1220	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**0**	**0**

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and the rest of existence.
3. To highlight plausible implications of such a holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with nature.

Syllabus

UNIT-I: Introduction to Value Education (6 hours)

Right Understanding, Relationship and Physical Facility; Understanding Value Education; Self-exploration as the Process for Value Education; Continuous Happiness and Prosperity – the Basic Human Aspirations; Happiness and Prosperity – Current Scenario; Method to Fulfill the Basic Human Aspirations.

Practice Sessions: Sharing about Oneself; Exploring Human Consciousness; Exploring Natural Acceptance.

UNIT-II: Harmony in the Human Being (7 hours)

Understanding Human being as the Co-existence of the Self and the Body; Distinguishing between the Needs of the Self and the Body;The Body as an Instrument of the Self;Understanding Harmony in the Self;Harmony of the Self with the Body;Programme to ensure self-regulation and Health.

Practice Sessions: Exploring Harmony of Self with the Body; Exploring Sources of Imagination in the Self;Exploring the difference of Needs of Self and Body.

UNIT-III: Harmony in the Family and Society (7 hours)

Harmony in the Family – the Basic Unit of Human Interaction;'Trust' – the Foundational Value in Relationship;'Respect' – as the Right Evaluation;Other Feelings, Justice in Human-to-Human Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order.

Practice Sessions: Exploring the Feeling of Trust; Exploring the Feeling of Respect; Exploring Systems to fulfil Human Goal.

UNIT-IV: Harmony in the Nature/Existence (6 hours)

Understanding Harmony in the Nature; Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature; Realizing Existence as Co-existence at All Levels; The Holistic Perception of Harmony in Existence.

Practice Sessions: Exploring the Four Orders of Nature; Exploring Co-existence in Existence.

UNIT-V:Implications of the Holistic Understanding – A Look at Professional Ethics (7 hours)

Natural Acceptance of Human Values; Definitiveness of (Ethical) Human Conduct; A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order;Competence in Professional Ethics; Holistic Technologies, Production Systems and Management Models-Typical Case Studies;Strategies for Transition towards Value-based Life and Profession.

Practice Sessions: Exploring Ethical Human Conduct, Exploring Humanistic Models in Education, Exploring Steps of Transition towards Universal Human Order.

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1: Evaluate the significance of value inputs in formal education and start applying them in their life and profession.

CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.

CO3: Analyse the value of harmonious relationship based on trust and respect in their life and profession.

CO4: Examine the role of a human being in ensuring harmony in society and nature.

CO5: Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	3	-	3	3	-	-	-
CO2	-	-	-	-	-	3	-	3	3	-	-	-
CO3	-	-	-	-	-	3	-	3	3	-	-	-
CO4	-	-	-	-	-	3	3	3	3	-	-	-
CO5	-	-	-	-	-	3	-	3	3	-	-	-

TEXT BOOKS:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics" Excel Books, New Delhi, 2019

2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2019.

REFERENCE BOOKS:

1. A.N. Tripathi, "Human Values", New Age Intl. Publishers.

2. A. Alavudeen, R. Kalil Rahman and M. Jayakumaran, "Professional Ethics and Human Values", Laxmi Publications.

3. A.R. Aryasri, Dharanikota Suyodhana,"Professional Ethics and Morals", Maruthi Publications.

4. M. Govindarajan, S. Natarajan and V.S. Senthil Kumar, "Engineering Ethics includes Human Values", PHI Learning Pvt. Ltd

5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

Internship

III Year II-Semester

POWER SYSTEM ANALYSIS

Subject Code: UGEE6T0120	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**-**	**-**	**3**

Prerequisites: Electrical circuit analysis, Power systems Transmission, Numerical techniques

Course Objective: The course is designed to give students the required knowledge for the mechanical design of overhead lines, cables, substations and DC transmission. Calculation of power flow in a power system network using various techniques, formation of Zbus and its importance are covered in this course. It also deals with short circuit analysis and analysis of power system for steady state and transient stability

Syllabus

UNIT –I	**Power System network matrices**	**Hours: 09**
Graph Theory- Bus admittance matrix using Direct inspection method and singular transformation– Bus impedance matrix representation- numerical problems.		
UNIT –II	**Power flow studies**	**Hours: 09**
Necessity of Power Flow Studies, Bus Classification – static load flow equations - load flow analysis using Gauss-Seidel, Newton-Raphson method - numerical problems (Max. 3 buses)–Decoupled and Fast Decoupled method (algorithmic approach) - Comparison of load flow methods		
UNIT –III	**Per unit system and Symmetrical Fault Analysis**	**Hours: 08**
single line diagram of power system components – per unit quantities – reactance diagram – Classification of Faults in a power system - Thevenin's theorem and applications, short circuit analysis – Short circuit capacity - numerical problems		
UNIT – IV	**Symmetrical Components**	**Hours: 08**
Introduction of symmetrical components - Transformation matrices used in resolution of unbalanced voltages and currents- Positive, Negative and Zero sequence networks of power system components like synchronous machines, transformers, transmission lines – numerical problems		
UNIT –V	**Unsymmetrical Fault Analysis**	**Hours: 08**
Unsymmetrical fault analysis - LG, LL, LLG and open circuit faults – analysis through sequence components – numerical problems		
UNIT –VI	**Power system Stability Analysis**	**Hours: 08**
steady state and transient stability – Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient - Power Angle Curve - swing equation – equal area criterion – Application of Equal Area Criterion - critical clearing angle and clearing time		

Course Outcomes: At the end of this course students will be able to
CO1: Develop Y bus and Z bus matrix for a power system network to apply in load flow studies
CO2: Interpret the power flow studies using Gauss-Seidel, Newton Raphson, decoupled and fast decoupled load flow methods
CO3: Apply per unit system in fault analysis anddetermine the symmetrical fault current and voltages
CO4: Apply symmetrical component theory to determine the unsymmetrical fault current and voltages
CO5: Explain the concepts of power system stability

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												

TextBooks:
1. Power System Analysis by Grainger and Stevenson, Tata Mc-Graw Hill. 2. Modern Power system Analysis – by I. J. Nagrath& D. P. Kothari: Tata McGraw–Hill Publishing Company, 2nd edition
Reference Books:
1. "Power System Analysis by HadiSaadat – TMH Edition. 2. Power System Analysis by B. R. Gupta, Wheeler Publications

POWER SYSTEM PROTECTION

Subject Code: UGEE6T0220	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Fundamentals of electrical circuits and principles of power system.

Course Objective:

In order to protect the equipment's and components against various operating conditions and over voltages protective devices are required to be installed in the system. Topics specified in this subject deal with various types of protective equipment's and their working principle including limitations etc.

UNIT–I	**Circuit Breakers**	**Hours: 10**
Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages - Restriking Phenomenon, Average and Maximum RRRV and Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications: Types and Numerical Problems – Auto reclosures. Operation of Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum, and SF6 circuit breakers and Miniature Circuit breaker (MCB).		
UNIT –II	**Electromagnetic Relays**	**Hours: 10**
Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays. Types of Over Current Relays: Instantaneous, DMT and IDMT types. Application of relays: Over current/ under voltage relays, Direction relays, Differential Relays and Percentage Differential Relays. Universal torque equation, Distance relays: Impedance, Reactance, and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison.		
UNIT –III	**Protection of Power Equipment & Transmission lines**	**Hours: 09**
Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on % Winding Unprotected. Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CTs Ratio, Buchholtz relay Protection. Protection of Lines: Over Current, Carrier Current protection-Translay Relay. Protection of Bus bars – Differential protection.		
UNIT – IV	**Protection Against Over voltages**	**Hours: 08**
Generation of Over Voltages in Power Systems.- Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination - BIL, Impulse Ratio, Standard Impulse Test Wave.		
UNIT –V	**Neutral Grounding**	**Hours: 09**
Grounded and Ungrounded Neutral Systems. - Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance - Arcing Grounds and Grounding Practices.		
UNIT –VI	**Static and Microprocessor Relays**	**Hours: 09**
Static relays: Static relay components– Static over current relay– Static distance relay- Microprocessor based digital relays. Simple Programs.		

Course Outcomes: At the end of this course students will be able to
CO1: Understand the basic operating principle of circuit breakers
CO2: To acquire the operation and working principles of different electromagnetic relays
CO3: Analyze operation of different protection schemes applied to power system equipment and
CO4: Understand and analyze protection against over voltages
CO5: Analyze the methods of neutral grounding
CO6: Understand and analyze the concept of static and microprocessor based relays

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3											
CO2	3	3	3											
CO3	3	3	3											
CO4	3	3	3											
CO5	3	3	3											
CO6	3	3	3											

TextBooks:

1. Power System Protection and Switchgear, by Badri Ram, D. N Viswakarma, TMH Publications, 2011

2. Electrical Power Systems by C. L. Wadhwa , New Age international (P) Limited, Publishers, 6th Edition 2007

3.Protection and Switchgear by BhaveshBhalja, R.P. Maheshwari, Nilesh G. Chothani, Oxford publishers

ReferenceBooks:

1. Switchgear and Protection by Sunil S Rao, Khanna Publishers, 2008.

2. Fundamentals of Power System Protection by Paithankar and S.R.Bhide., PHI, 2003.

3.Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd

4. Power System Protection and Switchgear by B.Ravindranath&M.Chander, New Age International Pvt .Ltd.

MICROPROCESSORS & MICROCONTROLLERS

Subject Code: UGEE6T0320	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**0**	**0**	**3**

Course Objective:

1. To develop an in-depth understanding of the operation of microprocessors& controllers.
2. To master the assembly language programming using concepts
3. To create an exposure to basic peripherals and interfacing techniques
4. To understand the concept of Interrupts and interfacing details of 8086 and 8051.
5. To impart the basic concepts of serial communication in 8086& 8051

Syllabus

UNIT –I	**8086 architecture:**	**Hours: 08**
8086 architecture- functional diagram, Register organization, memory segmentation, Memory addresses, physical memory organization, Signal descriptions of 8086-common function signals, timing diagrams, Interrupts of 8086.		
UNIT-II	**Instruction set and assembly language programming of 8086:**	**Hours :08**
Instruction formats, addressing modes, instruction set, assembler directives. Macros, Simple programs involving logical, branch and call instructions. Sorting, evaluating arithmetic expressions, string manipulations.		
UNIT –III	**I/O Interface:**	**Hours: 08**
8255 PPI, various modes of operation and interfacing to 8086, interfacing of key board, display. Stepper motor interfacing, D/A &A/D converter. **Interfacing with advanced devices:** Memory interfacing to 8086,Interrupts of8086, Vector interrupt table, Interrupt service routine, Serial communication standards, serial data transfer schemes, 8251 USART architecture and Interfacing.		
UNIT –IV	**Introduction to microcontrollers:**	**Hours: 06**
overview of 8051 microcontrollers, Architecture, I/O ports, Memory organization, addressing modes and instruction set of 8051, Simple programs.		
UNIT –V	**8051 Real Time Control:**	**Hours: 06**
Programming Timer interrupts, programming external hardware interrupts, Programming the serial communication interrupts, Programming 8051 timers and counters.		
UNIT –VI	**Design and Interface using 8051**	**Hours: 06**
LCD & Keyboard Interfacing – ADC, DAC – External Memory Interface- Stepper Motor and Waveform generation – Comparison of Microprocessor, Microcontroller.		

Course Outcomes: At the end of this course students will be able to
CO1: Understand the architecture of microprocessors and micro controller
CO2: Understand the programming model of microprocessors and micro controllers
CO3: Interface different external peripheral devices with microprocessors and micro controllers
CO4: Analyze a problem and formulate appropriate computing solution for processor or controller based application
CO5: Develop an assembly language program for specified application

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													
CO2	3	3	3											
CO3	3	3	3											
CO4	3	3	3											
CO5	3	3	3											

TextBooks:

1. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition 2006
2. Kenneth.J.Ayala. The 8051 microcontroller, 3rd edition,Cengage learning,2010
3. Advanced microprocessors and peripherals-A.K ray and K.M.Bhurchandani, TMH, 2nd edition2006.
4. Digital Electronics and Logic Design, Dr. Sanjay Sarma, Katson Books, Fourth Edition, 2016.

Microcontrollers and application, Ajay.V.Deshmukh,TMGH,2005

ReferenceBooks:

1. The 8051 microcontrollers, architecture and programming andapplications-K.Uma Rao, AndhePallavi., Pearson, 2009.
2. Micro computer system 8086/8088 family architecture, programming anddesign- By Liu and GA Gibson, PHI, 2nd Ed.

ADVANCED POWER ELECTRONICS
(PROFESSIONAL ELECTIVE-II)

Subject Code: UGEE6T0420	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**-**	**-**	**3**

Course Objective:

This course introduces the topologies, operation and control strategies of advanced power electronic converters.

Syllabus

UNIT –I	**DC-DC Converters**	**Hours: 08**
Switching-Mode Regulators – Buck Regulator – Boost Regulator – Buck-Boost Regulator – Cuk Regulator – Comparison of Regulators – Multi output Boost Regulator.		
UNIT –II	**Voltage Control of Single Phase Inverter**	**Hours: 08**
PWM – Single Pulse Width Modulation – Multiple Pulse Width Modulation – Sinusoidal Pulse Width Modulation – Modified Sinusoidal Pulse Width Modulation – Phase Displacement Control – Advanced Modulation Control Techniques.		
UNIT –III	**Voltage Control of Three Phase Inverter**	**Hours: 06**
Sinusoidal PWM – 60 Deg PWM – Third Harmonic PWM – Space Vector Modulation – Comparison of PWM techniques – Current Source Inverter – Variable DC link inverter.		
UNIT – IV	**Multilevel inverter**	**Hours: 06**
Diode Clamped Multilevel Inverter – Principle of operation – Features – Improved Diode Clamped Multilevel Inverter. Flying Capacitor Multilevel Inverter - Principle of operation – Features. Cascaded Multilevel Inverter - Principle of operation – Features.		
UNIT –V	**Power Factor Improvement**	**Hours: 08**
Extinction Angle Control – Symmetrical Angle Control – PWM control – Single Phase Sinusoidal PWM – Three Phase PWM Rectifier.		
UNIT –VI	**DC Power Supplies**	**Hours: 10**
Switched Mode DC Power Supplies – Flyback Converter – Forward Converter – Push-Pull Converter – Half Bridge Converter – Full Bridge Converter – Resonant DC Power Supplies – Bi-directional Power Supplies.		

Course Outcomes: At the end of this course students will be able to
CO1: Design and analyze the performance of DC-DC converters.
CO2: Acquire the knowledge about different types of Single and Three phase PWM modulation strategies.
CO3: Design simulated models for the analysis of different topologies of multilevel inverter.
CO4: Understand the basics in PF improvement.
CO5: Acquire the knowledge about different types DC power supply converters.

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		2											3
CO2	3		2											3
CO3	3		2											3
CO4	3		2											3
CO5	3		2											3

Text Books:

1. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint- 2008.
2. Power Electronics- Ned Mohan, Tore M.Undelan and William P.Robbins –John Wiley& Sons -2nd Edition.Power Electronics – Lander –Ed.2009.

Reference Books:

1. Modern power Electronics and AC Drives – B.K.Bose.

DIGITAL CONTROL SYSTEMS
(PROFESSIONAL ELECTIVE-II)

Subject Code:UGEE6T0520	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**-**	**-**	**3**

Prerequisites: Control Systems

Course Objective: The purpose of the proposed course is to present control theory that is relevant to the analysis and design of computer-controlled systems, with an emphasis on basic concepts and ideas.

Syllabus

UNIT –I	**Introduction and Signal Processing**
Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Signals and processing – Sample and hold devices – Sampling theorem and data reconstruction – Digital to Analog conversion and Analog to Digital Conversion Frequency domain characteristics of zero order hold.	
UNIT –II	**Review of Z-Transforms**
Z-Transform and theorems, finding inverse and method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems	
UNIT –III	**State Space Analysis**
State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations- Concepts of controllability and observability – Tests (without proof).	
UNIT – IV	**Stability Analysis**
Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.	
UNIT –V	**Design of Discrete Time Control System by Conventional Methods**
Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design using frequency response in the w–plane for lag and lead compensators and digital PID controllers	
UNIT –VI	**State Feedback Controllers and Observers**
Design of state feedback controller through pole placement – Ackerman's formula, Introduction to state observers-full order observer design.	

Course Outcomes: At the end of this course students will be able to

CO1: Explain the concepts of digital control systems and recall the fundamentals of signal processing

CO2: Recall the concepts of Z-Transformation

CO3: Interpret linear discrete–time systems in state model

CO4: Examine the stability of linear discrete-time systems by the use of Bilinear Transformation and Routh Stability criterion.

CO5: Identify an appropriate controller for the given specifications and apply conventional and modern design methods for their parameter selection

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													3
CO2	3													3
CO3	3													3
CO4	3	3												3
CO5	3	3	3											3
CO6	3													3

TextBooks:

1. "Discrete–Time Control systems", K. Ogata, Pearson Education/PHI, 2nd Edition, 2015.

REFERENCE BOOKS:

1. "Digital Control Systems", Kuo, Oxford, 2nd Edition, 2012.
2. "Digital Control and State Variable Methods", M. Gopal, McGraw Higher Ed, 4th Edition, 2012.
3. "Digital Control Systems", V. I. George, P. C. Kurian, Cengage Learning, 1st Edition, 2012.

DIGITAL SIGNAL PROCESSING
(Professional Elective-II)

Subject Code: UGEE6T0620	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**-**	**-**	**3**

Prerequisites: Signals & Systems

Course Objective: To Understanding the digital signal processing approach and digital filter design to introduce signals, systems, time and frequency domain concepts and the associated mathematical tools that are fundamental to all DSP techniques, provide a thorough understanding and working knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

Syllabus

UNIT –I	**SIGNALS AND SYSTEMS**	**Hours: 08**
Classification of signals: continuous and discrete, energy and power; mathematical representation of signals; sampling techniques, Nyquist rate, aliasing effect - Digital signal representation; Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance.		
UNIT –II	**DISCRETE FOURIER TRANSFORMS**	**Hours: 08**
DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – Decimation - in - time Algorithms(DIT), Decimation - in – frequency(DIF) Algorithms		
UNIT –III	**IIR FILTER DESIGN**	**Hours: 08**
Structures of IIR (Direct Form I &II, Signal flow graph, Transposed Structure, Cascade and parallel forms) – Design of Analog filter(HPF, BPF, LPF) – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (HPF, BPF, BRF).		
UNIT – IV	**FIR FILTER DESIGN**	**Hours: 08**
Structures of FIR (Transversal Structure & Linear phase realization) – Linear phase FIR filter – Filter design using windowing techniques (Rectangular, Triangular, Hamming, Hanning, Blackman, Kaiser), Frequency sampling techniques.		
UNIT –V	**INTRODUCTION TO DIGITAL SIGNAL PROCESSORS**	**Hours: 08**
Introduction to programmable DSPs: Selecting digital signal processor; Multiplier and Multiplier Accumulator (MAC) – Modified bus structures and memory access schemes in DSPs – Multiple access memory – Multiport memory – Pipelining – Special addressing modes.		
UNIT –VI	**ARCHITECTURE OF TMS 320C50**	**Hours: 08**
Introduction – Bus structure – Central arithmetic logic unit –Auxiliary registrar – Index registrar – Auxiliary register compare register – Block move address register –Parallel logic unit – Memory mapped registers – Program controller – Some flags in the status registers – On–chip registers, On–chip peripherals.		

Course Outcomes: At the end of this course students will be able to
CO1: Explain the basic concepts of Signals and systems
CO2: Apply the Discrete Fourier transforms tool for sequences of finite length
CO3: Develop IIR filter and FIR filter for the given set of specifications.
CO4: Summarize fundamentals of programmable DSPs and architecture of DSP processors

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	-	3	2									3	3
CO2	3	-	-	3									-	-
CO3	3	-	3	3									-	-
CO4	2	3	-	2									3	3

TextBooks:

1. "Digital Signal Processing: Principles, Algorithms, and Applications", Proakis J. G., and Manolakis D. G,Prentice-Hall, 4thEdition, 2007.
2. "Digital Signal Processing", Ramesh Babu P, SciTech Publications (India) Pvt. Ltd., New Delhi, 4th Edition, 2010.

ReferenceBooks:

1. "Discrete – Time Signal Processing," Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, Prentice Hall, New Delhi, 3rd Edition, 2009.
2. "Digital Signal Processing – A Computer Based Approach", Mitra S.K., Tata McGraw - Hill Education India Private Limited, New Delhi, 4th Edition, 2011.
3. "The Scientist and Engineer's Guide to Digital Signal Processing", Steven W. Smith, California Technical Publishing San Diego, California, 2nd Edition, 2002.
4. "Digital Signal Processors, Architecture, Programming and Applications," Venkataramani B., Bhaskar M, Tata McGraw- Hill Education India Private Limited, New Delhi, 1st Edition, 2002.
5. "Digital Signal Processing", Emmanuel C. Ifeachor, Barrie.W.Jervis, Pearson Education, 2ndEdition, 2002.

ELECTRICAL DISTRIBUTION SYSTEMS
(Professional Elective-II)

Subject Code: UGEE6T0720	**L**	**T**	**P**	**C**
III Year / II Semester	**3**	**-**	**-**	**3**

Prerequisites: Power systems generation & transmission

Course Objective: This subject deals with the general concept of distribution system, substations and feeders as well as discusses distribution system analysis, protection and coordination, voltage control and power factor improvement**.**

Syllabus

UNIT –I	**GENERAL CONCEPTS**	**Hours: 09**

Introduction to distribution systems, Classification of Distribution Systems - Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, Load modeling and characteristics – Coincidence factor – Contribution factor loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT –II	**SUBSTATIONS & DISTRIBUTION FEEDERS**	**Hours: 10**

Air insulated substations - Substations layout - Bus bar arrangements: single bus bar, sectionalized single bus bar, main and transfer bus bar system. Gas insulated substations (GIS)-single line diagram - Location of substations: Rating of distribution substation – Service area within primary feeders – Benefits derived through optimal location of substations.

Design Considerations of distribution feeders: Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT –	**VOLTAGE DROP AND POWER LOSS CALCULATIONS**	**Hours: 09**

Voltage Drop Calculations in D.C Distributors for: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor, A.C. Distributors - Power Factors referred to receiving end voltage and with respect to respective load voltages - Numerical Problems, Three phase balanced primary lines.

UNIT –	**PROTECTION & COORDINATION**	**Hours: 09**

Objectives of distribution system protection - types of common faults - procedure for fault calculations, over current Protective Devices: Principle of operation of Fuses, Auto-Circuit Recloser - Auto-line sectionalizes - circuit breakers. Coordination of Protective Devices: Objectives - general coordination procedure - Fuse to Fuse-Auto-Recloser to Fuse, Circuit breaker to Fuse, Circuit breaker to Auto-Recloser

UNIT –V	POWER FACTOR IMPROVEMENT & VOLTAGE CONTROL	Hours: 09

Causes of low Power Factor - Capacitive compensation for power factor control – Methods of Improving PF - Power factor correction – Capacitor allocation – Effect of shunt capacitors (Fixed and switched) - Most economical PF for constant KW load and constant KVA type loads - Procedure to determine the best capacitor location.

UNIT –VI	**Voltage Control**:	Hours: 09

Necessity of voltage control in power system-methods for voltage control – Effect of series capacitors– Effect of AVB/AVR –Line drop compensation

Course Outcomes: At the end of this course students will be able to
CO1:explain the various concepts of distribution system
CO2:analyze the substation and distribution feeders
CO3:determine the voltage drop and power loss in distribution feeders
CO4:interpret the protection and its coordination.
CO5: explain power factor improvement and voltage control concepts
CO6: able to understand analyze voltage control methods

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												
CO6	3	3												

TextBooks:

1. Electric Power Distribution system, Engineering" – by TuranGonen, McGraw–hill Book Company.
2. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
3. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing Company, 4th edition, 1997.
4. Dr M K Khedkar and Dr G M Dhole, "A Textbook of Electric Power Distribution Automation", University

ReferenceBooks:

1. Electrical Power Distribution &Automation by S.Sivanagaraju&V.Shankar, Dhanpat Rai & Co
2. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.
3. D. Bassett, K. Clinard, J. Grainger, S. Purucker, and D.Ward, "Tutorial Course: Distribution Automation", IEEE Tutorial Publication 88EH0280-8-PWR, 1988.

VLSI Design
(Professional Elective-II)

Subject Code: UGEE6T0820	**L**	**T**	**P**	**C**
IV Year / I Semester		**3**	**-**	**-**	**3**

Prerequisites: Digital Electronics

Course Objective: Tolearn the different steps involved in the fabrication of ICs using MOS transistor, CMOS/BICMOS transistors, passive components and its electrical properties,design rules to be followed to draw the layout of any logic circuit and different types of logic gates using CMOS inverter and analyze their transfer characteristics, design building blocks of data path of any system using gates, understand basic programmable logic devices and testing of CMOS circuits.

Syllabus

UNIT –I	**INTRODUCTION**	**Hours: 08**
Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS **Basic Electrical Properties:** Basic Electrical Properties of MOS and BiCMOS Circuits: $I_{ds}V_{ds}$ relationships, MOS transistor threshold Voltage, g_m, g_{ds}, Figure of merit ωo;Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.		
UNIT –II	**VLSI CIRCUIT DESIGN PROCESSES**	**Hours: 08**
VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.		
UNIT –III	**GATE LEVEL DESIGN**	**Hours: 08**
Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.		
UNIT – IV	**DATA PATH SUBSYSTEMS**	**Hours: 08**
Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters. **Array Subsystems:** SRAM, DRAM, ROM, Serial Access Memories.		
UNIT –V	**PROGRAMMABLE LOGIC DEVICES**	**Hours: 08**
PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design.		
UNIT –VI	**CMOS TESTING**	**Hours: 08**
CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques.		

Course Outcomes: At the end of this course students will be able to
CO1: Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS
CO2: Choose an appropriate inverter depending on specifications required for a circuit
CO3: Design different types of logic gates using CMOS inverter and analyze their transfer characteristics and building blocks of data path using gates
CO4: Design simple memories using MOS transistors and can understand design of large memories
CO5: Design simple logic circuit using PLA, PAL, FPGA and CPLD

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												
CO6	3	3												

TextBooks:
1.Essentials of VLSI circuits and systems – Kamran Eshraghian, EshraghianDougles and A. Pucknell, PHI, 2005 Edition 2.CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.
ReferenceBooks:
1.CMOS logic circuit Design - John .P. Uyemura, Springer, 2007. 2.Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.

Open Elective-I

DYNAMICS & CONTROL LAB

Subject Code: UGEE6P1020	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**1.5**

List of Experiments

Any 10 of the following experiments are to be conducted

A. Temperature Control System

I. Model development experiments:

1. Compare simulated temperature response to data from the TC Lab
2. Compare experimental results to the predicted results using non-linear and linear models of TC Lab
3. Collect step response data from the TC Lab and compute parameters of an FOPDT model

II. Controller design experiments:

4. Quantify the TC Lab offset between the setpoint (desired target) and the measured temperature when using a proportional-only controller.
5. Implement a PI controller and test the performance with a setpoint change
6. Implement a PID controller and test the performance with a setpoint change

B. DC Motor Control system

7. Finding and validation of motor model for speed control
8. PI controller design for set point tracking on DC motor control kit
9. PI controller design for disturbance rejection on DC motor control kit
10. PID Controller design for motor position control

Course Outcomes: At the end of this course students will be able to

CO1: Determine the models of physical system in real-time environment

CO2: Compare first principle model, non-linear models and linear models of dynamical systems

CO3: Design a PI/PID controller to meet the design requirements

CO4: Experimentally validate the performance of controller for both tracking and disturbance rejection requirements.

CO-PO MAPPING:

Pos	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3		3	3									
CO2	3	3		3	3									
CO3	3	3		3	3									
CO4	3	3		3	3									

References:

1. http://apmonitor.com/pdc/index.php/Main/ArduinoTemperatureControl
2. https://github.com/APMonitor/mdc

MICROPREOCESSORS & MICROCONTROLLERS LAB

Subject Code: UGEE6P1120	**L**	**T**	**P**	**C**
III Year / II Semester	**0**	**0**	**3**	**1.5**

Course Objective:

This course introduces the assembly language programming of 8086 and 8051 microcontrollers. It gives a practical training of interfacing the peripheral devices with the 8086 microprocessor. The course objective is to introduce the basic concepts of microprocessor and to develop in students the assembly language programming skills and real time applications of Microprocessor as well as microcontroller.

Syllabus

List of Experiments

1. Arithmetic operation – Multi byte addition and subtraction, multiplication and division, Signed and unsigned arithmetic operation, ASCII – Arithmetic operation.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
3. By using string operation and Instruction prefix: Move block, Reverse string Sorting, Inserting, Deleting, Length of the string, String comparison.
4. Modular Program: Procedure, Near and Far implementation, Recursion.
5. DOS/BIOS programming: Reading keyboard (Buffered with and without echo) – Display characters, Strings.
6. Interfacing 8255–PPI
7. Programs using special instructions like swap, bit/byte, set/reset etc.
8. Programs based on short, page, absolute addressing.
9. Interfacing 8259 – Interrupt Controller.
10. Interfacing 8279 – Keyboard Display.
11. Stepper motor control using 8253/8255.
12. Arithmetic and logical operation using 8051 kit.

Course Outcomes: At the end of this course students will be able to
CO1: Develop assembly language programs for various applications using 8086 & 8051 trainer kits
CO2: Illustrate how the different peripherals (8255, 8259 etc.) are interfaced with 8086 Microprocessor.
CO3: Develop the assembly level programming using 8086 instruction set in TASM
CO4: Develop technical writing skills and effective communication
CO5: Acquire teamwork skills for working in groups

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2			3										
CO2				2										
CO3				2										
CO4										3				
CO5									3					

POWER SYSTEMS LAB

Course Code: UGEE6P1220	**L**	**T**	**P**	**C**
III Year / II Semester	**-**	**-**	**3**	**1.5**

Course Objectives: To study and analyze different power system protective equipment and renewable energy sources by conducting suitable experiments.

List of Experiments

Any 10 of the following:

1. Experimental simulation of Electrical Power transmission line model
2. Experimental simulation of fault analysis on 3 phase Alternator
3. Testing of CT, PT's and Insulator strings.
4. Characteristics of current and potential transformer
5. Characteristics of IDMT Overcurrent Relay
6. Characteristics of Micro controller based IDMT over/under voltage relay
7. Characteristics of Micro controller based single phase differential relay
8. Determination the sequence impedances of 3-Φ Transformer
9. Experimental study of wind profile and wind power characteristics
10. Determination of characteristics of Solar Photovoltaic (PV) module/cell
11. MPPT tracking in PV System
12. Determination of sequence impedances of a cylindrical rotor Synchronous Machine.
13. Determination of Sub-transient reactance's of a Salient Pole Synchronous Machine.

Course Outcomes: At the end of this course students will be able to
CO1: Analyze characteristics of Solar PV systems, and switchgear equipment.
CO2: Determine sequence impedance and Sub-transient reactance of synchronous machine and
CO3: Analyze electric power transmission line model

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3						3	3				
CO2	3	3	3						3	3				
CO3	3	3	3						3	3				

IoT / Robotics

Subject Code: UGEE6K1320	**L**	**T**	**P**	**C**
III Year / II Semester	**1**	**0**	**2**	**2**

Prerequisites: C Programming, Electronic devices, Actuators, Communication protocol and Control systems

Course Objective: To understand and acquire knowledge on various Electronic devices and sensors with the help micro controller for a specific operation or data communication to analyze the designed system.

Syllabus

IoT: Introduction to IoT, arduino simulation environment, sensor & actuators with arduino, basic networking with esp8266 Wi-Fi module, IoT protocols, cloud platforms for IoT, IoT protocols, IoT architecture, web of things, IoT applications.

Robotics: Introduction to robotics, robot kinematics, trajectory and motion planning, robot dynamics, actuators and sensors.

Course Outcomes: At the end of this course students will be able to
CO1: Measure various physical parameters with the help of sensors.
CO2: Interface with different actuators for required operations.
CO3: Gain knowledge about data communication to analyze the designed system.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	3	3	-	-	-	-	-	-	-	-	-
CO3	-	3	3	3	3	-	-	-	-	-	-	-	-	-

Reference Books:

1. Arduino Cookbook by Michael Margolis, O'Reilly Media, Inc. 1st edition.
2. Arduino for Beginners: Essential Skills Every Maker Needs, John Baichta, Pearson Education, Inc. (https://ptgmedia.pearsoncmg.com/images/9780789748836/samplepages/0789748835.pdf).
3. Raspberry pi 3! An Introduction to Using with Python, Scratch, JavaScript and More, Gary Mitnick, Createspace Independent Publishing Platform, 2017
4. Raspberry Pi Cookbook for Python Programmers, Tim Cox, Packt publishing Ltd., 2nd revised edition, 2016.
5. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet ofThings", Springer, 2011.
7. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.
8. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applicationsand Protocols", Wiley, 2012. References:
9. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
10. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

11. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1
12. Fu. K.S, Gonzalez. R.C, Lee. C.S.G "Robotics –Control, Sensing, Vision, and Intelligence", McGraw Hill, 2015
13. Pratihar.D.K, "Fundamentals of Robotics",Narosa Publishing House,India,2019.
14. Groover Mikell .P, "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2014
15. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
16. Koren Y., "Robotics for Engineers", McGraw Hill Book Co., 1992
17. Maja J Mataric, "The Robotics Primer "Universities Press. 2013.
18. John J. Craig , "Introduction to Robotics Mechanics and Control", Pearson Education India,2008

INTELLECTUAL PROPERTY RIGHTS & PATENTS

(Mandatory Course)

Subject Code: UGEE6A1420	**L**	**T**	**P**	**C**
III Year /II Semester	**2**	**0**	**0**	**0**

Course Objectives: This course introduces about intellectual property laws, trademarks, copyrights and patents.

Syllabus

UNIT-I: **(6 Hours)**

Intellectual Property Law: Basics, Types,Agencies Responsible for IP Registration, International Organizations, Agencies and Treaties, Importance of IPR.

Trademark Law: Purpose of Trademarks, Types,Acquisition,Common Law Rights, Lawsand Treaties Governing Trademarks,Categories,Trade Names and Business Names, Protectable Matter, Exclusions from Trademark Protection, Selecting and Evaluating a Mark, Trademark Search.

UNIT-II: **(5 Hours)**

Copyright Law: Common Law Rights, Originality of Material, Fixation of Material, Works of Authorship, Exclusions, Compilations, Collections and Derivative Works.

Rights Afforded by Copyright Law: Rights of Reproduction, Derivative Works, Distribution and the First Sale Doctrine, Work Publicly, Rights to Display the Work Publicly, Other Limitations on Exclusive Rights, Moral Rights and the Visual Artists Rights, Compulsory Licenses.

UNIT-III: **(7 Hours)**

Copyright Ownership and Transfers: Ownership Issues, Joint Works, Ownership in Derivative or Collective Works, Works Made for Hire, Transfers, Termination of Transfers andDuration.

Copyright Infringement: Elements, Contributory and Vicarious Infringement, Defences to Infringement, Infringement Actions.

New Developments: Protection for Computer Programs and Automated Databases, Copyright in the Electronic Age, Entertainment Notes, Recent Developments, Terms of the Trade, Semiconductor Chip Protection.

UNIT-IV: **(6 Hours)**

Patent Law: Introduction, Patentability, Design Patents, Plant Patents, Double Patenting.

Patent Searches and Application: Searching, Application Process, Prosecuting the Application, Post-issuance Actions, Term and Maintenance of Patents.

UNIT-V: **(6 Hours)**

Patent Ownership and Transfer: Ownership Rights, Sole and Joint Inventors, Disputes,Inventions made by Employees and Independent Contractors, Assignment of Rights, Licensing, Invention Developers and Promoters.

Patent Infringement: Direct Infringement, Inducement to Infringe, ContributoryInfringement, First Sale Doctrine, Indirect Infringement, Infringement Abroad, Claims Interpretation,Defences, Remedies,Resolving a Dispute andLitigation.

UNIT-VI: **(5 Hours)**

New Developments: International Patent Protection, Patent Cooperation Treaty, European Patent Organization, Patent Prosecution Highway, Agreement on Trade-Related Aspects of IPR, Patent Law Treaty, Foreign Filing Licenses.

Intellectual Property Audits: Practical Aspects of Intellectual Property Audits, Conducting the Audit, Postaudit Activity.

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1: Understand the intellectual property law.

CO2: Understand the need of trademark and its use.

CO3: Familiar with copyright laws and its rights, ownership, transfers and copyright Infringement.

CO4: Acquire the knowledge on various aspects of patents.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	-	-
CO3	3	3	3	-	-	-	-	3	-	3	-	-
CO4	3	3	3	-	-	3	3	3	-	3	-	-

TEXT BOOKS:

1. Deborah E.Bouchoux, "Intellectual Property", Cengage Learning

2. Asha Vijay, Durafe Dhanashree and K. Toradmalle, "Intellectual Property Rights", Wiley India

3.Neeraj Pandey and KhushdeepDharni,"Intellectual Property Rights", PHI Learning, 2014.

REFERENCE BOOKS:

1. Kompal Bansal & Parishit Bansal, "Fundamentals of IPR for Engineers", BS Publications.

2. PrabhuddhaGanguli, "Intellectual Property Rights", Tata Mc-Graw Hill, New Delhi.

3. R.Radha Krishnan, S.Balasubramanian, "Intellectual Property Rights", Excel Books. New Delhi.

4. M.Ashok Kumar and Mohd.Iqbal Ali, "Intellectual Property Right", Serials Pub.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

6. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd.

7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand.

8. Dr. A. Srinivas, "Intellectual Property Rights (Patents & Cyber Law)", Oxford University Press, New Delhi.

IV Year I- Semester

POWER SYSTEM OPERATION AND CONTROL
(Professional Elective-III)

Subject Code: UGEE7T0120	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Power Systems-I, Control systems

Course Objective: This subject deals with, Economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers. It also emphasizes on power system monitoring and control

Syllabus

UNIT –I	**ECONOMIC OPERATION OF POWER SYSTEMS**	**Hours: 09**
Optimal operation of Generators in Thermal Power Stations, - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected - Optimum generation allocation including the effect of transmission line losses – Loss Coefficients - General transmission line loss formula.		
UNIT –II	**HYDRO-THERMAL SCHEDULING& UNIT Commitment**	**Hours: 09**
Hydrothermal Scheduling: Optimal scheduling of Hydrothermal System: Hydroelectric power plant models – Scheduling problems – Short term hydrothermal scheduling problem. **Unit Commitment**: Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming		
UNIT –III	**MODELING OF POWER SYSTEM**	**Hours: 09**
Mathematical Modeling of Speed Governing System – Derivation of small signal transfer function. Modeling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models. Modeling of Excitation System: Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram, Representation of IEEE Type-1 Model		
UNIT – IV	**LOAD FREQUENCY CONTROL-1**	**Hours: 09**
Necessity of keeping frequency constant - Definitions of Control area – Load frequency control of 1-area system – Steady state analysis – Dynamic response – uncontrolled case and controlled case		
UNIT –V	**LOAD FREQUENCY CONTROL-II**	**Hours: 09**
Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias Control, Load Frequency Control and Economic dispatch control.		
UNIT –VI	**REACTIVE POWER CONTROL**	**Hours: 09**
Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation –Specifications of load compensator – Uncompensated and compensated transmission lines: Shunt and series compensation		

Course Outcomes: At the end of this course students will be able to
CO1: explain the economic operation of power systems
CO2: interpret the hydrothermal scheduling and unit commitment
CO3: model various power system components
CO4:analyze the operation of Load frequency control of single area power system
CO5: analyze the operation of Load frequency control of two area power system
CO6: explain the concept of reactive power control

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												
CO6	3	3												

TextBooks:

1. "Modern Power System Analysis", I.J. Nagrath and D.P. Kothari, Tata McGraw Hill, 4thEdition, 2011.
2. "Power System Analysis", HadiSaadat, Tata McGraw–hill, 2nd Edition, 2002.
3. "Electrical power systems", C.L. Wadhwa, New Age International (P) Limited, Publishers, 6th edition, 2010.
4. Electrical Power Systems by P.S.R. Murthy, B.S. Publications

ReferenceBooks:

1. "Electric Energy systems Theory", O.I. Elgerd, Tata McGraw–hill, 2nd Edition, 2007.
2. "Power System Analysis", Grainger and Stevenson, Tata McGraw Hill, 1st Edition 2003.
3. "Power System Analysis and Design", J.Duncan Glover and M.S.Sarma, Thompson, 3rd Edition, 2002.
4. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4thedition

HIGH VOLTAGE ENGINEERING
(Professional Elective-III)

Sub Code: UGEE7T0220	**L T P C**
IV YEAR-I SEM	**3 - - 3**

Prerequisites: Fundamentals of matamethics, chemistry and knowledge of circuit analysis and power system fundamentals**.**

Course Objectives: The aim of this course is to learn the importance principles and of HV generation, measurement, numerical study of electrostatic field computation methods, break down properties of gas, solid, and liquid dielectrics. Non destructive and testing of electrical apparatus.

Syllabus

UNIT –I	**Introduction to High Voltage Technology**	**Hours: 08**
Electric Field Stresses – Uniform and non–uniform field configuration of electrodes – Estimation and control of electric Stress – Numerical methods for electric field computation.		
UNIT –II	**Break down phenomenon in gaseous, liquid and solid**	**Hours: 08**
Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases – Paschen's law – Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquid – Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown – Breakdown of solid dielectrics in practice – Breakdown in composite dielectrics used in practice.		
UNIT –III	**Generation of High voltages and High currents**	**Hours: 09**
Generation of high DC voltages – Generation of high alternating voltages – Generation of impulse voltages – Generation of impulse currents – Tripping and control of impulse generators.		
UNIT – IV	**Measurement of high voltages and High currents**	**Hours: 08**
Measurement of high AC, DC and Impulse voltages – Voltages and measurement of high currents – Direct, alternating and Impulse.		
UNIT –V	**Non–destructive testing of material and electrical**	**Hours: 08**
Measurement of DC resistivity – Measurement of dielectric constant and loss factor – Partial discharge measurements.		
UNIT –VI	**High voltage testing of electrical apparatus**	**Hours: 09**
Testing of insulators and bushings – Testing of isolators and circuit breakers – Testing of cables – Testing of transformers – Testing of surge arresters.		

Course Outcomes: At the end of this course students will be able to
CO1: To be acquainted with the performance of high voltages with regard to different configurations
CO2: To be able to analyze the theory of breakdown and withstand phenomena of all types of
CO3: To acquaint with the techniques of generation of AC, DC and Impulse voltages.
CO4: To be able to apply knowledge for measurement of high voltage, high current AC, DC ,Impulse
CO5: To analyze the techniques of testing various equipment's used in HV engineering.

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P12	PSO1	PSO2
CO1	3	3	3											
CO2	3	3	3											
CO3	3	3	3	3										
CO4	3	3	3	3	2	3								
CO5	3	3	3	2	2	3								

Text Books:

1. "High Voltage Engineering" by M. S. Naidu and V. Kamaraju – TMH Publications, 3rd Edition
2. "High Voltage Engineering: Fundamentals" by E. Kuffel, W. S. Zaengl, J. Kuffel by Elsevier, 2nd Edition.
3. "High Voltage Engineering and Technology" by Ryan, IET Publishers.

Reference Books:

1. "High Voltage Engineering" by C. L. Wadhwa, New Age Internationals (P) Limited, 1997.
2. "High Voltage Insulation Engineering" by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.

ADVANCED ELECTRIC DRIVES
(Professional Elective-III)

Subject Code: UGEE7T0320	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**-**	**-**	**3**

Course Objective:
This course introduces the Advanced Electric Drives with relevant Power Electronic converters for different applications and control strategies.

Syllabus

UNIT –I	**Modeling of AC-DC convertor fed DC drive**	**Hours: 08**
Modeling of AC-DC convertor fed DC drive components & design of controller: Transfer function of Dc motor and load, convertor, current and speed controllers, current and speed feedback elements. Closed loop two quadrant DC motor drive, closed loop four quadrant DC motor drive		
UNIT –II	**DC-DC convertor drive fed DC motor drive**	**Hours: 08**
DC-DC convertor drive fed DC motor drive: Four quadrant DC-DC convertor fed dc motor drive, steady state analysis of DC-DC convertor dc motor drive, pulsating torques.		
UNIT –III	**Closed loop operation of DC-DC convertor fed dc**	**Hours: 06**
Closed loop operation of DC-DC convertor fed dc motor drive: Design of current controller, design of speed controller, modeling of current and speed controller, introduction to simulation of speed controlled dc motor drive.		
UNIT – IV	**3-phase Induction Motor Drives**	**Hours: 06**
Analysis of IM fed from non-sinusoidal supply – starting and plugging; variable frequency control, torque-slip relation, starting torque and braking torque, closed-loop VSI fed IM drive. Concept of space vector, vector control of IM: direct or feed-back vector control, flux vector estimation, vector control of line side PWM converter - vector control of converter fed inverter drive.		
UNIT –V	**Synchronous motor drives**	**Hours: 08**
Variable frequency control of synchronous motor, closed-loop control of inverter fed synchronous motor drive. Permanent magnet synchronous motor drive.		
UNIT –VI	**BLDC motor drives**	**Hours: 10**
BLDC motor drives, VSI fed BLDC motor drives, back EMF, phase current and torque waveforms, control of BLDC motors with sensors, sensor-less control of BLDC motors		

Course Outcomes: At the end of this course students will be able to
CO1: Analyze the control and operation of DC Drive fed by Rectifier.
CO2: Acquire the knowledge of DC-DC convertor drive fed DC motor drive and Closed loop operation.
CO3: Design and implementation of 3-phase Induction Motor Drives.
CO4: Analyze the control and operation of Synchronous motor.
CO5: Analyze the control and operation of BLDC motor drives.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		3											3
CO2	3		3											3
CO3	3		3											3
CO4	3		3											3
CO5	3			3										3

Text Books:

1. Electrical Motor Drives Modeling, Analysis and Control – R. Krishna, Prentice Hall India.
2. Power Semiconductor Drives – G.K. Dubey.
3. "Control of electric drives", W. Leonhard, Springer Verilog

Reference Books:

1. Power Electronics and Motor control – Shepherd, Hulley, Liang-II Edition, Cambridge University Press.
2. Power control of AC motors", J.M.D. Murphy and F. G. Turnbul

Utilization of Electrical Energy
(Professional Elective-III)

Subject code: UGEE7T0420	**L**	**T**	**P**	**C**
IV YEAR -I SEM	**3**	**-**	**-**	**3**

Pre requisite: Fundamentals of circuits and electrical machine, lighting Principles.

Objective: This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding an illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course.

Syllabus

UNIT –I	**Selection of Motors**	**Hours: 10**
Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise–Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization.		
UNIT –II	**Electric Heating and Welding**	**Hours: 09**
Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating – Arc furnaces – Direct and indirect arc furnaces **Electric Welding** Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding		
UNIT –III	**Illumination fundamentals**	**Hours: 10**
Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Discharge lamps, MV and SV lamps – Lumen or flux method of calculation - Sources of light.		
UNIT – IV	**Various Illumination Methods**	**Hours: 07**
Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control–Types and design of lighting and flood lighting–LED lighting, principle of operation, street lighting and domestic lighting – Conservation of energy		
UNIT –V	**Electric Traction – I**	**Hours: 07**
System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed– time curves for different services – Trapezoidal and quadrilateral speed time curves-High speed transportation trains.		
UNIT –VI	**Electric Traction – II**	**Hours: 07**
Calculations of tractive effort– power –Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking, retardation adhesive weight and coefficient of adhesion–Principles of energy efficient motors-Modern traction motors.		

Course Outcomes:
CO1: To able to choose the selection of motors for suitable application.
CO2: To acquaint with the different types of heating and welding techniques.
CO3: To study the basic principles of illumination and analyze the different types of lightning system including design
CO4: To acquire the basic principle of electric traction including speed–time curves of different traction services and to analyze the various traction systems for braking, acceleration and other related parameters

CO-PO mapping:

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P12	PSO1	PSO2
CO1	3	3												
CO2	3	3	3		2	2								
CO3	3	3	3	3										
CO4	3	3	3	3										

Text Books:

1. "Utilization of Electric Energy" – by E. Openshaw Taylor, Orient Longman.
2. "Art & Science of Utilization of electrical Energy" – by Partab, DhanpatRai& Sons.

Reference Books:

1. "Utilization of Electrical Power including Electric drives and Electric traction" – byN.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. "Generation, Distribution and Utilization of electrical Energy" – by C.L. Wadhwa,New Age International (P) Limited, Publishers, 1997.

CONTROL SYSTEMS DESIGN
(Professional Elective-III)

Subject Code: UGEE7T0520	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Control Systems

Course Objective: This course aims to introduce the aspects of designing and operating an automated process so that it maintains specifications on profitability, quality, safety, environmental impact, etc.

Syllabus

UNIT I: Design Specifications **6hrs**

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

UNIT II: Design of Classical Control System in the Time Domain **8hrs**

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

UNIT III: Design of Classical Control System in Frequency Domain **8hrs**

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

UNIT IV: Design of PID Controllers **6hrs**

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

UNIT V: Control System Design in State Space **8hrs**

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.

UNIT VI: Nonlinearities and Its Effect on System Performance **8hrs**

Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Course Outcomes: At the end of this course students will be able to

CO1: Explain the design problem and related specifications in time and frequency domains

CO2: Identify appropriate compensator/ controller and apply the design procedure for the

Estimating the parameters of simple controller structures (P, PI, PID, compensators)

CO3: Apply the design procedures to select appropriate state feedback control and observer gains for the specified design requirements

CO4: Interpret the effects of nonlinearities on system performance

CO-PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		3											3
CO2	3		3										2	3
CO3	3		3											3
CO4	3	3												3

TEXT BOOKS:

1. "Control Systems Engineering Norman S. Nise, Wiley, 6th Edition, 2012.
2. "Modern Control Engineering", Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
3. "Control Systems: Principles and Design", M. Gopal, Mcgraw Higher Ed, 4th Edition, 2012
4. "Control Systems Engineering", I. J. Nagrath and M. Gopal, New Age International Ltd., 2nd Edition, 2006.

REFERENCE BOOKS:

1. "Digital Control Engineering", M Gopal, New Age International Ltd., Publishers, 2nd Edition, 2014.
2. "Linear control system analysis and design (conventional and modern)",J. J. D'Azzo and C. H. Houpis, Mcgraw Higher Ed, 4th Edition, 1995.
3. "Design of feedback Control Systems", R. T. Stefani and G. H. Hostetter, Saunders College Pub., 3rd Edition, 1994.

PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS
(Professional Elective-IV)

Subject Code: UGEE7T0620	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Digital electronics, Control Systems

Course Objective: To make the students aware about the automation used in various industrial applications and the use of PLC in different processes

Syllabus

UNIT –I	**PLC BASICS**	**Hours: 06**
PLC system, I/O modules and interfacing, CPU processor, programming Equipment, Programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules.		
UNIT –II	**PLC PROGRAMMING**	**Hours: 06**
Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.		
UNIT –III	**PLC REGISTERS**	**Hours: 08**
PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.		
UNIT – IV	**PLC FUNCTIONS -I**	**Hours: 08**
Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number Comparison functions, Number Conversion functions.		
UNIT –V	**PLC FUNCTIONS –II**	**Hours: 06**
Data Handling functions: SKIP, Master Control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications.		
UNIT –VI	**ANALOG PLC OPERATION**	**Hours: 08**
Analog modules & systems, Analog signal processing, Analog output Application Examples, PID principles, PID Modules, PID tuning, PID functions		

Course Outcomes: At the end of this course students will be able to
CO1: Interpret PLC system and construction of PLC ladder diagrams
CO2: Apply the knowledge of PLC programming on some case studies
CO3: Describe characteristics of registers and conversion examples
CO4: Apply PLC functions to timing and counting applications
CO5: Analyze the analog operations of PLC

CO – PO Mapping														
POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												
CO6	3	3												

TextBooks:

1. "Programmable Logic Controllers: Principles and Applications", John W. Webb, Ronald A. Reis Prentice Hall, 2003 - Technology & Engineering
2. "Programmable Logic Controllers- Programming Method and Applications", Jr. Hackworth & F.D Hackworth Jr., Pearson Education,1st edition, 2003.
3. "Introduction to Programmable Logic Controllers", Delmar Thomas, Cengage Learning, 3rd edition, 2007.

REFERENCE BOOKS:

1. "W. Bolton", Programmable Logic Controllers, Newnes, 4th Edition 2000.

GREEN ELECTRONICS
(Professional Elective-III)

Subject Code: UGEE7T0720	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**-**	**-**	**3**

Course Objective:
This course introduces the Green energy generation and control with relevant Power Electronic converters for different applications.

Syllabus

UNIT –I	**Buck Converters for PV Generation**	**Hours: 06**
Buck Converter - Converter efficiency - Buck topology - Single-Cycle analysis. Discontinuous Conduction Mode – DCM Buck Converter.		
UNIT – II	**Boost Converters for PV Generation**	**Hours: 06**
Boost Converter - Analysis of the Boost Converter. Buck-Boost Converter. Flyback Converter - Flyback topology and operation.		
UNIT –II	**Forward Converters for Wind Generation**	**Hours: 08**
Forward Converter - Forward topology and operation. Capacitive Converters - Capacitive Voltage Doubler - Analysis of the Capacitive Voltage Doubler.		
UNIT –IV	**Inverter for Wind Generation**	**Hours: 10**
Inverters - Basic inverter. Power Factor Correction - Power Factor - PFC Corrected Converter - PFC Controller. Soft Switching - Quasi-Square-Wave Converter.		
UNIT –V	**Photo-Voltaic Power Generation**	**Hours: 08**
Solar Photovoltaic Systems - Balance of systems – IV characteristics – Maximum Power Point Tracking techniques: Perturb and Observe (P&O) technique – Hill climbing technique.		
UNIT –VI	**Wind Energy**	**Hours: 08**
Wind Energy - Wind patterns – Types of turbines – Kinetic Energy of Wind – Betz coefficient – Tip–Speed ratio – Efficiency – power output of wind turbine – selection of generator (synchronous, induction).		

Course Outcomes : At the end of this course students will be able to
CO1: Design and implementation of different converters for the control and conversion of Green energy
CO2: Acquire the knowledge Solar power generation.
CO3: Acquire the knowledge Wind power generation.

CO – PO Mapping													
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3						2							
CO2	3						2							
CO3	3													3

Text Books:

1. Non Conventional Energy Sources, G.D. Rai, khanna publishers.
2. https://web.stanford.edu/class/ee152/resources/course_notes_092416.pdf

Reference Books:

1. Solar energy: principles of thermal collection and storage, s. P. Sukhatme and j. K. Nayak, tmh, New Delhi, 3rd edition.

HVDC & FACTS
(Professional Elective IV)

Subject Code: UGEE7T0820	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Power electronics, Power systems.

Course Objectives: It is important for the student to understand the principle of operation of series and shunt compensators by using power electronics. And HVDC Transmission & its Converters, Power factor improvement.

Syllabus

UNIT –I	**DC TRANSMISSION TECHNOLOGY**	**Hours: 08**
Comparison of AC and DC Transmission. Types of HVDC Systems. Components of a HVDC system. Application of DC Transmission. Six pulse Line Commutated Converter (LCC) and three level Voltage		
UNIT –II	**COMPONENTS OF HVDC SYSTEMS**	**Hours: 08**
Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. DC line faults in LCC systems. DC line faults in VSC systems. DC breakers. Mono-polar Operation. Ground Electrodes.		
UNIT –III	**CONTROL OF HVDC CONVERTERS**	**Hours: 08**
Principles of Link Control in a LCC HVDC system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.		
UNIT – IV	**INTRODUCTION To FACTS**	**Hours: 06**
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 –V	**VOLTAGE SOURCE AND CURRENT SOURCE CONVERTERS**	**Hours: 09**
Concept of voltage source converter (VSC) – Single phase bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.		
UNIT –VI	**SHUNT & SERIES COMPENSATORS**	**Hours: 08**
Shunt Compensation: Schematic and basic operating principles of Thyristor Controlled Reactor (TCR),Thyristor Switched Capacitor (TSC),Static VAR compensator (SVC) and Static Compensator (STATCOM).Series Compensation: Schematic and basic operating principles of GTO ,Thyristor controlled Series Capacitor (GSC) and Thyristor Controlled Series Capacitor (TCSC).		

Course Outcomes: At the end of this course students will be able to
CO1: To apply knowledge to represent the HVDC system and compare to AC system
CO2: To analyze the components of HVDC systems and HVDC Converter control strategies.
CO3: To apply knowledge to represent the concept of FCATS.
CO4: To analyze the VSC and CSC converter topologies and the Series and shunt compensators

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3	3										
CO2	3	3	3	3										
CO3	3	3	3	2										
CO4	3	3	3	3	2									

Text Books:
1."HVDC Power Transmission Systems", K. R. Padiyar, New Age International Publishers, 2nd Edition, 2011. 2. "Understanding FACTS" N.G. Hingorani and L. Guygi, IEEE Press. Indian Edition Standard Publications, 2001. 3. "Direct Current Transmission", E. W. Kimbark, Wiley-Interscience, 1st Edition, 1971. Publishers, 2013
Reference Books:
1."High Voltage Direct Current Transmission", J. Arrillaga, Peter Peregrinus Ltd., 1983. 2. "Flexible ac transmission system (FACTS)" Edited by Yong HueSong and Allan T Johns, Institution of Electrical Engineers, London. 3. "Thyristor-based FACTS Controllers for Electrical Transmission Systems", by R. Mohan Mathur and Rajiv K.Varma, Wiley.

ENERGY AUDIT, CONSERVATION AND MANAGEMENT
(Professional Elective -IV)

Subject Code: UGEE7T0920	**L**	**T**	**P**	**C**
IV Year / Semester-I	**3**	**-**	**-**	**3**

Prerequisites: Fundamentals of energy systems.

Course Objective:

1. To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy conservation and energy auditing.
2. To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding energy conservation and energy management.

Syllabus

UNIT –I	**Basic Principles of Energy Audit**	**Hours: 09**
Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, building energy audit.		
UNIT –II	**Energy Management**	**Hours: 09**
Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.		
UNIT –III	**Energy Efficient Lighting**	**Hours: 08**
Introduction, terms used in illumination–Laws of illumination-Luminous efficiency – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED – Energy conservation measures .		
UNIT – IV	**Power Factor and energy instruments**	**Hours: 07**
Methods of Power factor improvement – Location of capacitors – Energy Instruments – Watt–hour meter – Data loggers – Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.		
UNIT –V	**Economic Aspects and Analysis**	**Hours: 09**
Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts).		
UNIT –VI	**Computation of Economic Aspects**	**Hours: 08**
Calculation of simple payback method – Net present worth method – Power factor correction – lighting Applications of life cycle costing analysis – Return on investment.		

Course Outcomes: At the end of this course students will be able to
CO1: Understand the significance and procedure for energy conservation and audit.
CO2:. Understand the fundamentals of energy management functions.
CO3: Analyze, calculate and improve the energy efficiency and performance of electrical utilities.
CO4: Analyze the power factor and increase the efficiency of energy instruments.
CO5: Understand the economic analysis and system energy management for electrical system and equipment.
CO6: Determine pay back periods for energy saving equipment.

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3											
CO2	3	3	3											
CO3	3	3	3											
CO4	3	3	3	3		2								
CO5	3	3	3	3	2	3								
CO6	3	3	3			3								

Text Books:

1. Energy management by W.R. Murphy AND G. McKay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995.

Reference Books:

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
2. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
3. Energy management hand book by W.C.Turner, John wiley and sons.
4. Energy management and conservation –k v Sharma and pvenkata seshaiah-I K International Publishing House pvt.ltd,2011.
5. http://www.energymanagertraining.com/download/Gazette_of_IndiaPartIISecI-37_25-08-2010.pdf

ARTIFICIAL INTELLIGENCE IN ELECTRICAL ENGINEERING

(Professional Elective-IV)

IV Year I Semester
Subject Code: UGEE7T1020

L	T	P	C
3	-	-	3

SYLLABUS

UNIT –I	**Introduction**	**Hours: 06**
Introduction, Humans and Computers, Biological Neural Networks, Historical development of neural network, Terminology and Topology, Biological and artificial neuron models, Basic learning laws		
UNIT –II	**Neural Networks**	**Hours: 08**
MCCulloch-pitts neuron model, Activation functions, learning rules, neural network architectures-Single-layer feed-forward networks:– Perceptron, Learning algorithm for perceptron-limitations of Perceptron model		
UNIT – III	**ANN paradigm**	**Hours: 08**
Multi-layer feed-forward network (based on Back propagation algorithm) – Radial –basis function networks-Recurrent networks (Hopfield networks).		
UNIT –IV	**Genetic algorithms & Modelling**	**Hours: 06**
Genetic algorithms & Modelling-introduction-encoding-fitness function-reproduction operators-genetic operators-cross over and mutation-generational cycle-convergence of genetic algorithm		
UNIT –V	**Classical and Fuzzy Sets**	**Hours: 08**
Introduction to classical sets – properties – Operations and relations – Fuzzy sets – Membership – Uncertainty – Operations – Properties – Fuzzy relations – Cardinalities – Membership functions-Fuzzification – Membership value assignment – Development of rule base and decision-making system – Defuzzification to crisp sets – Defuzzification methods		
UNIT –	**Applications of AI Techniques:**	**Hours: 08**
Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Reactive power control, Speed control of DC and AC Motors.		

Course Outcomes: At the end of this course students will be able to
CO1: Comprehend feed forward neural networks, feedback neural networks and
CO2: Recognize fuzziness involved in various systems and fuzzy set theory.
CO3: Develop fuzzy logic control for applications in electrical engineering
CO4: Develop genetic algorithm for applications in electrical engineering.

CO – PO Mapping														
POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO**	**PSO**
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												
CO6	3	3												

TextBooks:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran and G.A.Vijaya lakshmi Pai–PHI Publication.
2. Fuzzy logic with fuzzy applications- by T.J.Ross, TMH.

REFERENCE BOOKS:

3. Introduction to Artificial Neural Systems – Jacek M. Zurada, Jaico Publishing House, 1997.
4. Fundamentals of Neural Networks Architectures, Algorithms and Applications-by laurene Fausett, Pearson.
5. Neural Networks, Algorithms, Applications and programming Techniques by James Freeman, David M.Skapura.
6. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH

ENERGY STORAGE TECHNOLOGIES
(Professional Elective-V)

Subject Code: UGEE7T1120	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**-**	**-**	**3**

Course Objective:
This course introduces the need for energy storage, devices and technologies available and their applications

Syllabus

UNIT –I	**Electrical Energy Storage Technologies**	**Hours: 08**
Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.		
UNIT –II	**Needs for Electrical Energy Storage**	**Hours: 08**
Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, the role of electrical energy storage technologies: from viewpoint of a utility, consumers and generators of renewable energy.		
UNIT –III	**Features of Energy Storage Systems**	**Hours: 06**
Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG).		
UNIT – IV	**Types of Electrical Energy Storage systems**	**Hours: 06**
Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems, Standards for EES, Technical comparison of EES technologies.		
UNIT –V	**Energy Storage Applications-I**	**Hours: 08**
Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems.		
UNIT –VI	**Energy Storage Applications-II**	**Hours: 10**
Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries.		

Course Outcomes: At the end of this course students will be able to
CO1: Analyze the characteristics of energy from various sources and need for storage.
CO2: Classify various types of energy storage and various devices used for the purpose.
CO3: Identify various real time applications.

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													
CO2	3													
CO3	3	3												

Text Books:

1. "James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Books:

1. "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

ROBOTICS & CONTROL
(Professional Elective-V)

Subject Code: UGEE7T1220	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic Mathematics, Control systems

Course Objective: Through this course students will acquire the ability to conductresearch, develop innovative designs in the field of systems engineering and control of robots.

Syllabus

UNIT I: Spatial Descriptions and Transformations **8hrs**

Introduction - Descriptions: positions, orientations and frames - Mappings: Changing descriptions from frame to frame - Operators: translations, rotations, transformations, Transformation arithmetic - Transform equations - More on representation of orientation - Transformation of free vectors - Computational considerations.

UNIT II: Manipulator Kinematics **8hrs**

Introduction - Link description - Link connection description - convention for affixing frames to links - Manipulator kinematics - Actuator space, Joint space and Cartesian space - Examples: Kinematics of two industrial robots - Computational considerations.

UNIT III: Inverse Manipulator Kinematics **8hrs**

Introduction – Solvability - The notation of manipulator subspace when n<6 - Algebraic Vs. Geometric - Algebraic solution by reduction to polynomial - Pieper's solution when three axes intersect - Examples of inverse manipulator kinematics - The standard frames - SOLVE - ing a manipulator - Repeatability and accuracy - Computational considerations.

UNIT IV: Jacobians: Velocities and Static Forces **8hrs**

Introduction - Notation for time varying position and orientation - Linear and Rotation of velocity of rigid bodies - More on angular velocity - Motion of the links of a Robot - Velocity " propagation" from link to link – Jacobians – Singularities - Static forces in Manipulators - Jacobians in the force domain - Cartesian transformation of velocities and static forces.

UNIT V: Manipulator Dynamics **8hrs**

Introduction - Acceleration of a rigid body - Mass distribution - Newton's Equation, Euler's equation - Iterative Newton –Euler dynamic formulation - Iterative Vs. Closed form - An example of closed form dynamic equations - The structure of the Manipulator dynamic equations - Lagrangian Formulation of manipulator Dynamics - Formulating manipulator dynamics in Cartesian space - Computational considerations.

UNIT VI: Linear Control of Manipulators **8hrs**

Introduction - Feedback and closed loop control - Second order linear systems - Control of second order systems - Control law partitioning – Trajectory - Following control - Disturbance rejection - Continuous Vs. Discrete time control - Modeling and control of a single joint - Architecture of industrial robot controller.

Course Outcomes: At the end of the course, students will be able to

CO1: describe the mathematics of spatial descriptions and transformations
CO2: understand the manipulator kinematics & inverse manipulator kinematics
CO3: understand the dynamics of manipulator
CO4: express the Jacobians of velocity and static forces
CO5: apply linear control techniques for manipulators

CO-PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3		3											
CO2	3		3											
CO3	3		3											
CO4	3		3											

Text Books:

1. J. J. Craig, Introduction to Robotics, Addison Wesley , 1986
2. Mark W. Sponge, Sethhutchinson and M. Vidyasagar Robot Modeling and Control, Wiley student Edition, 2006.

References:

1. Tsuneo Yoshikawa, Foundations of Robotics –Analysis and Control, Eatern economy Edition, 1990
2. Znihua Qu and Drasen M Dawson, Robust Tracking Control of Robot Manipulators, IEEE Press, 1996.
3. J. J. Craig, Adaptive Control of Mechanical Manipulators, Addison Wesley, ReadingMA, 1988.

POWER QUALITY
(Professional Elective-V)

Subject Code: UGEE7T1320	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**-**	**-**	**3**

Prerequisites: Fundamentals of Power Systems and Power Electronics

Course Objective: This main objective of this course is to study various power quality issues, voltage regulation, and transient over voltages, distributed generation, power quality monitoring and measurement equipment.

Syllabus

UNIT –I	**Overview of Power Quality**	**Hours: 09**
Concern about the Power Quality - General Classes of Power Quality Problems – Transients -Long-Duration Voltage Variations - Short Duration Voltage Variations - Voltage Unbalance - Waveform Distortion - Voltage fluctuation - Power Frequency Variations - Power Quality Terms - Voltage Sags and Interruptions - Sources of Sags and Interruptions – Nonlinear loads.		
UNIT –II	**Transient over Voltages**	**Hours: 08**
Source of Transient over Voltages - Principles of Over Voltage Protection - Devices for Over Voltage Protection - Utility Capacitor Switching Transients - Utility Lightning Protection - Load Switching Transient Problems.		
UNIT –III	**Harmonic distortion and solutions**	**Hours: 09**
Voltage vs. Current Distortion - Harmonics vs. Transients - Power System Quantities under Non-sinusoidal Conditions - Harmonic Indices – Sources of harmonics -Effects of Harmonic Distortion – solutions for mitigation of harmonics		
UNIT – IV	**Long Duration Voltage Variations**	**Hours: 08**
Principles of Regulating the Voltage - Device for Voltage Regulation - Utility Voltage Regulator Application - Capacitor for Voltage Regulation - End-user Capacitor Application - Regulating Utility Voltage with Distributed Resources – Flickering		
UNIT –V	**Monitoring and Instrumentation**	**Hours: 08**
Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – PQ monitoring standards		
UNIT –VI	**Distributed Generation and Power Quality**	**Hours: 08**
Resurgence of Distributed Generation - DG Technologies - Interface to the Utility System - Power Quality Issues - Operating Conflicts - DG on Low Voltage Distribution Networks		

Course Outcomes: At the end of this course students will be able to
CO1: Differentiate between different types of power quality problems
CO2: Understand and analyze the concepts Transient over voltages.
CO3: Understand the Harmonics distortion and apply the techniques to mitigate the harmonics
CO4: Understand the principles of Voltage Regulation and flickering
CO5: Apprehend the power quality monitoring concepts and analyze measuring instruments.
CO6: Analyze power quality issues with Distributed generation

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												
CO6	3	3												

TextBooks:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.

Reference Books:

1. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Power Quality by C.Shankaran, CRC Press,2001

Smart Grid
(Professional Elective-V)

Subject code: UGEE7T1420	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Fundamentals of power system and communication & Information

Course Objectives: The aim of this course is to study the fundamental of smart grid technology, Wide area measurement system of the smart grid, smart meters and power quality management and information and communications in smart grid.

UNIT-I: Introduction to Smart Grid **Hours:09**
Introduction to Smart Grid - Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid.
UNIT-II: Smart Grid Architecture: **Hours:09**
Components and Architecture of Smart Grid Design,. The fundamental components of Smart Grid designs – Concept of Transmission Automation and Distribution Automation.
UNIT-III: Wide Area Monitoring System **Hours:10**
Introduction to Synchrophasor Network-Synchrophasor network elements –Phasor Measurement Unit (PMUs) – Working Principle of PMU –Phasor data concentrator- functions of PDC –Wide Area Measurement system definition –WAMS process - Architecture of Wide Area Measurement Systems (WAMS)- functions of WAMS.
UNIT-IV: Smart Metering **Hours:09**
Introduction, smart metering – evolution of electricity metering, key components of smart metering- Smart metering infrastructure -smart meters: an overview of the hardware used.
UNIT-V: Power Quality Management in Smart Grid **Hours:10**
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.
UNIT-V1 Information and Communication Technology for Smart Grid Hours:08
Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Course Outcomes:
CO1: Acquire the knowledge on smart grid and development of smart grid architecture.
CO2: Analyze the wide area monitoring system and acquire the knowledge of smart meters.
CO3: Analyze the power quality issues in smart grid and acquire the concept of information and communication technologies in smart grid.

CO – PO Mapping														
POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO**
CO1	3	3	3											
CO2	3	3	3	3	3									
CO3	3	3	3	3	3									

Text Books:

1. "Smart Grids, Infrastructure, Technology and Solutions" by Stuart Borlase, CRC Press, 1e, 2013.

2. "Synchronized Phasor Measurements and their Applications", by A.G. Phadke and J.S. Thorp, Springer Edition, 2e, 2017.

3. "Integration of Green and Renewable Energy in Electric Power Systems", by Ali Keyhani, Mohammad N. Marwali, Min Dai Wiley online library.

4. "The Smart Grid: Enabling Energy Efficiency and Demand Response", by Clark W. Gellings, CRC Press.

Reference Books:

1. "Smart Grid", by Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012.

2." Smart Grid: Fundamentals of Design and Analysis", by James Momoh, Wiley, IEEE Press., 2012. Publishers, 2013.

3. "Smart Grid: Technology and Applications", by JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, AkihikoYokoyama, Wiley student edition.

4., "Smart Grids", by Jean Claude Sabonnadière, NouredineHadjsaïd Wiley Blackwell 19

5 "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", by . Peter S. Fox Penner,Island Press; 1 edition 8 Jun 2010

6., "Smart Grids (Power Engineering)",by Stuart Borlase CRC Press.

7. "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", by Andres Carvallo, John Cooper, Artech House Publishers July 2011.

SENSORS AND DATA ACQUISITION
(Professional Elective-V)

Subject Code: UGEE7T1520	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objective:

- To provide the basic understanding of measurement and instrumentation systems and the insight of the resistive sensors and its applications in real life.
- To introduce the concept of the reactive sensors and self-generating sensors and its applications in real life.
- To familiarize the characteristics, working principle and application of special purpose transducers.
- To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life.

Syllabus

UNIT –	**Introduction to Sensor system**	**Hours: 08**
General concepts and terminology of Sensor systems, Transducers classification-sensors and actuators, General input-output configurations / Block diagram of sensor system, Static and dynamic characteristics of measurement system.		
UNIT –	**Resistive Sensors**	**Hours: 08**
Resistive sensors- Potentiometers, strain gages (piezo-resistive effect), resistive temperature detectors (RTD), light dependent resistor (LDR). Wearable applications: Strain sensor for monitoring Physiological signals, body movement, examples for resistive sensors.		
UNIT –	**Reactive Sensors**	**Hours: 08**
Inductive sensors - variable reluctance sensors, Hall effect, Eddy current sensors, Linear and angular variable differential transformers (LVDT), Magneto-resistive. Capacitive sensors- variable capacitor, differential capacitor, examples for reactive sensors.		
UNIT –	**Self-Generating Sensors**	**Hours: 06**
Thermoelectric sensors -Thermocouple, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, examples for self-generating sensors.		
UNIT –	**Mechanical Transducers**	**Hours: 08**
Accelerometers: Characteristics and working principle, Types- Capacitive, piezoelectric; Gyroscopes: working principle, Rotor Gyroscope; Diaphragm Pressure Sensor. Wearable applications: Motion sensors for fall detection, example for Mechanical transducers.		
UNIT –	**Data Acquisition Systems**	**Hours: 08**
Data Acquisition System Block diagram, Components of an Analog Data Acquisition System, Components of Digital Data Acquisition System, Uses of Data Acquisition System, Data logger.		

Course Outcomes: At the end of this course students will be able to
CO1: Gain the basic idea of characteristics and the errors associated with sensors
CO2: Demonstrate the concept of resistive sensors which can be employed for real life applications
CO3: Realize the concept of reactive sensors employed for different applications
CO4: Understand the working principle of self-generating sensors
CO5: Understand the working principle of mechanical transducers
CO6: Realize the concepts of data acquisition systems

CO – PO Mapping														
POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3												3	
CO2	3												3	
CO3	3												3	
CO4	3												3	
CO5	3												3	
CO6	3												3	

TextBooks:

1. B. C. Nakra, K.K. Choudhury, "Instrumentation, Measurement and Analysis" -3 rd Edition, Tata McGraw, 2009
2. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 3rd ed., Springer, 2010.
3. Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications" Elsevier, 2014

ReferenceBooks:

1. A.K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai.
2. Er. R.K. Rajput, "Electronic Measurements and Instrumentation", S. Chand & Company Ltd. 3 rd Edition.
3. Bentley, John P., "Principles of Measurement Systems", 4thedition, Pearson/Prentice Hall, 2005
4. Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier Inc., 2005.
5. Subhas C. Mukhopadhyay, "Wearable Electronics Sensors-For Safe and Healthy Living", Springer International Publishing, 2015.
6. Electronic Instrumentation", H. S. Kalsi Tata McGraw-Hill Edition, 3rd Edition, 2010.

Open Elective -III

Open Elective -IV

MANAGEMENT SCIENCE

Subject Code: UGEE7T1720	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites

- General Awareness about Principles of Management
- To have an insight about Production and Operations Management
- To be able to acquire knowledge about Human Resource Management, Marketing, Strategic Management

Course Objectives

- To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management.
- To make the students equip with knowledge on techniques of PERT and CPM in project management

Syllabus

UNIT –I	**Introduction to Management**	**Hours: 08**
Concept and importance of Management, Functions of management, Evaluation of Management thought, Fayol's principles of Management, Maslow's need hierarchy & Herzberg's two factor theory of Motivation, Decision making process, Designing organizational structure, Principles of Organization, Types of organization structures		
UNIT –II	**Operations Management**	**Hours: 08**
Plant Location Principles and types of plant Layout , Work study, Statistical Quality control Charts – R Chart, c chart, p chart, Simple problems on R, c and p charts, Materials Management: Objectives - Need for inventory control- Inventory control techniques EOQ , ABC, HML, SDE, VED and FSN analysis		
UNIT –III	**Human Resources Management** (HRM)	**Hours: 08**
Concepts of HRM, Basic functions of HR manager, Job Evaluation and Merit Rating, Performance Appraisal, Methods of Performance appraisal Concepts Compensation		
UNIT – IV	**Marketing Management**	**Hours: 08**
Functions of marketing, Marketing Mix, Marketing strategies based on Product life cycle, Pricing Strategies, Channels of distribution (Place), Promotional Mix		
UNIT –V	**Project Management (PERT/CPM)**	**Hours: 10**
Network analysis, Program Evaluation and Review Technique (PERT), Critical path method (CPM) - Identifying critical path, Difference between PERT & CPM(simple problems)		
UNIT –VI	**Strategic Management**	**Hours: 08**
Mission, Goals, objectives, policy, strategy, Environmental scanning, SWOT analysis, Steps in strategy formulation and implementation Generic strategy alternatives		

Course Outcomes : At the end of this course students will be able to
CO1: Understand the Fundamentals of Management with specific insight as its function and role
CO2: Learn the Concepts of production, Management of human Resources and Management of Marketing activities along with business environment
CO3: Apply the problem solving skills to demonstrate logical solution to real life problems
CO4: Create the awareness of business strategies to deal with the dynamic business environment

CO – PO Mapping

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1									2					
CO2						2								
CO3											2			
CO4											2			

Text Books:

1. Dr. Arya Sri, "Management Science", TMH 2011
2. L. M. Prasad, "Principles & Practices of Management" Sultan chand& Sons, 2007

Reference Books:

1. K. Aswathappa and K. Sridhara Bhat, "Production and Operations Management", Himalaya Publishing House, 2010
2. Philip Kotler Philip Kotler, Kevin Keller, Mairead Brady, Malcolm Goodman, Torben Hansen, "Marketing Management" Pearson Education Limited, 05-May-2016

DIGITAL CONTROLLER PROGRAMMING FOR
POWER ELECTRONIC SYSTEMS LAB
(Skill Advanced Course)

Subject Code: UGEE7K1820	**L**	**T**	**P**	**C**
IV Year / I Semester	**1**	**-**	**2**	**2**

Course Objectives: To train students on the Digital Controller Code design for gate pulse generation related to the Power Electronic Converter control.

Syllabus

EXPERIMENTS:

(Any 10 Experiments)

1. Arduino code based Gate pulse generation for Three Phase Bridge Rectifier.
2. Arduino code based Gate pulse generation for Three Phase Inverter.
3. Arduino Programming with MATLAB and Simulink for PWM Pulse generation.
4. DSP Micro controller with MATLAB and Simulink model design for Three Phase Bridge Rectifier.
5. DSP Micro controller with MATLAB and Simulink model design for Three Phase Inverter.
6. DSP Micro controller with MATLAB and Simulink model design for PWM Pulse generation.
7. FPGA - VHDL code based pulse generation for Single Phase Bridge Rectifier.
8. FPGA - VHDL code based pulse generation for Three Phase Bridge Rectifier.
9. FPGA - VHDL code based pulse generation for Single Phase Inverter.
10. FPGA - VHDL code based pulse generation for Three Phase Inverter.
11. FPGA with MATLAB and Simulink model design for PWM Pulse generation.

Course Outcomes: At the end of this course students will be able to,

CO1: Demonstrate the procedure and formatting for Logical codes.
CO2: Analyze the operation of Gate control pulse for various converter

CO – PO MAPPING:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3			2										3
CO2	3			3										3

Internship

IV Year II-Semester

Major Project / Internship