DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC REGULATIONS (R21)

FOR

B. Tech Four Year Degree Programme

(Applicable for the batches admitted from the A.Y. 2021-22)

PACE INSTITUTE OF TECHNOLOGY AND SCIENCES
(Autonomous)
Approved by AICTE and Govt. of Andhra Pradesh, Accredited by NAAC(A Grade)
Recognized under 2(f) & 12(B) of UGC, Permanently Affiliated to JNTUK, Kakinada
NH-16, Near Valluramma Temple, Ongole-523272
Andhra Pradesh, India.

ACADEMIC REGULATIONS (R21) FOR B. TECH. (REGULAR)
Applicable for students of B. Tech. (Regular) from Academic Year 2021-22 onwards

Pace Institute of Technology and Sciences,Ongole, 2021 Regulations (R21 Regulations) applicable for all the students admitted into first year of all B.Tech programmes from the academic year 2021-22 & B.Tech Lateral Entry Scheme from the Academic Year 2022-23 onwards

1. **Courses of study:**
   The following courses of study are offered at Pace Institute of Technology and Sciences,Ongole

Sl No	Branch	Short name	Code
1	Civil Engineering	CE	01
2	Electrical and Electronics Engineering	EEE	02
3	Mechanical Engineering	ME	03
4	Electronics & Communication Engineering	ECE	04
5	Computer Science and Engineering	CSE	05
6	Computer Science and Information Technology	CSIT	07
7	Information Technology	IT	12
8	Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)	CSE(IoT&CSBT)	47
9	Artificial Intelligence and Data Science	AIDS	54
10	Artificial Intelligence and Machine Learning	AIML	61
11	*Computer Science and Engineering (Indian Language)	CSE-R	63

   * Notified in A.Y: 2022-2023

2. **Medium of Instruction:**
   The medium of instruction of the entire B. Tech undergraduate programme in Engineering & Technology (including examinations and project reports) will be in English only. Similarly, the medium of instruction and examinations in AICTE approved Indian language B.Tech programme are in Telugu and English.

3. **Admissions:**
   Admission to the B. Tech Programme shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or on the basis of any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

4. **Programme Pattern:**

   (i) Total duration of the B. Tech (Regular) Programme is four academic years.

(ii) Each Academic year of study is divided in to two semesters.

(iii) Minimum number of instruction days in each semester is 90.

(iv) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).

(v) The total credits for the Programme are 160.

(vi) A three-week induction program is mandatory for all first year UG students and shall be conducted as per AICTE/UGC/APSCHE guidelines.

(vii) Student is introduced to "Choice Based Credit System (CBCS)".

(viii) A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)

(ix) A student has to register for all courses in a semester.

(x) All the registered credits will be considered for the calculation of final CGPA.

(xi) Each semester has – "Continuous Internal Evaluation" (CIE) and "Semester End Examination" (SEE). Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.

(xii) A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and prepare engineering graduates to connect with the needs of the industry and society at large.

(xiii) The charactor of students and make them aware of social needs, the extracurricular/co-curricular activities are included, which do not carry any credits. These activities include National Service Scheme (NSS), National Cadet Corps (NCC), Yoga & Meditation, Sports & Games and Professional Club Activities.

(xiv) Each department shall assign a faculty advisor/mentor after admission to each student or group of students from same department to provide guidance in courses registration/career growth/ placements/opportunities for higher studies/GATE/other competitive exams etc.

5. **Subject/Course Classification:**

All subjects/courses offered for the undergraduate programme in E & T (B. Tech degree programmes) are broadly classified as follows.

6. **Registration for Courses:**

(i) The Department shall invite registration forms from the students at the beginning of the semester for the registration for courses each semester. The registration process shall be closed within one week. If any student

Sl No	Category	Code	APSCHE breakup of Credits	AICTE Credits of breakup
1	Humanities and social science including Management courses	HSMC	10.5	12
2	Basic Science courses	BSC	21	25
3	Engineering courses science	ESC	24	24
4	Professional core Courses	PCC	51	48
5	Open Elective Courses	OEC	12	18
6	Professional Courses Elective	PEC	15	18
7	Internship, seminar, project work	PROJ	16.5	15
8	Skill Oriented Courses	SC	10	-
9	Laboratory Courses	LC	-	-
10	Mandatory courses	MC	Non-credit	Non-credit
			160	160

wishes to withdraw the registration, he/she shall submit a letter to the principal through the class teacher/instructor and HOD. The principal shall communicate the registration and withdraw details courses of each student in a consolidated form to the college examination section.

(ii) There are four open electives in each branch. All Open Electives are offered to students of all branches in general. A student shall choose an open elective, by consulting the HOD/advisor, from the list in such a manner that he/she has not studied the same course in any form during the Programme.

(iii) A student shall be mandated to pursue two elective courses under MOOCs during the programme. Students are advised to register for only for minimum 12 weeks in duration MOOCs courses. Student has to pursue and acquire a certificate for a MOOC course only from the SWAYAM/NPTEL through online with the approval of Head of the Department 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 details of the MOOCs courses registered by the students shall be submitted to the college examination center. The Head of the Department shall appoint a mentor for each of the MOOC subjects registered by the students to monitor the student's assignment submissions given by SWAYAM/NPTEL. 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 will 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, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed. Even, if any student not cleared the courses through MOOCs up to the 7^{th} semester, he/she has to register for external examination through offline

mode in last semester of the programme (i.e., 8^{th} Semester) at college level.

(iv) Two summer internships or one internship and one Community Service Project (CSP), each with a minimum of six weeks duration shall be mandatorily done/completed respectively at the end of second and third years (during summer vacations). The internship can be done by the students at local industries, Govt. Organizations, Construction agencies, Industries, Hydel and thermal power projects and also in software MNCs. After completing the summer internship, the students shall register in the immediate respective odd semester and it will be evaluated at the end of the semester as per norms of the college. The student has to produce the summer internship satisfactory report and certificate taken from the organization to be considered for evaluation. The Department shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship. The information pertaining to CSP is mentioned in Annexure-I.

(v) In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

(vi) Curricular Framework for Skill oriented courses

(a) There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.

(b) For skill oriented/skill advanced course, one theory and two practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.

(c) Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining three 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.

(d) Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HOD of the college.

(e) 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. However, the department has to assign mentors in the college to monitor the performance of the students.

(f) 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, then the department shall mark overall 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. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency. The credits will be awarded to the student upon producing the successful Course Completion Certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per college norms at the end of the semester.

7. **Award of B. Tech. Degree:**

(i) A student will be declared eligible for the award of B.Tech Degree if he fulfills the following academic regulations:

(a) A student shall be declared eligible for award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years.

(b) After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.

(c) The student shall register for 160 credits and must secure all the 160 credits.

(d) All students shall register for NCC/NSS activities and will be required to participate in an activity specified by NSS officer 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, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

(e) Courses like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure 40% of the marks

allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

(f) Credit Definition:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit
2 Hours Practical (Lab) per week	1 Credit

(ii) Award of B. Tech. (Honor)/B. Tech. (Minor):
B. Tech. with Honors or a B. Tech. with a Minor will be awarded if the student earns 20 additional credits are acquired as per the regulations/guidelines. The regulations/guidelines are separately provided. Registering for Honors/Minor is optional.

8. **Attendance Requirements:**

(i) A student is eligible to write the semester end examinations if he acquires a minimum of 40% in each course and 75% of attendance in aggregate of all the courses.

(ii) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) may be granted by the College Academic Committee. However, this condonation concession is applicable only to any two semesters during the entire programme.

(iii) Shortage of Attendance below 65% in aggregate shall not be condoned.

(iv) A student who is short of attendance in a semester may seek re-admission into that semester when offered within 4 weeks from the date of commencement of class work.

(v) Students whose shortage of attendance is not condoned in any semester are not eligible to write their semester end examination of that class.

(vi) 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.

(vii) A student will be promoted to the next semester if he satisfies the (i) attendance requirement of the present semester and (ii) minimum required credits.

(viii) If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

(ix) For induction programme attendance shall be maintained as per AICTE norms.

(x) For non-credit mandatory courses the students shall maintain the attendance similar to credit courses.

9. **Evaluation-Distribution and Weightage of marks:**

(i) Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the College Examination section from time to time.

(ii) For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

(iii) A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/ project etc by securing not less than 35% of marks in the semester end exam and minimum 40% of marks in the sum total of the internal marks and semester end examination marks together.

(iv) Distribution and Weightage of marks:

The assessment of the student's performance in each course will be based on Continuous Internal Evaluation (CIE) and Semester-End Examination (SEE). The performance of a student in each semester shall be evaluated course–wise with a maximum of 100 marks for theory course and 50 marks for practical course. For theory courses the distribution shall be 30 marks for Internal Evaluation and 70 marks for the Semester End Examinations.

Sl.No	Components	Internal	External	Total
1	Theory	30	70	100
2	Engineering Graphics/Design/Drawing	30	70	100
3	Practical	15	35	50
4	Internship/Industrial Training/ Skill Development programme/Research Project	-	50	50
5	Mini Project	50	-	50
6	Project Work	60	140	200

(v) Continuous Internal Theory Evaluation:

(a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (ii) one descriptive examination and (iii) one assignment. The online examination (objective) shall be 10 marks and descriptive examination shall be for 15 marks with a total duration of 1 hour 50 minutes (20 minutes for objective and 90 minutes for descriptive paper).

(b) The first online examination (objective) is set with 20 multiple choice questions for 10 marks (20 questions x $\frac{1}{2}$ marks) from first two and half units (50% of the syllabus). The descriptive examination is set with 3 full questions for 5 marks each from first two and half units (50% of the syllabus), the student has to answer all questions. In the similar lines, the second online and descriptive examinations shall be conducted on the rest of the syllabus.

(c) The assignment is given by the concerned class teacher for five marks from first two and half units (50% of the syllabus). The second assignment shall be given from rest of the syllabus. The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. However, There shall be no assignment with viva voce and class room tests for Applied/Engineering physics course. Finalized internal marks for Applied/Engineering physics course can be calculated with 80% weightage for the better of the two mid-term examinations and 20% for the other shall be considered for marks of 25 and is added to virtual lab - assignments 5 marks for awarding total 30 marks.

(d) The total marks secured by the student in each mid-term examination are evaluated for 30 marks. The first mid marks (Mid-1) consisting of marks of online objective examination, descriptive examination and assignment shall be submitted to the college examination section within one week after completion of first mid examination.

(e) The mid marks submitted to the college examination section shall be displayed in the concerned department notice boards for the benefit of the students.

(f) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of college examination section within one week from the submission.

(g) Second mid marks (Mid-2) consisting of marks of online objective examination, descriptive examination and assignment shall also be submitted to College examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of college examination section within one week from the submission.

(h) Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for another mid exam.

(i) Example:

Mid-1 marks =Marks secured in (online examination-1+descriptive examination-1 +one assignment-1)

Mid-2 marks=Marks secured in (online examination-2+ descriptive examination-2 +one assignment-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

(j) With the above criteria, college examination section will send mid marks of all courses in consolidated form to all the concerned departments and same shall be displayed in the concerned department notice boards. If any discrepancy found, it shall be brought to the notice of college examination section through proper channel within

one week with all proofs. Discrepancies brought after the given deadline will not be entertained under any circumstances.

(k) For practical subjects there shall be continuous evaluation during the semester for 15 internal marks .The internal 15 marks shall be awarded as follows: day to day work - 5 marks, Record-5 marks and the remaining 5 marks to be awarded by conducting an internal laboratory test.

(l) A student is required to undergo a mini project of his/her choice by applying theoretical concepts to develop a practical component /element/system that includes design/ testing/ analysis. The performance of a student in the mini project shall be internal evaluation by a three-member committee constituted by the HoD as per the following parameters: Innovation-10 Marks, Mini project report-15 Marks, Presentation-15 Marks and remaining 10 Marks to be awarded by conducting an internal Viva voce.

(vi) Semester End Theory Examinations Evaluation:

(a) The semester end examinations will be conducted college examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain subquestions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

(b) For practical subjects the end examination shall be conducted by the teacher concerned and external examiner appointed by Chief Controller of Examinations for 35 marks.

Note: Laboratory marks and the internal marks awarded by the department are not final. The marks are subject to scrutiny and scaling by the Chief Controller of Examinations wherever felt desirable. The internal and laboratory marks awarded by the department will be referred to a Committee. The Committee shall arrive at a scaling factor and the marks will be scaled as per the scaling factor. The recommendations of the Committee are final and binding. All the laboratory records and internal test papers shall be preserved in respective departments as per college norms and shall be produced to the Committees of University as and when they ask for.

(c) For the course having design and / or drawing (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester for 15 marks each and final marks can be calculated with 80% weightage for better of the two tests and 20% weightage for other test and these are to be added to the marks obtained in day-to-day work.

(d) Evaluation of the summer internships: 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. Students shall pursue this internship during summer vacation just before its offering as per course structure. The minimum duration of this course shall be at least 6 weeks. The student shall register for the internship as per course structure after commencement of academic year. 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. Attendance requirements are as per the norms of the College. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner appointed by the Chief Controller of Examinations; Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the College.

(e) The job-oriented skill courses may be registered at the department or at any accredited external agency. A student shall submit a record/ report on the on the list skills learned. If the student completes job-oriented skill course at 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: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief Controller of Examinations) and internal examiner (course instructor or mentor). There are no internal marks for the job-oriented skill courses.

(f) Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the department internally. Two internal examinations shall be conducted for 30 marks and a student has to

secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (SA)/Not-completed (US) will be specified.

(g) Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. 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 portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. 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 will 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, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

(h) Major Project (Project - Project work, seminar and internship in industry): In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner. Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the Chief Controller of Examinations and is evaluated for 140 marks.

10. **Recounting of Marks in the Semester End Examination:**
A student can request for recounting of his/her answer book on payment of a prescribed fee as per college norms.

11. **Re-evaluation of the End Semester Examination:**
A student can request for Revaluation of his/her answer book on payment of a prescribed fee as per college norms.

12. **Supplementary Examinations:**
A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the college.

13. **Malpractices in Examinations:**
Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the college.

14. **Promotion Rules:**
The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.8 for promotion to higher classes

    (a) A student shall be promoted from first year to second year if he fulfills the minimum attendance requirement as per College norms.
    (b) A student will be promoted from II to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.
    (c) A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

15. **Course Pattern:**
The entire course of study is for four academic years; all years are on semester pattern

    (a) A student eligible to appear for the semester end examination in a course, but absent from it or has failed in the semester end examination, may write the exam in that course when conducted next.
    (b) When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

16. **Earning of Credit:**
A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range A+ to E as given below. Letter grade 'F' in any course implies failure of the student in that course and no credits earned. Absent is also treated as no credits earned. For project same % percentages will be followed for grading.

Marks Range Theory (Max – 100)	Marks Range Lab (Max – 50)	Level	Letter Grade	Grade Point
≥ 90	≥ 45	Outstanding	O	10
$\geq 80 \leq 89$	$\geq 40 \leq 44$	Excellent	S	9
$\geq 70 \leq 79$	$\geq 35 \leq 39$	Very Good	A	8
$\geq 60 \leq 69$	$\geq 30 \leq 34$	Good	B	7
$\geq 50 \leq 59$	$\geq 25 \leq 29$	Fair	C	6
$\geq 40 \leq 49$	$\geq 20 \leq 24$	Pass	P	5
<40	<20	Fail	F	0
-	-	Absent	AB	0

17. **Computation of SGPA and CGPA**

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

(a) SGPA(S_k) of k^{th} semester (1 to 8) is 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 total number of credits of all the courses undergone/registered by a student, i.e.,

$$SGPA(S_k) = \frac{\sum_{i=1}^{n}(C_i \times G_i)}{\sum_{i-1}^{n} C_i}$$

(b) CGPA: The CGPA is calculated in the same manner taking into account all the 'm' courses/subjects registered by student over all the semesters of a Programme i.e., in all eight semesters

$$CGPA = \frac{\sum_{i=1}^{n}(C_i \times S_i)}{\sum_{i-1}^{n} C_i}$$

(c) SGPA and CGPA shall be rounded off to 2 decimal points and reported in transcripts.

(d) While computing the SGPA/CGPA, the subjects in which the student is awarded Zero grade points will also be included.

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

(f) Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters O, S, A, B, C, P, F and AB.

(g) As per AICTE regulations, conversion of CGPA into equivalent percentage as follows:

$$EquivalentPercentage = (CGPA – 0.75) \times 10$$

(h) Illustration of Computation of SGPA and CGPA

(i) **Illustration for SGPA:**

Let us assume there are 6 subjects in a semester. The grades obtained as follows:

Course	Credit	Grade Obtained	Grade point	Si= Credit Point (Credit x Grade)
Subject 1	3	A	8	3 X 8 = 24
Subject 2	4	B	7	4 X 7 = 28
Subject 3	3	C	6	3 X 6 = 18
Subject 4	3	O	10	3 X 10 = 30
Subject 5	3	P	5	3 X 5 = 15
Subject 6	4	C	6	4 X 6 = 24
	20			139

Thus, SGPA =139/20 =6.95=6.9 (approx.)

Semester 1	Semester 2	Semester 3	Semester 4
Credits: 19.5 SGPA: 6.9	Credits: 19.5 SGPA: 7.8	Credits: 21.5 SGPA: 5.6	Credits: 21.5 SGPA: 6.0
Semester 5	Semester 6	Semester 7	Semester 8
Credits: 21.5 SGPA: 6.3	Credits: 21.5 SGPA: 8.0	Credits: 23 SGPA: 6.4	Credits: 12 SGPA: 7.5

(ii) **Illustration for CGPA:**

Thus,

$CGPA = \frac{19.5\times6.9+19.5\times7.8+21.5\times5.6+21.5\times6.0+21.5\times6.3+21.5\times8.0+23\times6.4+12\times7.5}{160} = 6.75$

18. **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	$\geq$ 7.75 (without any supplementary appearance)	From the CGPA secured from 160 credits
First Class	$\geq$ 6.75	
Second Class	$\geq$ 5.75 <6.75	
Pass Class	$\geq$ 5.00 <5.75	

19. **Minimum Instruction Days**

The minimum instruction days for each semester shall be 90 working days. There shall be no branch transfers after the completion of the admission process. There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.

20. **Withholding of Results**

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

21. **Transitory Regulations**

(i) Discontinued or detained candidates are eligible for re-admission as and when next offered.

(ii) The re-admitted candidate will be governed by the rules & regulations under which the candidate has been admitted.

(a) In case of transferred students from other Universities, credits shall be transferred to PACE as per the academic regulations and course structure of College.

(b) The students seeking transfer to PACE from various other Universities / Institutions have to obtain the credits of any equivalent subjects as prescribed by PACE. In addition, the transferred candidates have to pass the failed subjects at the earlier Institute with already obtained internal/sessional marks to be conducted by PACE.

22. **Gap - Year**

Gap Year concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I/II/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.

23. **General**

(i) Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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

(iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the competent authority of the college is final.

(iv) The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College.

ACADEMIC REGULATIONS (R21) FOR B. TECH. (LATERAL ENTRY SCHEME)
Applicable for students admitted into II B. Tech. from the Academic Year 2022-23 onwards

1. **Award of B. Tech. Degree**
   A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:

   (a) A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years. After six academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.

   (b) The candidate shall register for 121 credits and secure all the 121 credits.

2. **The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech (lateral entry).**

3. **Promotion Rule**
   A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.
   A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

4. **Award of Class**
   After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	Remarks
First Class with Distinction	$\geq$ 7.75 (without any supplementary appearance)	From the CGPA secured from 121 credits
First Class	$\geq$ 6.75	
Second Class	$\geq$ 5.75 <6.75	
Pass Class	$\geq$ 5.00 <5.75	

   The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

5. **All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B.Tech. (Lateral Entry Scheme).**

Annexure-I

COMMUNITY SERVICE PROJECT

I. 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.

II. Objective

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;

(i) To sensitize the students to the living conditions of the people who are around them

(ii) To help students to realize the stark realities of the society.

(iii) To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability

(iv) To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.

(v) To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.

(vi) To help students to initiate developmental activities in the community in coordination with public and government authorities.

(vii) 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.

III. Implementation of Community Service Project

(i) Every student should put in a minimum of 180 hours for the Community Service Project during the summer vacation.

(ii) Each class/section should be assigned with a mentor.

(iii) 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

(iv) A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.

(v) The log book has to be countersigned by the concerned mentor/faculty in charge.

(vi) Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.

(vii) The final evaluation to be reflected in the grade memo of the student.

(viii) The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.

(ix) 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.

(x) Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

IV. **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

(V) **Expected Outcomes**

(1) Benefits of Community Service Project to Students

Learning Outcomes

(a) Positive impact on students' academic learning

(b) Improves students' ability to apply what they have learned in "the real world"

(c) Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development

(d) Improved ability to understand complexity and ambiguity

Personal Outcomes

(a) Greater sense of personal efficacy, personal identity, spiritual growth, and moral development

(b) Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

(a) Reduced stereotypes and greater inter-cultural understanding

(b) Improved social responsibility and citizenship skills

(c) Greater involvement in community service after graduation

Career Development

(a) Connections with professionals and community members for learning and career opportunities

(b) Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

(a) Stronger relationships with faculty

(b) Greater satisfaction with college

(c) Improved graduation rates

(2) Benefits of Community Service Project to Faculty Members

(a) Satisfaction with the quality of student learning

(b) New avenues for research and publication via new relationships between faculty and community

(c) Providing networking opportunities with engaged faculty in other disciplines or institutions

(d) A stronger commitment to one's research

(3) Benefits of Community Service Project to Colleges and Universities

(a) Improved institutional commitment

(b) Improved student retention

(c) Enhanced community relations

(4) Benefits of Community Service Project to Community

(a) Satisfaction with student participation

(b) Valuable human resources needed to achieve community goals

(c) New energy, enthusiasm and perspectives applied to community work

(d) Enhanced community-university relations.

VI. **Suggestive List of Programmes Under Community Service Project**

(a) 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.

(b) For Engineering Students

- Water facilities and drinking water availability
- Health and hygiene
- Stress levels and coping mechanisms
- Health intervention programmes
- Horticulture
- Herbal plants
- Botanical survey
- Zoological survey
- Marine products

- Aqua culture
- Inland fisheries
- Animals and species
- Nutrition
- Traditional health care methods
- Food habits
- Air pollution
- Water pollution
- Plantation
- Soil protection
- Renewable energy
- Plant diseases
- Yoga awareness and practice
- Health care awareness programmes and their impact
- Use of chemicals on fruits and vegetables
- Organic farming
- Crop rotation
- Floury culture
- Access to safe drinking water
- Geographical survey
- Geological survey
- Sericulture
- Study of species
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Human genetics
- Blood groups and blood levels
- Internet Usage in Villages
- Android Phone usage by different people
- Utilization of free electricity to farmers and related issues
- Gender ration in schooling level- observation.

Complimenting 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 are;

(c) Programmes for School Children

- Reading Skill Programme (Reading Competition)
- Preparation of Study Materials for the next class.
- Personality / Leadership Development
- Career Guidance for X class students
- Screening Documentary and other educational films

- Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
- Awareness Programme on Socially relevant themes.

(d) Programmes for Women Empowerment

- Government Guidelines and Policy Guidelines
- Womens' Rights
- Domestic Violence
- Prevention and Control of Cancer
- Promotion of Social Entrepreneurship

(e) General Camps

- General Medical camps
- Eye Camps
- Dental Camps
- Importance of protected drinking water
- ODF awareness camp
- Swatch Bharat
- AIDS awareness camp
- Anti Plastic Awareness
- Programmes on Environment
- Health and Hygiene
- Hand wash programmes
- Commemoration and Celebration of important days

(f) Programmes for Youth Empowerment

- Leadership
- Anti-alcoholism and Drug addiction
- Anti-tobacco
- Awareness on Competitive Examinations
- Personality Development

(g) Common Programmes

- Awareness on RTI
- Health intervention programmes
- Yoga
- Tree plantation
- Programmes in consonance with the Govt. Departments 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

VII. **Role of Students:**

(a) Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.

(b) For conducting special camps like Health related, they will be coordinating with the Governmental agencies.

(c) As and when required the College faculty themselves act as Resource Persons.

(d) 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.

(e) 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.

(f) 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

1. **Duration: 8 weeks**

(a) Preliminary Survey (One Week)

(i) A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.

(ii) 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.

(iii) The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

(b) 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.

(c) 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.

(d) 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 College Examination section.

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.

Annexure-II

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

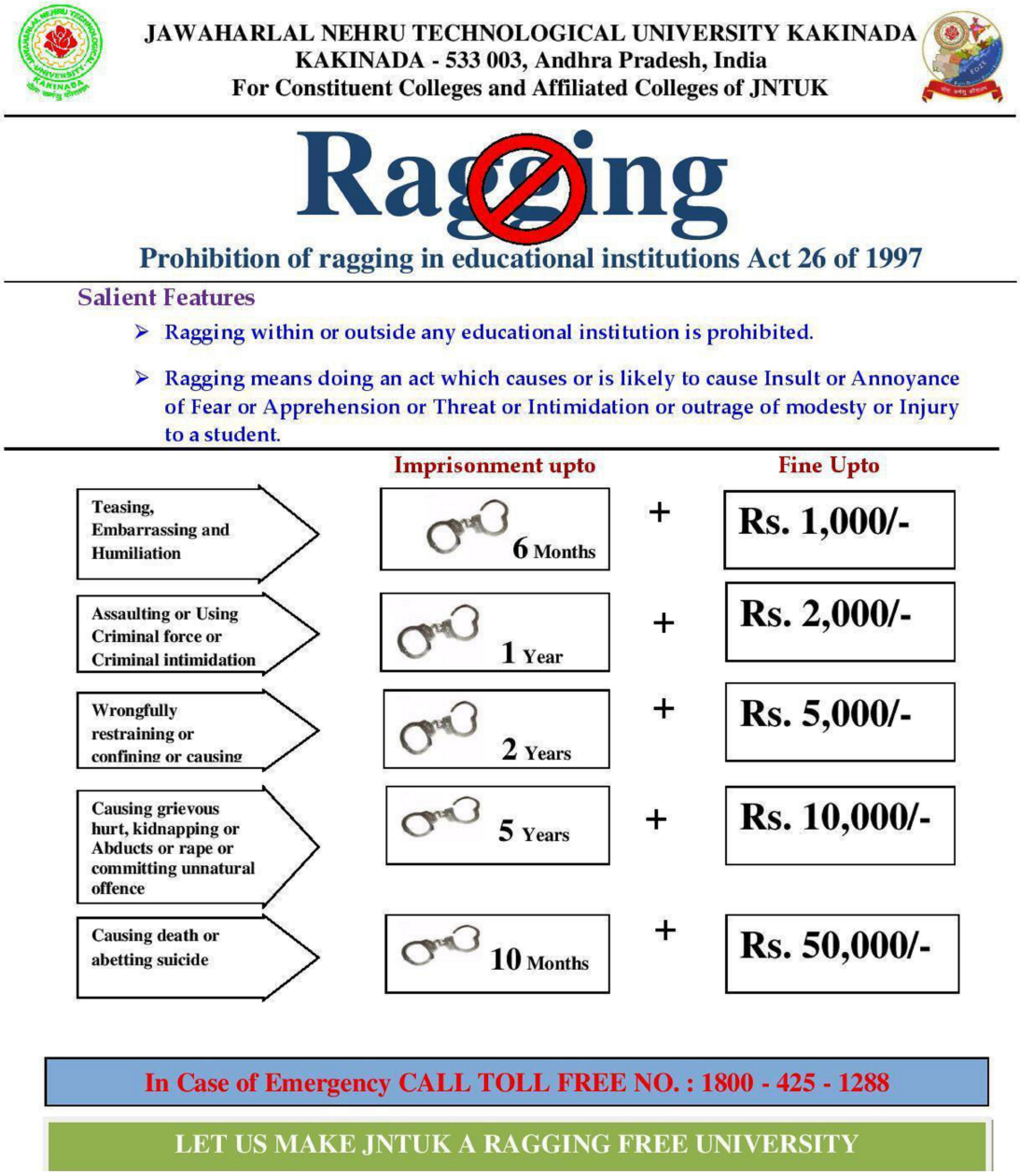
Sl. No.	Nature of Malpractices/Improper conduct If the candidate:	Punishment
1. a.	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination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

4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

7	Leaves the exam hall taking away answer script or intentionally tears the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all Semester End Examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.

12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Chief Controller of Examinations for further action and impose suitable punishment.	

Annexure-III



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India
For Constituent Colleges and Affiliated Colleges of JNTUK

Ragging

ABSOLUTELY NO TO RAGGING

1. **Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.**
2. **Ragging entails heavy fines and/or imprisonment.**
3. **Ragging invokes suspension and dismissal from the College.**
4. **Outsiders are prohibited from entering the College and Hostel without permission.**
5. **Girl students must be in their hostel rooms by 7.00 p.m.**
6. **All the students must carry their Identity Cards and show them when demanded**
7. **The Principal and the Wardens may visit the Hostels and inspect the rooms any time.**

Jawaharlal Nehru Technological University Kakinada
For Constituent Colleges and Affiliated Colleges of JNTUK

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

I Year - I Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21HST01	Communicative English	3	0	0	3
2	P21BST01	Linear Algebra & Differential Equations	3	0	0	3
3	P21BST04	Applied Chemistry	3	0	0	3
4	P21EST01	Engineering Graphics	3	0	0	3
5	P21EST03	C-Programming for Problem Solving	3	0	0	3
6	P21HSL01	English Language Communication Skills Lab	0	0	3	1.5
7	P21BSL03	Applied Chemistry Lab	0	0	3	1.5
8	P21ESL02	C-Programming for Problem Solving Lab	0	0	3	1.5
9	P21MCT01	Induction program	2	0	0	0
					Total Credits	19.5

I Year - II Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21BST02	Applied Physics	3	0	0	3
2	P21BST06	Numerical Methods & Vector calculus	3	0	0	3
3	P21EST06	Electrical Circuts Analysis-I	3	0	0	3
4	P21EST11	Electronic Devices and Circuits	3	0	0	3
5	P21EST13	Data Structures	3	0	0	3
6	P21BSL01	Applied Physics Lab	0	0	3	1.5
7	P21ESL05	Electronic Devices and Circuits Lab	0	0	3	1.5
8	P21ESL06	Data Structure Lab	0	0	3	1.5
9	P21MCT02	Biology for Engineering	2	0	0	0
					Total Credits	19.5

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

II Year - I Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21BST07	Transformation Techniques and Differential Equations	3	0	0	3
2	P21EET01	Electrical Circuit Analysis – II	3	0	0	3
3	P21EET02	Electro Magnetic Fields	3	0	0	3
4	P21EET03	Electrical Machines - I	3	0	0	3
5	P21EET04	Power Systems –I	3	0	0	3
6	P21EEL01	Electrical Circuits Lab	0	0	3	1.5
7	P21EEL02	Electrical Machines – I Lab	0	0	3	1.5
8	P21EEL03	Electrical workshop	0	0	3	1.5
9	P21EES01	Skill Oriented Course - I	1	0	2	2
10	P21MCT03	Environmental Studies	2	0	0	0
					Total Credits	21.5

II Year - II Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21CST01	Python Programming	3	0	0	3
2	P21EET05	Electrical Machines - II	3	0	0	3
3	P21EET06	Power Systems - II	3	0	0	3
4	P21EET07	Electrical Measurements	3	0	0	3
5	P21ECT02	Switching Theory and Logic Design	3	0	0	3
6	P21CSL01	Python Programming Lab	0	0	3	1.5
7	P21EEL04	Electrical Machines – II Lab	0	0	3	1.5
8	P21EEL05	Electrical Measurements Lab	0	0	3	1.5
9	P21EES02	Skill Oriented Course - II	1	0	2	2
					Total Credits	21.5
		Internship 2 Months (Mandatory) during summer vacation				

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PACE R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

III Year - I Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21EET08	Power Electronics	3	0	0	3
2	P21EET09	Control Systems	3	0	0	3
3	P21ECT10	Pulse and Digital Circuits	3	0	0	3
4	P21EETXX	Professional Elective-I	3	0	0	3
5	P21XXXXX	Open Elective-I	3	0	0	3
6	P21EEL06	Power Electronics Lab	0	0	3	1.5
7	P21EEL07	Control Systems Lab	0	0	3	1.5
8	P21EESO3	Certificate course being offered by industries/ professional bodies/ APSSDC or any other accredited bodies.	1	0	2	2
9	P21XXXXX	Professional Ethics and Human values	2	0	0	0
10	P21XXXX	Summer Internship 2 Months (Mandatory) after II Year (to be evaluated during III Year I Semester)	0	0	0	1.5
					Total Credits	21.5

Professional Elective - I		
S.No	**Course Code**	**Course Title**
1	P21EEP01	Renewable Energy Sources
2	P21EEP02	Energy Audit and Conservation Management
3	P21EEP03	Electrical Machine Modelling
4	P21EEP04	Fundamentals of Electrical Vehicles

Open Elective - I		
S.No	**Course Code**	**Course Title**
NPTEL COURSE		

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PACE R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

III Year - II Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21EET11	Power System Analysis	3	0	0	3
2	P21EET12	Switchgear and Protection	3	0	0	3
3	P21ECT05	Linear and Digital IC Applications	3	0	0	3
4	P21EEXXX	Professional Elective-II	3	0	0	3
5	P21XXXXX	Open Elective-II	3	0	0	3
6	P21EEL08	Electrical Simulation Lab	0	0	3	1.5
7	P21EEL09	Power Systems Lab	0	0	3	1.5
8	P21EEL10	PDC Lab/LDIC Lab	0	0	3	1.5
9	P21EES04	Soft Skill/MATLAB	1	0	2	2
10	P21XXXXX	Design Thinking for Innovation	2	0	0	0
					Total Credits	21.5
Industrial/Research Internship (Mandatory) 2 Months during summer vacation						

Professional Elective - II		
S.No	**Course Code**	**Course Title**
1	P21EEP05	Power Semiconductor Drives
2	P21EEP06	Utilization of Electrical Energy
3	P21EEP07	Control and Integration of RES
4	P21EEP08	IOT Applications in Electrical Engineering

Open Elective - II		
S.No	**Course Code**	**Course Title**
NPTEL COURSE		

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PACE R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

IV Year - I Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21EETXX	Professional Elective-III	3	1	0	3
2	P21EETXX	Professional Elective-IV	3	0	0	3
3	P21EETXX	Professional Elective-V	3	0	0	3
4	P21XXXXX	Open Elective-III	3	0	0	3
5	P21XXXXX	Open Elective-IV	3	0	0	3
6	P21XXXXX	Universal Human Values-II	3	0	0	3
7	P21XXXXX	Employability Skills	1	0	2	2
8	P21XXXXX	Industrial/Research Internship 2 Months (Mandatory) after III Year (to be evaluated during IV Year I Semester)	0	0	0	3
					Total Credits	23

Professional Elective - III		
S.No	**Course Code**	**Course Title**
1	P21EEP09	Power System Operation and Control
2	P21EEP10	Electrical Distribution Systems
3	P21EEP11	Special Electrical Machines
4	P21EEP12	Smart Grid Technologies
5	P21EEP13	Extra High Voltage AC Transmission

Professional Elective - IV		
S.No	**Course Code**	**Course Title**
1	P21EEP14	HVDC Transmission
2	P21EEP15	Flexible AC Transmission Systems
3	P21EEP16	Machine Learning Applications in Electrical Engineering
4	P21EEP17	Industrial Automation
5	P21EEP18	Power Electronics for Renewable Energy Sources

Professional Elective - V		
S.No	**Course Code**	**Course Title**
1	P21EEP17	Programmable Logic Controller
2	P21EEP18	Instrumentation
3	P21EEP19	Electric and Hybrid Vehicles
4	P21EEP20	AI Techniques in Electrical Engineering

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PACE R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

IV Year - II Semester						
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P21EEXXX	Project Work, Seminar and Internship in Industry	0	0	0	12
Internship (6 Months)						
		Total Credits				12

Course Code	Course Name	Course Structure			
		L	T	P	C
P21HST01	Communicative English	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: The students should have basic knowledge of English grammar and LSRW skills.

Course Objectives: The student will be able

1. To enable the engineering students to develop their basic communication skills in English for academic and social purposes.
2. To equip the students with appropriate oral and written communication skills.
3. To inculcate the skills of listening, reading and critical thinking.
4. To integrate English Language learning with employability skills and training.
5. To enhance the students' proficiency in reading skills enabling them to meet the academic demands of their course.

Course Outcomes: After going through this course the student will be able to

1. Use English Language effectively in spoken and written forms
2. Interpret the contextual meaning of words
3. Comprehend the given texts and respond appropriately
4. Recall and reproduce the theme in a given context
5. Communicate confidently in formal and informal contexts

UNIT–I **(9 Lectures)**

a. Reading Skills: Leela's Friend – R.K. Narayan
b. Vocabulary: Synonyms, Antonyms and Word formation, Root Words
c. Grammar: Parts of Speech, Sentence structure and Types of sentences
d. Writing: Letter Writing, Note Making and Note Taking

UNIT–II **(9 Lectures)**

a. Reading Skills: Dr. A.P.J. Abdul Kalam's Biography
b. Vocabulary: Prefixes, Suffixes and Affixes
c. Grammar: Prepositions and Articles
d. Writing: Paragraph Writing and Precis Writing

UNIT–III **(9 Lectures)**

a. Reading Skills: Three Days to See – Helen Keller
b. Vocabulary: Collocations, One word substitutes & Idioms
c. Grammar: Tenses, Active voice & Passive voice
d. Writing: Technical Report Writing

UNIT–IV **(9 Lectures)**

a. Reading Skills: Satya Nadella's Email to His Employees on His First Day as CEO of Microsoft
b. Vocabulary: Phrasal verbs and Commonly confused words
c. Grammar: Subject–Verb Agreement (Concord) and Question tags
d. Writing: Curriculum vitae, Cover Letter and Resume Writing. (Functional, Chronological and standard Resumes)

UNIT–V **(9 Lectures)**

a. Reading Skills: Mokshagundam Visveswaraya
b. Vocabulary: Homonyms, Homophones and Homographs
c. Grammar: Modal Auxiliaries, Degrees of Comparison and Direct speech & Indirect Speech
d. Writing: E- mail Writing and Essay Writing

Text Books:

1. New Horizons – Pearson Publishers
2. Fluency in English", A Course Book for Engg. Students, Published by Orient Black Swan, Hyderabad, 2016 print.
3. "Technical Communication- Principles and Practice", Third Edition. New Delhi: Oxford University press.
4. Epitome of Wisdom – Maruthi Publications

Reference Books:

1. Meenakshi raman, Sangeetha, Sharma Fundamentals of technical communication, Pg: 119-153 Oxford University press, 2015
2. Rutherford, Andhrea. J, Communication skills for technology. Pearson, New Delhi.2001
3. Raymond Murphy, Murphy's English Grammar, Cambridge University Press 2004
4. Meenakshi raman, Sangeetha, Sharma,Technical communication: English Skills for Engineers, Oxford University press, 2009
5. Michael Swan, Practical English Usage, Oxford University press, 1996

Web Resources:

1. `www.englishhints.com`
2. `www.enchantedlearning.com`
3. `www.learnenglish.de/grammar/prefixtext.html`

4. http://www.magickeys.com/books/riddles/words.html
5. http://www.pinnacle.edu.in/campusfiles/1826_campusFile_1.pdf
6. http://www.yourdictionary.com
7. http://www.learnenglish.com
8. http://www.cambridge.org
9. http://www.eslcafe.com
10. http://www.eslgames.com
11. http://www.penguin.co.uk
12. http://www.edufind.com/english/practice
13. www.englishhints.com,www.enchantedlearning.com,
14. www.learnenglish.de/grammar/prefixtext.html
15. http://www.magickeys.com/books/riddles/words.html

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST01	Linear Algebra & Differential Equations	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basics of Matrix Algebra, Differentiation, Integration

Course Objectives: The student will be able to

1. The concept of rank of a matrix which is used to know the consistency of system of linear equations and find the solution by using various analytical and numerical methods.
2. Eigen values and eigenvectors of a given matrix. Cayley-Hamilton theorem to find the inverse and power of a matrix and determine the nature of the quadratic form,
3. Recognize and model differential equations, apply analytical techniques to compute solutions for engineering problems.
4. The general solution to the higher order linear differential equations and applies to calculate the current in electrical circuits.
5. Explore the use of Laplace transform method to solve with initial value problems of ordinary differential equations.

Course Outcomes: After going through this course the student will be able to

1. Demonstrate the understanding of rank of a matrix. Analyze the solution of the system of linear equations.
2. Find the Eigen values and Eigenvectors of a matrix, apply Cayley-Hamilton theorem to determine inverse and power of a matrix and identify the nature of the quadratic form.
3. Solve the differential equations of first order and first degree related to various engineering fields.
4. Find the complete solution to the higher order linear differential equations and apply these methods to find the current in complex electrical circuits.
5. Apply the technique of Laplace transform and solve differential equations for analytical solutions with the initial conditions.

UNIT–I: Solving System of Linear Equations (8 Lectures)

Rank of a matrix by Echelon form-Normal form- Normal form through PAQ method – Solving system of homogeneous and non-homogeneous linear equations – Gauss elimination – Gauss Jordon methods.

UNIT–II: Eigen values – Eigenvectors, Cayley-Hamilton Theorem and Quadratic forms (10 Lectures)

Eigen values - Eigenvectors– Properties – Cayley-Hamilton theorem (without proof)- Finding inverse and power of a matrix by Cayley-Hamilton theorem–Reduction to Diagonal form. Quadratic forms: Rank, index, signature and nature of the

quadratic forms–Reduction of quadratic form to canonical forms by orthogonal transformation.

UNIT–III: Differential Equations of First Order and First Degree (10 Lectures)

Linear differential equation - Bernoulli's differential equation–Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling-Law of natural growth and decay-Orthogonal trajectories-Electrical circuits.

UNIT–IV: Linear Differential Equations of Higher order (8 Lectures)

Non-homogeneous equations of higher order with constant coefficients-with RHS term of the type e^{ax}, $sinax$, $cosax$, polynomials in x, $e^{ax}V(x)$, $x^nV(x)$ and general method - Method of Variation of parameters.

Applications: LCR circuit

UNIT–V: Laplace Transforms (9 Lectures)

Laplace transforms of standard functions– First shifting Theorem-Change of scale property multiplication by t^n–division by t, transforms of derivatives and integrals – Second shifting theorem– Laplace transform of Periodic functions.

Inverse Laplace transforms – Convolution theorem (without proof)

Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44^{th} Edition, Khanna Publishers
2. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10^{th} Edition, Wiley-India.
2. H. K. Das, Advanced Engineering Mathematics, 22^{nd} Edition, S. Chand & Company Ltd.
3. David Poole, Linear Algebra- A modern introduction, 4^{th} edition, Cengage.
4. Peter O' Neil, Advanced Engineering Mathematics, Cengage
5. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

Web Resources:

1. `http://tutorial.math.lamar.edu/Classes/DE/DE.aspx`
2. `http://mathworld.wolfram.com/topics`
3. `http://www.nptel.ac.in/course.php`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST04	Applied Chemistry	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic Chemistry at Intermediate or equivalent level.

Course Objectives: The student will be able

1. To analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.
2. To utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
3. To understand various synthetic methods of nonmaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors
4. To analyze the principles of different analytical instruments and their applications.
5. To Design models for energy by different natural sources.

Course Outcomes: After going through this course the student will be able to

1. Analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.
2. Utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
3. Understand various synthetic methods of nonmaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors
4. Analyze the principles of different analytical instruments and their applications.
5. Design models for energy by different natural sources.

UNIT–I: Polymer Technology (9 Lectures)

Polymerization: Introduction, classification, methods of polymerization (Emulsion and Suspension), mechanical properties.

Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (Poly ethylene, PVC, Polycarbonates and Bakelite).

Elastomers: Introduction, preparation, properties and applications (Buna S, Thiokol and Polyurethanes).

Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers,

UNIT–II: Electrochemical Cells and Corrosion (10 Lectures)

Galvanic Cells, Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery, Lead Acid battery and Ni-Cd cells).

Corrosion: Definition, theories of corrosion (Chemical and Electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, corrosion control (Proper designing and cathodic protection), protective coatings (Surface preparation, Cathodic coatings, Anodic coatings, Electroplating and Electroless plating).

UNIT–III: Chemistry of Advanced Materials (10 Lectures)

Nano materials: Introduction, sol-gel method, characterization by (Brunauer Emmet Teller (BET), and transmission electron microscopy (TEM) with example (TiO2), applications of fullerenes, carbon nanotubes (types, preparation and applications).

Liquid crystals: Introduction-types-applications.

Super conductors: Type –I, Type II-characteristics and applications

Non-elemental semiconducting materials: Stoichiometric, controlled valency & chalcogen photo/ semiconductors preparation of semiconductors (zone refining, Czochralski crystal pulling, epitaxy, diffusion, ion implantation)– semiconductor devices (p-n junction diode as rectifier, junction transistor).

UNIT–IV: Spectroscopic Techniques & Synthesis Of Essential Drug Molecules (9 Lectures)

Spectroscopic Techniques: Electromagnetic spectrum-types of molecular spectra and their absorption criteria ,UV-visible spectroscopy (electronic spectroscopy), Beer-Lambert's law and its limitations ,– applications of UV visible spectroscopy ,IR spectroscopy principle, Molecular vibrations – stretching and bending vibrations – applications of IR, NMR (Nuclear magnetic resonance)–working principle and instrumentation of NMR, chemical shift(δ) – applications of NMR

Synthesis of essential drug molecules: Preparation, properties and uses of Paracetamol , Aspirin, Ibuprofen

UNIT–V: Non-Conventional Energy Sources (7 Lectures)

Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion.

Text Books:

1. P.C. Jain and M. Jain "Engineering Chemistry", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "Engineering Chemistry", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "A Textbook of Engineering Chemistry", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

Reference Books:

1. K. SeshaMaheshwaramma and MridulaChugh, "Engineering Chemistry", Pearson India Edition.
2. O.G. Palana, "Engineering Chemistry", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "Preparation and characterization of materials" Academic press, New York (latest edition).
4. B. S. Murthy, P. Shankar, "Textbook of Nanoscience and Nanotechnology", University press (latest edition).

Web Resources:

1. http://jntuk-coeerd.in/
2. http://en.wikipedia.org/wiki/title
3. http://nptel.ac.in/coures/105106/.com
4. https://en.wikipedia.org/wiki/Electrochemistry
5. https://www.youtube.com/watch?v=WLyaZbT97EI&list=PLzW3l18TEXrpqo3jRarGr9ao-61tB2184
6. https://encyclopedia.che.engin.umich.edu/
7. http://encyclopedia.che.engin.umich.edu/Pages/ProcessParameters/Spectrometers/Spectrometers.html

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST01	Engineering Graphics	1	0	4	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Nill

Course Objectives: The student will be able

1. To introduce the students to use drawing instruments and to draw polygons, Engineering Curves and Scales, orthographic projections, projections of points.
2. To introduce the students to use projections of lines.
3. To make the students draw the projections of the planes and the various types of solids.
4. To enable the students to gain the ability to convert the Isometric views in to Orthographic views vice versa and development of surfaces of regular solids.
5. To introduce the students to use the Fusion 360 for creating basic geometric figures.

Course Outcomes: After going through this course the student will be able to

1. Construct polygons, scales and engineering curves and Identify the position of points with use of orthographic projections.
2. Identify the position of points and lines with use of orthographic projections.
3. Analyze the location and position of plane figures and solids through orthographic projections.
4. Develop 2D and 3D objects by converting their view.
5. Construct basic geometric figures using Fusion 360.

UNIT–I **(9 Lectures)**

Introduction To Engineering Graphics: Introduction to Drawing instruments and their uses, construction of regular polygons, Conic sections- ellipse, parabola, hyperbola using general method, Scales- Diagonal scale, Vernier scale.

Projections of Points: Principle of orthographic projection-Method of Projection – First and third angle projection methods- Projections of Points.

UNIT–II **(9 Lectures)**

Projections Of Lines: projection of straight lines- parallel to one plane and inclined to the other plane, projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT–III **(9 Lectures)**

Projections Of Planes: projections of plane figures- triangle, square, rectangle, pentagon and hexagon, circle with surfaces inclined to both the reference planes.

Projections Of Solids: projections of solids: projections of regular solids with the axis inclined to only one reference plane.

UNIT–IV **(9 Lectures)**

Surface Development: development of surfaces for basic solids- prisms, pyramids, cylinder and cone.

Projections of Pictorial Views: Conversion of isometric views into orthographic views and conversion of orthographic views in to isometric views.

UNIT–V **(9 Lectures)**

Introduction To Autodesk Fusion 360: fusion 360 fundamentals-Getting Started -The Fusion 360 Interface Design Navigation & Display-Design Units and Origin -Quick Shape Creation.

Creating Sketched Geometry: Introduction to the sketching workflow - sketch entities -dimensioning sketch constraint.

Text Books:

1. Engineering Drawing by N.D. Bhatt & V.M. Panchal, Charotar Publications, 2014.
2. Engineering Drawing by Basant Agrawal and C.M. Agrawal, McGraw Hill Education Pvt. Limited, 2013.
3. Engineering Drawing by Prof. K.L. Narayana & Prof. R.K.Kannaiah, Scitech Publications, 2010.
4. Parametric Modeling with Autodesk Fusion 360 By Randy H. Shih SDC publications April 23, 2021

Reference Books:

1. Engineering Graphics with AutoCAD 2002 by James D. Bethune, PHI, 2011.
2. Engineering Graphics. P I Varghese Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Engineering drawing – P.J. Shah .S.Chand Publishers,2010.
4. Engineering Drawing- Johle/Tata Macgraw Hill Book Publishers, 2010.
5. Autodesk Fusion 360: A Tutorial Approach Kindle Edition by Prof. Sham Tickoo Purdue Univ. and CADCIM Technologies.

Web Resources:

1. https://lecturenotes.in/subject/436/engineering-drawing-ed.
2. web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf.
3. https://www.smartzworld.com/notes/engineering-drawing-pdf-1st-year-notes-ppts
4. https://www.researchgate.net/305754529_A_Textbook_of_Engineering_Drawing
5. www.academia.edu/32510080/N_d_bhatt_engineering_drawing_pdf

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST03	C - Programming for Problem Solving	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Nill

Course Objectives: The student will be able

1. To impart adequate knowledge on the need of programming languages and problem solving techniques.
2. To impart problem solving skills.
3. To enable student to write programs in C and to solve the problems.

Course Outcomes: After going through this course the student will be able to

1. Design algorithms and flowchart / Pseudo code for a given problem.
2. Design programs involving decision structures and loops.
3. Implement different operations on arrays and solve problems using functions.
4. Understand pointers and strings.
5. Implement structures, unions and file operations in C programming for a given application problem.

UNIT–I **(8 Lectures)**

Introduction to Programming: Computer hardware, Bits and Bytes, programming languages, application and system software, the software development process.

Idea of algorithm: steps to solve logical and numerical problems. Representation of algorithm: flowchart/pseudo code with examples, from algorithms to programs.

UNIT–II **(9 Lectures)**

Introduction to C: Overview of C, Constants, Variables and Data Types, Operators and Expressions, Managing Input and Output. Decision Making - Branching and Looping. Enumerated Data type, Renaming Data type with type def, Type Casting.

UNIT–III **(10 Lectures)**

Arrays: Definition, Declaration, Initialization, Assignment, Processing array, Passing array to a function, Two and multi dimensional array. **Functions:** Defining a function, Accessing a function, Passing argument to functions, Function prototypes, Nested function call, Storage classes.

UNIT–IV **(9 Lectures)**

Pointers: Definition, initialization, operations on pointers, functions and pointers, arrays and pointers, pointers to pointers, dynamic memory allocation.

Strings: C Strings, String Input / Output functions, arrays of strings, string manipulation functions.

UNIT–V **(9 Lectures)**

Structures: Definition, declaration, initialization, accessing members, array of structures, arrays within structure, functions and structures, pointers to structures, nested structures, unions.
File Handling: Types, operations on files, modes, file I/O functions, Random Access Functions.

Text Books:

1. Byron S Gottfried, —Programming with C, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B.Koffman.
3. Balagurusamy. 2011. C Programming. Tata Mc Graw Hills, New Delhi, India.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
2. Yashavant P. Kanetkar. —Let Us C, BPB Publications, 2011.

Web Resources:

1. https://www.studytonight.com/c/
2. https://www.cprogramming.com/tutorial/c-tutorial.html
3. https://www.javatpoint.com/c-programming-language-tutorial
4. https://www.tutorialspoint.com/cprogramming/

Course Code	Course Name	Course Structure			
P21HSL01	English Language Communication Skills Lab	L	T	P	C
		0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Basic knowledge of English grammar, Basic understanding of English vocabulary, Ability to speak simple sentences, Have interest to learn the language.

Course Objectives: The student will be able

1. To facilitate computer assisted multimedia instructions enabling individualized and independent language learning.
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
3. To bring about a consistence accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
4. To improve the fluency of students in spoken English and neutralize their mother tongue influence.
5. To train students to use language appropriately for public speaking, group discussion and interviews.

Course Outcomes: After going through this course the student will be able to

1. Better understanding of nuances of English language through audio visual experience and group activities.
2. Neutralization of accent for intelligibility.
3. Speaking skills with clarity and confidence which in turn enhances their employability skills.
4. Better understanding of the production of sounds of language.
5. Suitable body language for employability.

EXERCISE–I

A. Introduction to Phonetics
   Consonant sounds
   Vowel sounds – Pure Vowels & Diphthongs

B. Greeting, Introducing & taking leave and Ice – Breaking Activity

EXERCISE–II

A. Structure of Syllables - Plural markers & Past tense Markers

B. JAM Session & Situational Dialogues

EXERCISE–III

A. Word Stress & Rules of 'r' pronunciation

B. Role play, Giving Directions & Story Narration

EXERCISE–IV

A. Consonant Cluster, Neutralization of Mother Tongue Influence and Listening Comprehension – Listening for General Details

B. Describing objects, events, places etc. & Presentation Skills – Extempore, Public Speaking.

EXERCISE–V

A. Intonation & Listening Comprehension – Listening for Specific Details

B. Interview Skills & Group Discussion

Text Books:

1. Strengthen your Communication Skills - Maruthi Publication, Hyderabad 2013
2. A textbook of English Phonetics for Indian Students by T. Balasubramanian (Macmillan)

Reference Books:

1. INFOTECH English (Maruthi Publications).
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)
3. Suresh Kumar, E. & Sreehari, P. 2009. A Handbook for English Language Laboratories. New Delhi: Foundation
4. Speaking English Effectively 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
5. Sasi Kumar, V & Dhamija, P.V. How to Prepare for Group Discussion and Interviews. Tata McGraw Hill
6. Hancock, M. 2009. English Pronunciation in Use. Intermediate. Cambridge: CUP
7. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad
8. Hewings, M. 2009. English Pronunciation in Use. Advanced. Cambridge: CUP
9. Marks, J. 2009. English Pronunciation in Use. Elementary. Cambridge: CUP
10. Nambiar, K.C. 2011. Speaking Accurately. A Course in International Communication. New Delhi : Foundation

11. Soundararaj, Francis. 2012. Basics of Communication in English. New Delhi: Macmillan

12. Spoken English (CIEFL) in 3 volumes with 6 cassettes, OUP.

13. English Pronouncing Dictionary Daniel Jones Current Edition with CD.

Web Resources:

1. http://www.cambridge.org
2. http://www.edufind.com/english/practice
3. http://www.learnenglish.com
4. http://www.penguin.co.uk

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BSL03	Applied Chemistry Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Basic Chemistry at Intermediate or equivalent level.
Course Objectives: The purpose of this course to provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.
Course Outcomes: After going through this course the student will be able to

1. Carrying out different types of titrations for estimation of concerned in materials using comparatively more quantities of materials involved for good results.
2. Handling different types of instruments for analysis of materials using small quantities of materials involved for quick and accurate results.

LIST OF EXPERIMENTS: Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis.

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of water sample containing Na_2CO_3 and NaOH.
3. Determination of Mn^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (p^Hmetry method).
9. Determination of isoelectric point of amino acids using p^Hmetry method (or) conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Estimation of Vitamin C.
13. Preparation of Nylon-6, 6 and Bakelite (demonstration only).

Reference Books:

1. Dr. Jyotsna Cherukuris (2012) Laboratory Manual of engineering chemistry-II,
2. VGS Techno Series 3. Chemistry Practical Manual, Lorven Publications

Web Resources:

1. https://vlab.amrita.edu/index.php?sub=2&brch=193.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ESL02	C - Programming for Problem Solving Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Nil

Course Objectives: The student will be able

1. To understand the various steps in program development.
2. To understand the basic concepts in C Programming Language.
3. To understand different modules that includes conditional and looping expressions.
4. To understand how to write modular and readable C Programs.
5. To write programs in C to solve problems using arrays, structures and files.

Experiment Wise Programs

EXERCISE–I

a. Write a simple C program to Print "Hello World"

b. Write a simple C Program to Calculate Area and Circumference of Circle

c. Write a simple C program to implement basic arithmetic operations - sum, difference, product, quotient and remainder of given numbers.

EXERCISE–II: Write C programs to demonstrate the following operators

a. Assignment Operator.

b. Relational and Logical Operator.

c. Increment and decrement operator.

d. Bitwise operators.

e. Ternary operator.

EXERCISE–III

a. Write a C programs - to find the largest and smallest of 2 numbers(if – else), to find the largest and smallest of 3 numbers(Nested if – else), roots of quadratic equation(else – if ladder).

b. The total distance travelled by vehicle in't' seconds is given by distance=ut+1/2 at 2 where 'u' and 'a' are the initial velocity and acceleration.

   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'.

c. Write a c program, which takes two integer operands and one operator from the user, performs the operation and the prints the result. (consider the operators $+, -, *, /, \%$ and use switch statement).

EXERCISE–IV

a. Write a C program to find the sum of individual digits of a positive integer

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.

EXERCISE–V

a. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: $1 + x + x^2 + x^3 + ... + x^n$

b. Write a C program to generate Pascal's triangle.

c. Write a C program to construct a pyramid of numbers

EXERCISE–VI

a. Write a c program to find both the largest and smallest number in a list of integers.

b. Write a c program that uses functions to perform the following:

   i. Addition of Two Matrices.

   ii. Multiplication of Two Matrices.

EXERCISE–VII

a. Write a programs that use both recursive and non-recursive functions

b. To find the factorial of a given integer.

c. To find the GCD of two given integers.

EXERCISE–VIII

a. Write a c program that uses functions to perform the following operations:

   i. To insert a sub-string in given main string from a given position.

   ii. To delete n Characters from a given position in a given string.

b. Write a C program to determine if the given string is a palindrome or not.

EXERCISE–IX

a. Write a C program that displays the position or index in the string S Where the string T begins, or - 1 if S doesn't contain T.

b. Write a C program to count the lines, words and characters in a given text .

EXERCISE–X

a. Write a program to print the details of a student like(Name, Rollno, marks) using nested structures.

b. Write a C Program to Calculate Difference Between Two Time Period.

EXERCISE–XI

a. Write a C program that uses functions to perform the following operations:

   i. Reading a complex number
   ii. Writing a complex number
   iii. Addition of two complex numbers
   iv. Multiplication of two complex numbers
   (Note: represent complex number using a structure.)

EXERCISE–XII

a. Write a C program which copies one file to another and display the contents of a file

b. Write a C program to reverse the first n characters in a file.

c. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST02	Applied Physics	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: The basics of analytical and conceptual understanding of physics

Course Objectives: The student will be able

1. To study the wave nature of light through Interference and diffraction.
2. To learn the basic principles of Lasers and fiber optics.
3. To express the physics of electrostatics and electromagnetic wave concepts through Maxwell's equations.
4. To study the basic concepts of Quantum mechanics.
5. Aware of limits of classical free electron theory and apply band theory of solids.
6. Acquire the knowledge of semiconductor physics.

Course Outcomes: After going through this course the student will be able to

1. Understanding the basic concepts of optics and how to apply them for engineering applications.
2. Acquire the knowledge of fundamentals of Lasers and fiber optics enables the students to develop Laser devices to apply them in various systems like communications, Industries and medicine.
3. Set students to be exposed to Electrostatics, Maxwell's equations, electromagnetic waves and fundamental concepts of quantum mechanics.
4. Enable to learn the fundamental concepts of free electron theory and band theory of solids.
5. Develop knowledge of band theory of solids for fundamentals of Semiconductor physics enables the students to apply the knowledge to various systems like communications, solar cell, photo cells and so on.

UNIT–I: Wave Optics (9 Lectures)

Interference: Introduction, Principle of Superposition of waves, colors in thin films, interference in thin films, Newton's rings: Determination of wavelength and refractive index.

Diffraction: Introduction, differences between interference and diffraction, difference between Fraunhofer and Fresnel's diffraction, Fraunhofer diffraction at single slit, Fraunhofer diffraction due to double slit, Diffraction grating (N-slits qualitative), resolving power of grating.

UNIT–II: Lasers and Fiber Optics (9 Lectures)

Lasers: Introduction, Characteristics of laser, absorption, spontaneous emission, stimulated emission, Einstein's coefficients, population inversion, pumping, pumping mechanisms, Types of Lasers: Ruby laser, He-Ne laser, diode laser, Applications of Lasers.

Fiber optics: Introduction, Total internal reflection-wave propagation in optical fiber, Acceptance angle, numerical aperture, applications of optical fiber.

UNIT–III: Electrostatics, Maxwell's Equations and Electromagnetic Waves

(9 Lectures)

Electrostatics: Coulombs law, electric field, electric field intensity, electric flux density, electrostatic potential, divergence of electric field, Laplace's and Poisson's equations for electrostatic potential, Gauss theorem in electrostatics.

Maxwell's equations and electromagnetic waves: Gauss theorem in magneto statics, Faraday's law of electromagnetic induction, Ampere's law, displacement current, Maxwell's equations in vacuum, electromagnetic wave equation in dielectric medium, velocity of propagation of electromagnetic wave, poynting vector and poynting theorem.

UNIT–IV: Quantum Mechanics, Free Electron Theory and Band Theory

(10 Lectures)

Quantum Mechanics: Introduction to quantum physics, de-Broglie's hypothesis and properties of matter waves, Schrodinger's time independent wave equation, Schrodinger's time dependent wave equation, Particle in one dimensional box.

Free electron theory: classical free electron theory of metals- assumptions and failures, quantum free electron theory of metals-assumptions and failures, Fermi Dirac distribution function- Fermi level, Femi energy, density of states.

Band theory of solids: Introduction, Bloch's theorem, Kronig penny model (qualitative), E-K diagram, Brillouin's zones, classification of solids into metals, semiconductors and insulators, effective mass of electron and concept of hole.

UNIT–V: Semiconductor Physics **(8 Lectures)**

Semiconductor physics: Introduction, intrinsic and extrinsic semiconductors, carrier concentration in intrinsic semiconductors, electrical conductivity of intrinsic semiconductor, Fermi energy, carrier concentration in N-type and P-type semiconductors, dependence of Fermi energy on carrier-concentration and temperature, drift and diffusion, Hall effect and its applications, mechanism in LED, solar cell and photo conductor.

Text Books:

1. A Textbook of Engineering Physics by Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand.
2. Optics by Ajoy Ghatak, Tata McGraw-Hill Publishing company limited
3. Introduction to Electrodynamics by David Griffiths, Cambridge University Press
4. Introduction to Quantum physics by Eisberg and Resnick.

Reference Books:

1. Applied physics by Palanisamy (Scitech publications)
2. Optics by Eugene Hecht, Pearson Education.
3. Principle of Lasers by O. Svelto
4. Electricity, magnetism and light by W. Saslow
5. Semiconductor Optoelectronics by J. Singh, Physics and Technology, Mc Graw-Hill inc
6. Engineering Physics by B.K. Pandey, S. Chaturvedi - Cengage Learing.

Web Resources:

1. https://nptel.ac.in/courses/115/106/115106066/
2. https://ocw.mit.edu/high-school/physics/exam-prep/electromagnetism/maxwells-equations/#1
3. https://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/electronic-materials/14-semiconductors/

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST06	Numerical Methods & Vector Calculus	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Differentiation, Partial differentiation, Integration, Differential Equations

Course Objectives: The student will be able

1. The different numerical techniques to solve algebraic and transcendental equations and evaluate the polynomials from the numerical data.
2. The approximate solutions using numerical methods in the absence of analytical solutions of various systems of ordinary differential equations and integrations.
3. Enhance the knowledge level to visualize integrals in higher dimensional coordinate systems, possible representation and evaluation of geometrical and physical quantities in terms of multiple integrals.
4. Interpret concepts of vector functions, vector fields, differential calculus of vector functions in Cartesian coordinates and apply them for various engineering problems.
5. Evaluate line, surface and volume integrals and construct relation between line, surface and volume integrals using vector integral theorems.

Course Outcomes: After going through this course the student will be able to

1. Evaluate approximate roots of the polynomial and transcendental equations by different algorithms and apply Newton's forward, backward interpolation and Lagrange's formulae for equal and unequal intervals.
2. Apply different algorithms for approximating the integrals of numerical data and solutions of ordinary differential equations to its analytical computations.
3. S Evaluate the multiple integrals by using change of variables and change of order of integration. Also apply double and triple integration techniques in evaluating areas and volumes bounded by regions and solids.
4. nterpret the physical meaning of different operators such as gradient, curl and divergence.
5. Determine line, surface and volume integrals. Apply Green's, Stoke's and Gauss divergence theorems to calculate line, surface and volume integrals.

UNIT–I: Iterative Methods, Finite differences and Interpolation (10 Lectures)

Introduction-Solution of algebraic and transcendental equations-Bisection method -Method of false position-Newton-Raphson method (Single variable only)

Interpolation: Introduction-Errors in polynomial interpolation-Finite differences – Forward differences-Backward differences-Relations between operators-Newton's forward and backward formulae for interpolation -Interpolation with unequal intervals -Lagrange's interpolation formula.

UNIT–II: Numerical integration, Solution of ordinary differential equations with initial **(9 Lectures)**

Trapezoidal rule – Simpson's 1/3rd and 3/8th rule– Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Modified Euler's method-Runge-Kutta method (second and fourth order).

UNIT–III:Multiple Integrals: **(9 Lectures)**

Double integrals (Cartesian and Polar) – Change of order of integration – Change of variables (Cartesian to Polar coordinates) –Triple integrals- Change of variables (Cartesian to Cylindrical and Spherical coordinates).

Applications: Areas by double integrals and Volumes by triple integrals.

UNIT–IV: Vector Differentiation: **(8 Lectures)**

Scalar and Vector point functions-Vector Differential operator- Gradient – Directional derivatives – Divergence – Curl – Laplacian second order operator- Vector identities- Applications: Scalar Potential function.

UNIT–V: Vector Integration: **(9 Lectures)**

Line integral – Work done – Circulation- Surface integral- Volume integral **Vector Integral Theorems (without proof):** Application of Green's theorem in a plane-Stoke's theorem- Gauss Divergence theorem.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. H. K. Das, Advanced Engineering Mathematics, 22ndEdition,S. Chand & Company Ltd.
3. David Poole, Linear Algebra- A modern introduction, 4th edition, Cengage.
4. Peter O' Neil, Advanced Engineering Mathematics, Cengage
5. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

Web Resources:

1. `http://tutorial.math.lamar.edu/Classes/DE/DE.aspx`
2. `http://mathworld.wolfram.com/topics`
3. `http://www.nptel.ac.in/course.php`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST06	Electrical Circuits Analysis -I	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Applied Physics

Course Objectives: The student will be able

1. To analyze the ohms law and network reduction techniques.
2. To determine voltage and current in electrical element.
3. To understand the concept of magnetic circuits.
4. To analyze the AC Circuits with R- L –C Parameters.
5. To analyze the network theorems

Course Outcomes: After going through this course the student will be able to

1. Analyze the ohms law and network reduction techniques.
2. Determine voltage and current in electrical element.
3. Understand the concept of magnetic circuits.
4. Analyze the AC Circuits with R- L –C Parameters.
5. Analyze the network theorems

UNIT–I: BASIC CIRCUIT CONCEPTS-I (9 Lectures)

Basic definitions – Types of network elements- Types of sources - Ohm's Law –Energy Sources – R – L – C Parameters –Network Reduction Techniques – Series, Parallel Circuits- Star-Delta and Delta-Star Transformations - Source transformation-Numerical Problems.

UNIT–II: BASIC CIRCUIT CONCEPTS-II (9 Lectures)

Kirchhoff's Laws – Voltage division and Current Division - Source Transformation Technique – Mesh and Node Analysis – Super Mesh and Super Node Analysis – Numerical Problems.

UNIT–III: MAGNETIC CIRCUITS (9 Lectures)

Basic definition of Magnetic Quantities - Faraday's laws of Electromagnetic Induction-Lenz's Law - Analogy between Electrical and Magnetic Circuits. Concept of Self and Mutual Inductance - Coefficient of Coupling – Coupled Circuits – Numerical Problems.

Applications: Areas by double integrals and Volumes by triple integrals.

UNIT–IV: AC CIRCUIT ANALYSIS (9 Lectures)

Representation of Sinusoidal Waveforms - Peak and RMS values -Phasor Representation, Real Power, Reactive Power, Apparent Power, Power factor – Significant of J Operator - Analysis of Single-Phase ACCircuits Consisting of R, L, C, RL, RC, RLC Combinations – Numerical Problems.

UNIT–V: Network Theorems –I (9 Lectures)

Network Theorems – Superposition Theorem - Reciprocity Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem - Numerical Problems.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, Mc-Graw Hill Company, 6th edition, 2007.
2. Network Analysis by Van Valkenburg; Prentice-Hall of India Private Ltd, 2015.

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, Mc Graw Hill Education (India), 2013.
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications, 2008.
3. Electric Circuits– (Schaum's outlines) by Mahmood Nahvi & JosephEdminister, Adapted by Kuma Rao, McGraw Hill, 5th Edition-2012.
4. Electric Circuits by David A. Bell, Oxford publications, 2009.
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications,2013.
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, DhanpatRai & Co, 2009.

Web Resources:

1. `www.allaboutcircuits.com`
2. `www.electronics-tutorials.ws`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST11	Elctronic Devices and Circuits	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Applied Physics

Course Objectives: The student will be able

1. The basic concepts of semiconductor devices will be reviewed.
2. Study the physical phenomenon such as conduction, transport mechanism and electrical characteristics of P-N diode and Study the physical phenomena such as basic principle of operation of different diodes.
3. The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
4. The principal of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.
5. To learn and understand the purpose of transistor biasing and its significance.

Course Outcomes: After going through this course the student will be able to

1. Analyze the basic concepts of semiconductor physics.
2. Design and formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation and Analyze the basic concepts of special purpose diodes.
3. Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
4. Understand the construction, principle of operation of transistors, BJT and FET with their V-I characteristics in different configurations.
5. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.

UNIT–I: (9 Lectures)

Review of Semi Conductor Physics: Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors

Junction Diode : energy band diagram of PN junction Diode, Open circuited p- n junction, Biased p-n junction.

UNIT–II: Special Semiconductor Devices: (9 Lectures)

p-n junction diode, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Varactor Diode, Photodiode, Tunnel Diode, UJT, PN-PN Diode, Construction, operation and V-I characteristics

UNIT–III: (9 Lectures)

Rectifiers: Basic Rectifier setup, half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms.

Filters: Inductor filter(Series inductor), Capacitor filter(Stunt inductor), π- Filter, comparison of various filter circuits in terms of ripple factors.

UNIT–IV: Transistor Characteristics (9 Lectures)

BJT: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, Photo transistor, typical transistor junction voltage values.

FET: FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

UNIT–V: (9 Lectures)

Transistor Biasing and Thermal Stabilization : Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S,S',S"), Bias compensation, Thermal runaway, Thermal stability.

FET Biasing- methods and stabilization.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. Halkias, satyabrata jit Tata Mc-Graw Hill,4th Edition, 2015.
2. Electronic Devices and Circuits- S Salivahanan, N Suresh kumar- Tata Mc-Graw Hill, 2012

Reference Books:

1. Electronic Devices and Circuits-K. Satya Prasad, VGS Book Links, 2nd Edition, 2014.
2. Electronic Devices and Circuits – Bell, Oxford, 5th Edition, 2010.

Web Resources:

1. physics.info/semiconductors/
2. www.allaboutcircuits.com/technical-articles/characteristics-of-junction-diodes/
3. www.academia.edu/8160398/Transistor_Biasing_and_Stabilisation
4. http://203.202.233.187/moodle/course/view.php?id=1074

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST13	Data Structures	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: C Programming

Course Objectives:

1. Comprehensive knowledge of data structures and ability to implement the same in software applications.
2. Exposure to algorithmic complexities, recursive algorithms, searching techniques.
3. Exposure to sorting technique, Applying stack techniques for logical operations.
4. Applying queue techniques for logical operations, Exposure to list representation models in various types of applications.
5. Implementation of tree in various forms, Advanced understanding of other variants of trees and their operations.
6. Orientation on graphs, representation of graphs, graph traversals, spanning trees Graphs.

Course Outcomes: After going through this course the student will be able to

1. Student will be able to choose appropriate data structure as applied to specified problem definition.
2. Implement appropriate sorting/searching technique for given problem
3. Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
4. Students will be able to implement Linear and Non-Linear data structures

UNIT–I: (9 Lectures)

Data Structure, Recursion & Searching: Preliminaries of algorithm, Algorithm analysis and complexity. Data Structure: Definition, types of data structures.

Recursion: Definition, Design Methodology and Implementation of recursive algorithms, Types of recursion (Linear, binary and Tail), recursive algorithms for factorial function, GCD Computation, Fibonacci sequence.

Searching: List Searches using Linear Search, Binary Search.

UNIT–II: (10 Lectures)

Sorting Techniques: Basic Concepts, Sorting by: Insertion (Insertion Sort), Selection (heap sort), Exchange(Bubble sort, Quick Sort) Merging(Merge sort) Algorithms.

Stacks: Basic Stack operations, Representation of a stack using arrays, Stack Applications: Reversing list, Infix to postfix transformation.

UNIT–III: (10 Lectures)

Queues: Introduction, Representation of a Queue using arrays, Queue Operations, Applications of queues- Round Robin Algorithm, Circular Queues, Priority Queues.
Linked List: Introduction, single linked list, representation of a linked list in memory, Operations on a single linked list, Reversing a single linked list, Applications: single linked list to represent polynomial expressions, Double linked list. , Circular linked list

UNIT–IV: (9 Lectures)

Trees: Basic tree concepts, Binary Trees: Properties, Representation of Binary Trees using arrays, operations on a Binary tree, Binary Tree Traversals (recursive).
Advanced Tree Concepts: Binary search tree, Basic concepts, BST operations: Searching, insertion, deletion, Balanced search trees-AVL Trees.

UNIT–V: (7 Lectures)

Graphs: Basic concepts, Graph Representations- Adjacency matrix, Adjacency lists, Graph algorithms: Graph Traversals (BFS & DFS), applications: Dijkstra's shortest path, Minimum Spanning Tree using Prim's & Kruskal's Algorithm.

Text Books:

1. Data Structures, 2/e, Richard F, Gilberg , Forouzan, Cengage,2007.
2. Data Structures and Algorithms, G.A.V.Pai, TMH, 2008
3. Data Structures and Algorithms Made Easy, Narasimha Karumanchi , Second Edition, 2011.

Reference Books:

1. Data Structure with C, Seymour Lipschutz, TMH,2010.
2. Classic Data Structures, 2/e, Debasis ,Samanta,PHI,2009
3. Fundamentals of Data Structure in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press.

Web Resources:

1. `www.geeksforgeeks.org`
2. `www.hackr.io.`
3. `www.letsfindcourse.com`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BSL01	Applied Physics Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: The basics of analytical and conceptual understanding of physics.

Course Objectives:

1. Deploy scientific method of experiments in the laboratory.
2. Develop the procedures and observational skills for appropriate use of simple and complex apparatus.
3. Enable analytical techniques, statistical analysis and graphical analysis.
4. Reinforce ideas and concepts covered in lecture host of experiments.
5. Train to find the radius of curvature of a Plano-convex lens forming Newton's rings.

Course Outcomes:

1. Apply the phenomenon of interference and diffraction of light waves.
2. HImplement the concept of resonance in LCR circuit and sonometer.
3. HM toAnalyze the S determine its dependent properties.
4. Evaluate the behavior of electronic components and its characteristics.

LIST OF EXPERIMENTS: (any eight of the following to be done)

1. Determination of Radius of Curvature of Plano-Convex lens by forming Newton's Rings.
2. Determination of Wavelengths of various spectral lines using diffraction grating with the normal incidence method.
3. Study of magnetic field along the axis of a current carrying coil and to verify Stewart-Gee's method.
4. Determination of energy gap of PN junction Diode.
5. Determination of hall coefficient and carrier concentration using Hall effect
6. Study of V-I characteristics of Zener diode.
7. Determination of frequency of a vibrating bar or electrical tuning fork using Melde's apparatus.
8. Determination of acceleration due to gravity using compound pendulum
9. Verification of laws of transverse waves by Sonometer.
10. Determination of Velocity of sound by volume resonator.
11. Determination of rigidity modulus by Torsional Pendulum.

Text Books:

1. Physics lab manual, department of physics, PACE Institute of Technology and Sciences.
2. 2. Madhusudhanrao, “Engineering Physics lab manual” Ist edition, Scietech Publication, 2015.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ESL05	Electronic Devices and Circuits Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Engineering Physics

Course Objectives:

1. To study basic electronic components.
2. To observe characteristics of electronic devices

Course Outcomes: At the end of the course student can able to

1. Measure voltage, frequency and phase of any waveform using CRO.
2. Generate sine, square and triangular waveforms with required frequency and amplitude using function generator.
3. Analyze the characteristics of different electronic devices such as diodes, transistors etc., and simple circuits like rectifiers etc.

PART-A ELECTRONIC WORKSHOP PRACTICE (2 lab sessions)

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT, and DIP), Coils, Gang Condensers, Relays, Bread Boards.
2. Identification, Specifications and Testing of Active Devices, Diodes, BJTs, Lowpower JFETs, MOSFETs, Power Transistors, LEDs, LCDs, Optoelectronic Devices, SCR, UJT, DIACs, TRIACs, Linear and Digital ICs.
3. Soldering practice – Simple Circuits using active and passive components.
4. Study and operation of

   a) Multimeters (Analog and Digital)

   b) Function Generator

   c) Regulated Power Supplies.

   d) CRO

PART-B List of Experiments: (Minimum of Ten Experiments has to be performed) (in 8 lab sessions)

1. P-N Junction Diode Characteristics :forward and reverse bias
2. Zener Diode V-I Characteristics.
3. Zener Diode as Voltage Regulator.
4. Half wave Rectifier with & without filters
5. Full wave Rectifier with & without filters

6. Full wave Rectifier with & without filters BJT Characteristics (CE Configuration) : Input &Output
7. BJT Characteristics (CB Configuration) : Input &Output
8. FET Characteristics (CS Configuration) : Drain & Transfer Characteristics
9. FET Characteristics (CG Configuration) : Drain & Transfer Characteristics
10. Transistor as an inverter.
11. UJT Characteristics
12. CRO Operation and its Measurements

Equipement Required:

1. Regulated Power supplies
2. Analog /Digital Storage Oscilloscopes
3. Analog /Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components

Course Code	Course Name	Course Structure			
P21ESL06	Data Structures Lab	L	T	P	C
		0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: C- Programming

Course Objectives:

1. To choose the appropriate data structure and algorithm design method for a specified application.
2. To solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps binary search trees, and graphs and writing programs for these solutions.

Course Outcomes: At the end of the course student can able to

1. Analyze worst-case running times of algorithms using asymptotic analysis and implement various data structures like linked lists.
2. Understand and implement stacks and queues using arrays and linked lists.
3. Analyze and implement various searching and sorting algorithms.
4. Design and implement appropriate hash function and collision-resolution algorithms

List of Experiments:

Exercise 1:

Write recursive program for the following

a. Write recursive C program for calculation of Factorial of an integer
b. Write recursive C program for calculation of GCD (n, m)
c. Write recursive program which computes the n^{th} Fibonacci number

Exercise 2:

a. Write recursive C program for functions to perform Linear search for a Key value in a given list.
b. Write recursive C program for functions to perform Binary search for a Key value in a given list.

Exercise 3:

a. Write C program that implement Bubble sort, to sort a given list of integers in ascending order.
b. Write C program that implement Quick sort, to sort a given list of integers in ascending order

Exercise 4:

a. Write C program that implement Insertion sort, to sort a given list of integers in ascending order
b. Write C program that implement merge sort, to sort a given list of integers in ascending order

Exercise 5:

a. Write C program that implement stack (its operations) using arrays
b. Write C program that implement stack (its operations) using Linked list

Exercise 6:

a. Write a C program that uses Stack operations to Convert infix expression into postfix expression
b. Write C program that implement Queue (its operations) using arrays.
c. Write C program that implement Queue (its operations) using linked lists

Exercise 7:

a. Write a C program that uses functions to create a singly linked list
b. Write a C program that uses functions to perform insertion operation on a singly linked list
c. Write a C program that uses functions to perform deletion operation on a singly linked list.

Exercise 8:

a. Write a C program to Create a Binary Tree of integers
b. Write a recursive C program for Traversing a binary tree in preorder, inorder and postorder.

Exercise 9:

Write a C program for BST operations (insertion, deletion)

Exercise 10:

a. Write a C program for finding minimum spanning tree in a graph by using Prim's algorithm.
b. Write a C program for finding minimum spanning tree in a graph by using Kruskal's algorithm.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21MCT02	Biology for Engineering	2	0	0	0

Internal Marks: 30 External Marks: 70

Course Prerequisite: Nill

Course Objectives:

1. Overall understanding of living organisms and their characteristics
2. Basic understating of the biological principles of cell biology
3. Awareness on basic organization of organisms
4. Understanding about the machinery of the cell functions
5. Basic knowledge on biological problems that requires engineering expertise

Course Outcomes: After going through this course the student will be able to

1. The overview ofbiological observations that lead to major discoveries.
2. The concept of the cell,various stages of cell cycle, ultrastructure of Eukaryotic cell, Glycolysis and Krebs cycle
3. Analysis of biomolecules, identification of DNA in the molecular basis
4. The concepts of recessiveness and dominance during the passage of genetic-material from parent to offspring
5. Chromosomal disorders, the concept of origin of life with detailed description of Darwinian evolution and Lamarckism

UNIT–I: History of Biology (5 Lectures)

Science and Engineering; Definition of Biology, Characteristics of living organisms, Diversity in the living world, Applications of biology; **Biological classification of organisms:**Nomenclature, History of biological classification, Systematic Hierarchy, **Classification of the five kingdoms:** Monera, Protista, Fungi, Plantae and animalia.

Major contributions of prominent scientists: Aristotle,Antonie van Leeuwenhoek, Linnaeus, William Harvey, Louis Pasteur,Watson & Crick,Charles Darwin, Salim-Moizuddin Abdul Ali and YellapragadaSubbarao.

UNIT–II: Cell Biologyand Immunology (10 Lectures)

Ultra structure of animal cell: Plasma membrane, Golgi complex, Endoplasmic reticulum, Mitochondria,Glycolysis, Kreb's cycle, Lysosomes, Ribosomes, chromosomes, and Nucleus.Cell divisions: Cell cycle stages, Mitotic phase, meiosis.

Immunity: Innate immunity, Acquired immunity.Immunoglobulins: structure and biological properties of immunoglobulin classes, Immune disorder: AIDS.

UNIT–III: Biomolecules (10 Lectures)

Introduction, properties of biomolecules,Carbohydrates:structure, classifications andfunctions of carbohydrates.Proteins:structure, classification and functions of proteins. Lipids:characteristic features of lipids, important functions in biological systems, classification of lipids and vitamins.

Nucleic acids: structure and properties of DNA & RNA.Enzymes: Mode of action of enzymes, properties of enzymes, classification and nomenclature of enzymes, importance of enzymes.

UNIT–IV: Genetics and Evolution (10 Lectures)

Introduction, reasons for Mendel's success, characters selected by Mendel, Mandel's laws:1. Law of dominance 2.Law of segregation or Law of purity of gametes 3.Law of independent assortment. Monohybrid cross,Dihybrid cross, Test cross, back cross. Multiple alleles and Blood grouping, Sex determination in human.Chromosomal disorders in human- Klinefelter's syndrome, Turner's syndrome and Down's syndrome.Protein synthesis: Transcription and Translation.

Evolution: Evolutionary concepts: Theory of special creation, Cosmozoic theory, Theory of spontaneous generation or abiogenesis, Biogenesis theory, Theory of catastrophism, Theory of organic evolution. Origin of life: Primitive atmosphere and molecules, Biological evolution, Experimental chemical origin of life.Theories of evolution: Lamarckism and Darwinism.

UNIT–V: Human Health & Diseases And Applied Biology (10 Lectures)

Common diseases in humans: Health, Disease, Pathogens, Transmission, Bacterial diseases: Typhoid, Pneumonia, Diphtheria, Tetanus, Plague, Cholera, Tuberculosis, Syphilis, Gonorrhoea,Leprosy, Peptic ulcers;Viral diseases:Common cold, Measles, Rubella, Rabies, Chickenpox, Flu,Smallpox, Chikungunya, Poliomyelitis, AIDS;Fungal diseases: Ringworm;Protozoan diseases:Malaria, Amoebic dysentery and Helminth diseases: Filariasis, Ascariasis.

Applied Biology:rDNA technology; Industrial use of microorganisms- alcohols, acids and vitamins; enzymes, pollution control, vaccines, hormones.Monoclonal antibodies and stem cells.

Reference Books:

1. Biology: A global approach: Campbell, N.A.; Reece, J.B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P.V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Web Resources:

1. Human health and diseases:`https://www.emedicalprep.com/study-material/biology/biology-in-human-lefare/human-health-and-disease`

2. Aristotle's biology: https://en.wikipedia.org/wiki/Aristotle%27s_biology.
3. Sir Ronald Ross:https://en.wikipedia.org/wiki/Ronald_Ross.
4. Recombinant DNA Technology:https://microbenotes.com/recombinant-dna-/technology-steps-applications-and-limitations/
5. Nucleic acids:https://www.khanacademy.org/science/ap-biology/gene-/expression-and-regulation/dna-and-rna-structure/a/nucleic-acids.

Course Code	Course Name	Course Structure			
P21BST08	Transformation Techniques and Differential Equations	L	T	P	C
		3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite:

1) Differentiation
2) Integration

Course Objectives: The student will be able

1. To understand Fourier series representation of Periodic signals.
2. To The Fourier transform can be used to interpolate functions and to smooth signals.
3. To solve finite difference equations using Z-transforms.
4. To enlighten the learners in the concept of differential equations and multivariable calculus.
5. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

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

1. Find or compute the Fourier series of periodic signals.
2. Know and be able to apply integral expressions for the forwards and inverse Fourier transform to range of non-periodic waveforms.
3. Solving methods for finite difference equations using Z-transforms.
4. Familiarize with functions of several variables which is useful in optimization.
5. Identify the solution methods for partial differential equation related to various engineering fields.

UNIT–I: Fourier series (8 Lectures)

Fourier series: Introduction – Periodic functions – Fourier series of periodic function –Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

UNIT–II: Fourier Transforms (10 Lectures)

Fourier Transforms: Fourier integral theorem (without proof) –Fourier sine and cosine integrals– Sine and cosine transforms –Properties–inverse transforms –Finite Fourier transforms.

UNIT–III: Z-TRANSFORMS (8 Lectures)

Introduction-properties-Damping rule-Shifting rule-Initial and Final value theorems – Inverse Z transform-Convolution theorem-Solution of difference equation by Z-transform

UNIT–IV: Partial differentiation (10 Lectures)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain

rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT–V: PDE of first order & Second order and Applications (9 Lectures)

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.
Second order PDE: Solutions of linear partial differential equations with constant coefficient – RHS term of the type e^{ax+by} , sin(ax+ by) , cos(ax+ by), $x^m\ y^n$
Applications of PDE: Method of separation of Variables

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44^{th} Edition, Khanna Publishers.
2. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10^{th} Edition, Wiley-India.
2. H. K. Das, Advanced Engineering Mathematics, 22^{nd} Edition, S. Chand & Company Ltd.
3. David Poole, Linear Algebra- A modern introduction, 4^{th} edition, Cengage.
4. Peter O' Neil, Advanced Engineering Mathematics, Cengage
5. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

text Web Resources:

1. `http://tutorial.math.lamar.edu/Classes/DE/DE.aspx`
2. `http://mathworld.wolfram.com/topics`
3. `http://www.nptel.ac.in/course.php`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET01	Electrical Circuits Analysis - II	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Circuits Analysis - I

Course Objectives: The student will be able

1. To Analyze the network theorems and understand the applications of network topology to electrical circuits
2. To Analyze the concepts of balanced and unbalanced three-phase circuits.
3. To understand the behavior of RLC networks for DC and Sinusoidal excitations.
4. To study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance
5. To calculate the various two port network parameters and to know interconnections.

Course Outcomes: After going through this course the student will be able to

1. Analyzethe network theorems and solve Electrical networks with network topology concepts.
2. Solve three- phase circuits under balanced and unbalanced condition
3. Observe transient behavior of electrical networks with DC and AC excitations
4. Interpret R, L,C network with variation of any one of the parameters i.e., R, L, C and f
5. Determine the parameters for different types of network and their interrelations.

UNIT–I: Network Theorems –II (10 Lectures)

Network Theorems – Millman'sTheorem,Substitution Theorem –Compensation TheoremNumerical Problems.

Graph Theory: Definitions of Graph and Tree, Basic cut set and tie set matrices for planar networks, , Duality and Dual networks.

UNIT–II: Balanced and Unbalanced Three phase circuits (9 Lectures)

Analysis of three phase balanced circuits: Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, analysis of balanced three phase circuits, measurement of active and reactive power.

Analysis of three phase unbalanced circuits: Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

UNIT–III: Transient Analysis in DC Circuits (8 Lectures)

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential and Laplace equations.

Transient Analysis in AC Circuits: Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential and Laplace equations.

UNIT–IV: Resonance (9 Lectures)

Series and parallel Resonance, Half power frequencies, Bandwidth and Q factor, Relation between half power frequencies, Numerical Problems

UNIT–V: Two Port Networks (9 Lectures)

Two port network parameters – Z, Y, ABCD and Hybrid parameters and their interrelations, Cascaded networks.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company, 6^{th} edition, 2007.
2. Network Analysis by Van Valkenburg; Prentice-Hall of India Private Ltd, 2015.

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India), 2013.
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications, 2008.
3. Electric Circuits– (Schaum's outlines) by MahmoodNahvi&JosephEdminister, Adapted by KumaRao, McGraw Hill, 5th Edition-2012.
4. Electric Circuits by David A. Bell, Oxford publications, 2009.
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications,2013.
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, DhanpatRai& Co, 2009.

Web Resources:

1. `www.allaboutcircuits.com`
2. `www.electronics-tutorials.ws`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET02	Electromagnetic Fields	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Applied Physics , Mathematics

Course Objectives: The student will be able

1. To study the production of electric field and potentials due to different configurations of static charges.
2. To study the properties of conductors and dielectrics, calculate the capacitance of various configurations and understand the concept of conduction and convection current densities.
3. To study the magnetic fields produced by currents in different configurations, application of ampere's law and the Maxwell's second and third equations.
4. To study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops. To develop the concept of self and mutual inductances and the energy stored.
5. To study time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced e.m.f.

Course Outcomes: After going through this course the student will be able to

1. Compute the production of electric field and potentials due to different configurations of static charges.
2. Calculate the capacitance of various configurations and understand the concept of conduction and convection current densities.
3. Calculate the magnetic fields produced by currents in different configurations, application of ampere's law and the Maxwell's second and third equations.
4. Estimate the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops. Develop the concept of self and mutual inductances and the energy stored.
5. Understand the concept of time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced e.m.f.

UNIT–I: Network Electrostatics – I (9 Lectures)

Coordinate systems: Introductino to coordinate systems, rectangular, cylindrical and spherical coordinate systems.

Electrostatics: 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 – potential gradient, Gauss's law – Maxwell's first law (div(D)=ρv), Laplace's and Poison's equations and solution of Laplace's equation in one variable.

UNIT–II: Electrostatics – II (10 Lectures)

Electric dipole – dipole moment – potential and EFI due to an electric dipole, Torque

on an Electric dipole in an electric field, conductors and Insulators – their behavior in electric field. Polarization, boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space. Capacitance of parallel plates, spherical 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: Magnetostatics (9 Lectures)

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Maxwell's second Equation (div(B)=0), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation (Curl (H)=J) 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.

UNIT–IV: Self and Mutual inductance: (8 Lectures)

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–V: Electro Dynamic Field (9 Lectures)

Faraday's laws of electromagnetic induction – integral and point forms, Maxwell's fourth equation (Curl(E)=$-\frac{\partial B}{\partial t}$), statically and dynamically induced EMF – modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.

Text Books:

1. 1. "Engineering Electromagnetics" by William H. Hayt& John. A. Buck Mc. Graw-Hill Companies, 8th Editon.2006.
2. "Field theory" by gangadhar K.A , khanna publishers, New delhi, 15th edition , 2004

Reference Books:

1. " Principles of Electro Magnetics" by Sadiku, Oxford Publications,4th edition
2. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2nd edition
3. "Electromagnetic Field Theory" by YaduvirSingh,Pearson.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan,Oxford higher Education.

Web Resources:

1. https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm
2. https://b-ok.cc/book/1268675/9b2a83
3. https://b-ok.cc/book/3558383/6a6c16
4. https://www.emfields-solutions.com/
5. https://www.electrical4u.com
6. https:indiabix.com
7. http://www.ece.uah.edu

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET03	Electrical Machines-I	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Circuits, Engineering Physics

Course Objectives: The student will be able

1. To Understand the construction, principle of operation and performance of DC machines.
2. To Learn the characteristics, performance, methods of speed control and testing methods of DC motors.
3. To predetermine the performance of single phase transformers with equivalent circuit models.
4. To Understand the methods of testing of single-phase transformer.
5. To Analyze the three phase transformers and achieve three phase to two phase conversion.

Course Outcomes: After going through this course the student will be able to

1. Assimilate the concepts of electromechanical energy conversion.
2. Mitigate the ill-effects of armature reaction and improve commutation in dc machines.
3. Understand the torque production mechanism and control the speed of dc motors.
4. Analyze the performance of single phase transformers.
5. Predetermine regulation, losses and efficiency of single phase transformers.
6.

UNIT–I: (10 Lectures)

Electromechanical Energy Conversion and introduction to DC machines Principles of electromechanical energy conversion - singly excited and multi excited systems

DC Generator Construction and principle of operation of DC Generator– EMF equation for generator –Excitation techniques– characteristics of DC generators –applications of DC Generators

UNIT–II: (8 Lectures)

Operation of DC motors Construction and principle of operation of DCMotorBack-emf and torque equations of dc motors – Armature reaction and commutation – characteristics of DC motors – Losses and Efficiency

Starters and its Applications Applications of DC motors.Necessity of a starter – starting by 3 point and 4-point starters.

UNIT–III: (9 Lectures)

Speed Control of motors and Testing of DC Machines Speed control of DC Motors– testing of DC machines – brake test, Swinburne's method –Hopkinson's method –field's test-Load test on DC Machines

Single-phase Transformers Types and constructional details – principle of operation –emf equation – operation on no load and on load – lagging, leading and unity power factors loads –phasor diagrams of transformers – equivalent circuit.

UNIT–IV: (9 Lectures)

Performance of transformers and auto transformers Regulation – Losses and Efficiency – effect of variation of frequency and supply voltage on losses – All Day Efficiency.

Tests on single phase transformers:open circuit and short circuit tests – Sumpner's test – separation of losses – parallel operation with equal voltage ratios – auto transformer – equivalent circuit – comparison with two winding transformers.

UNIT–V:3-Phase Transformers (9 Lectures)

Types of Polyphase connections –Relation between line and phase voltages and current in three phase tansformer- Uses of tertiary winding – Concept of Tap Changing - off load and on load tap changers – Scott connection of transformer for phase conversion.

Text Books:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers,7th edition, 2011.
2. Electric Machinery by A.E.Fitzgerald, Charleskingsley, Stephen D.Umans, TMH, 6th edition, 2003.

Reference Books:

1. Electrical Machines by D. P.Kothari, I. J. Nagarth, McGraw Hill Publications, 4th edition, 2010.
2. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition.
3. Electrical Machinery by AbijithChakrabarthi and SudhiptaDebnath, McGraw Hill, 1st edition.
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 4th edition, 2010.
5. Electric Machines by MulukutlaS.Sarma&MukeshkPathak, CENGAGE Learning, 1st edition, 2008.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons, 1st edition, 2009.

Web Resources:

1. `https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm`

2. https://b-ok.cc/book/1268675/9b2a83
3. https://b-ok.cc/book/3558383/6a6c16
4. https://www.emfields-solutions.com/
5. https://www.electrical4u.com
6. https:indiabix.com
7. http://www.ece.uah.edu

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET04	Power System-I	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power Systems

Course Objectives: The student will be able

1. To study the principle of operation of different components of a thermal power and hydro electric power plant.
2. Tostudytheworkingprincipleofnuclearpowerplant.
3. To study the constructional and operation of air and gas Insulated substations.
4. To study the constructional details of different types of cables and power factor.
5. To study the different types of load curves and tariffs applicable to consumers

Course Outcomes: After going through this course the student will be able to

1. Able to understand the of thermal powerplants.
2. Able to understand the working principle of nuclear powerplant.
3. Able to understand the different types of cables and power factor.
4. Able to understand the constructional and operation of air and gas Insulated substations.
5. Able to understand the different types of load curves and tariffs applicable to consumers

UNIT–I: Hydroelectric Power Stations: (9 Lectures)

Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation **Thermal Power Stations** Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

UNIT–II: Nuclear Power Stations (8 Lectures)

Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

UNIT–III: Classification of Air and Gas Insulated substations (9 Lectures)

Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, installation and maintenance of GIS, comparison of air insulated substations and gas insulated substations.

UNIT–IV: Power factor (9 Lectures)

Power factor, Power factor triangle, Causes of low power factor, Disadvantages of low power factor, Power factor improvement, Power factor improvement equipment, Calculations of power factor correction.

Underground Cables Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables.

UNIT–V:Economic Aspects of Power Generation & Tariff (10 Lectures)

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– costs of generation and their division into fixed, semi-fixed and runningcosts, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, blockrate,two-part, three–part, and power factor tariff methods.

Text Books:

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd, 2016.
2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3rd edition.

Reference Books:

1. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi, 2009.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL01	Electrical Circuits Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: ELECTRICAL CIRCUITS

Course Objectives:

1. To verify Kirchhoff's laws.& demonstrate various theorems
2. To find the Resonance frequency for Series and Parallel RLC Circuit
3. To determine the various parameters of a two port networks
4. To determine Parameters of a choke coil.

Course Outcomes: At the end of the course student can able to

1. Apply Kirchhoff's laws &various theorems
2. Determination of Series and Parallel RLC Circuit
3. Two port parameters of a given electric circuits
4. Determine Parameters of a choke coil.

(Out of 14 Any 10 of the following experiments are to be conducted)

1. Verification of Kirchhoff's circuit laws.
2. Verification of Superposition theorem
3. Verification of Thevenin's and Norton's Theorems
4. Verification of Maximum power transfer theorem
5. Verification of Compensation theorem
6. Verification of Reciprocity and Millman's Theorems
7. Series and parallel resonance
8. Determination of Impedance (Z) and Admittance (Y) Parameters for a two port network
9. Determination of Transmission and Hybrid parameters
10. Determination of Parameters of a choke coil.
11. Determination of cold and hot resistance of an electric lamp.
12. Locus diagrams of R-L(L Variable) and R-C (C Variable) series circuits
13. Determination of self, mutual inductances and coefficient of coupling
14. Measurement of 3-phase power by two wattmeter method for unbalanced loads

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL02	Electrical Machines-I Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Electrical Circuits Lab

Learing Objectives:

1. To plot the magnetizing characteristics of DC shunt generator and understand themechanism of self-excitation.
2. To control the speed of the DC motors.
3. Determine and predetermine the performance of DC machines.
4. To pre determine the efficiency and regulation of transformers and lossess their Performance.

Course Outcomes:

1. Select range of apparatus based on the ratings of DC Machines andTransformers.
2. Determine equivalent circuit parameters of transformers
3. Evaluate the efficiency of the machine by analyzing test results
4. Study speed control methods for dc machines

Any 10 of the following experiments 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. Brake test on DC shunt motor. Determination of performancecurves.
4. Load test on DC compound generator. Determination ofcharacteristics.
5. Hopkinson's test on DC shunt machines. Predetermination ofefficiency.
6. Swinburne's test and Predetermination of efficiencies as Generatorand Motor.
7. Brake test on DC compound motor. Determination of performancecurves.
8. Load test on DC series generator. Determination of characteristics
9. O.C. & S.C. Tests on Single phase Transformer
10. Sumpner's test on single phase transformers
11. Scott connection of transformers
12. Parallel operation of Single phase Transformers

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL03	Electrical Workshop	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Engineering Physics

Course Objectives:

1. To demonstrate the usage of measuring equipment
2. To train the students in setting up simple wiring circuits
3. To impart methods in electrical machine wiring

Course Outcomes:

After the completion of the course the student should be able to:

1. Explain the limitations, tolerances, safety aspects of electrical systems and wiring.
2. Select wires/cables and other accessories used in different types of wiring

Any 10 of the following experiments are to be conducted

List of Experiments:

1. Study of various electrical tools and symbols.
2. Study various types of electrical cables/wires, switches, fuses, fuse carriers, MCB, ELCB, RCCB and MCCB with their specifications and usage.
3. Soldering and de-soldering practice.
4. Identification of various types of resistors and capacitors and understand the usage digital multi-meter.
5. Identification of various semiconductor devices.
6. Study of Moving Iron, Moving Coil, Electrodynamic and Induction type meters.
7. Fluorescent lamp wiring.
8. Wiring of lighting circuit using two-way control (stair case wiring)
9. Go down wiring/ Tunnel wiring
10. Hospital wiring.
11. Measurement of voltage, current, power in DC circuit.
12. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and energy meter for calculating Power and Power Factor.
13. Measurement of earth resistance.
14. Wiring of backup power supply for domestic Installations including inverter, battery and load.
15. Troubleshooting of domestic electrical equipment's (tube light and fan).

16. Understand the usage of CRO, function generator. & Regulated power supply and Measurement of ac signal parameters using CRO.
17. Assembling electronic components on bread board.
18. Obtain V-I characteristics of Light Emitting Diode.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES01	Skill Oriented Course-I	1	0	2	2

Internal Marks: 0 External Marks: 50

1. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.
2. For skill oriented/skill advanced course, one theory and two practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.
3. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining three 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.
4. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HOD of the Department.
5. 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. However, the department has to assign mentors in the college to monitor the performance of the students.
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, then the department shall mark overall 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. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition.
7. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency.
8. The credits will be awarded to the student upon producing the successful Course Completion Certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per college norms at the end of the semester.
9. The job-oriented skill courses may be registered at the department or at any accredited external agency.
10. A student shall submit a record/report on the on the list skills learned.

11. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report.
12. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief Controller of Examinations) and internal examiner (course instructor or mentor).
13. There are no internal marks for the job-oriented skill courses.
14. For II-I & II-II Semesters Students can register a course in below domain or any other core domain with prior written approval of Head of the Department.

    (a) Solar Cells
    (b) Electrical Vehicle Design
    (c) Electrical Auto CAD
    (d) Aurdino
    (e) Raspberry pi
    (f) Internet of Things
    (g) AI applications in Electrical Engineering
    (h) Machine Learning applications in Electrical Engineering
    (i) SciLab
    (j) LabView
    (k) MultiSim
    (l) MATLAB
    (m) Simulink
    (n) Octave

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST14	Python Programming	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: NILL

Course Objectives:

1. To read and write simple Python programs.
2. 2. To develop Python programs with conditionals and loops.
3. To define Python functions and apply OOP concept.
4. To use Python data structures — lists, tuples, dictionaries.
5. To develop GUI applications in Python.

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

1. Understand the basics of python programming.
2. Understand control flow and implement various data structures provided by python.
3. Implement packages, methods and functions.
4. Develop real-world applications using oops and exception handling.
5. Build GUI Applications in Python.

UNIT–I: (8 Lectures)

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT–II: (9 Lectures)

Types, Operators and Expressions: Types - Integers, Strings, Booleans, Expressions and order of evaluations, Control Flow- if, if-elif-else, for, while, break, continue, pass.

Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions..

UNIT–III: (10 Lectures)

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from. Import statement, name spacing,

Python packages: Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT–IV: (9 Lectures)

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.

Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

UNIT–V: **(9 Lectures)**

Brief Tour of the Standard Library & Files - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics, file operations.

Text Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2^{nd} edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/).
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Books:

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.

Web Resources:

1. `https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/`
2. `https://www.codecademy.com/learn/learn-python`
3. `https://www.codementor.io/collections/learn-python-bwbc63ulz`
4. `http://www.diveintopython3.net/`
5. `https://www.python.org/3/`
6. `https://www.learnpython.org`

Course Code	Course Name	Course Structure			
		L	T	P	C
P18EET05	Electrical Machines-II	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic Electrical and Electronics Engineering, Electrical Machines-1

Course Objectives: The student will be able

1. To understand the principle of operation and performance of 3-phase induction motor.
2. To quantify the performance of induction motor and induction generator in terms oftorque and slip.
3. To understand the torque producing mechanism of a single phase induction motor.
4. To understand the principle of emf generation, the effect of armature reaction and redetermination of voltage regulation in synchronous generators.
5. To study parallel operation and load sharing of synchronous generators.
6. To understand the operation, performance and starting methods of synchronous Motors

Course Outcomes: After going through this course the student will be able to

1. Explain the operation and performance of three phase induction motor..
2. Analyze the torque-speed relation, performance of induction motor and induction generator.
3. Implement the starting of single phase induction motors.
4. Develop winding design and predetermine the regulation of synchronous generators.
5. Explain hunting phenomenon, implement methods of staring and correction of powerfactor with synchronous motor.

UNIT–I: (8 Lectures)

3-phase induction motors Construction details of squirrel cage and slip ring induction motors – production of rotatingmagnetic field – principle of operation – slip speed ,slip, rotor emf - rotor frequency – rotor current and pf at standstill and during running conditions - rotor power input, rotor copper loss and mechanical power developed and their interrelationship, – Equivalent circuit –phasor diagram

UNIT–II: (10 Lectures)

Characteristics and testing methods of induction motors Torque equation – expressions for maximum torque and starting torque and Their inter relations – torque slipcharacteristics – double cage and deep bar rotors – crawling and cogging – speed control ofinduction motor with V/f control method – no load and blocked rotor tests – circle diagramfor predetermination of performance-Numerical problems. – induction generator operation

UNIT–III: **(9 Lectures)**

Starting methods of 3-phase induction motors Methods of starting of three phase Induction motors: DOL, Auto transformer, Star-Delta, starter resistance and rotor resistance methods. **Single phase induction motors:** Constructional features- problem of starting-double revolving field theory- equivalent circuit- Methods of starting. AC series motors.

UNIT–IV: **(9 Lectures)**

Construction, operation, voltage regulation and parallel operation of synchronous generator: Constructional features of non-salient and salient pole machines –types of armature windings – distribution, pitch and winding factors – E.M.F equation –improvements of waveform and armature reaction –phasor diagrams-voltage regulation by synchronous impedance method – MMF method and Potier triangle method– two reaction analysis of salient pole machines and phasor diagram. Parallel operation with infinite bus and other alternators – synchronizing power – loadsharing.

UNIT–V: **(9 Lectures)**

Synchronous motor – operation, starting and performance Synchronous motor principle and theory of operation – phasor diagram – starting torque – variation of current and power factor with excitation – capability curves - synchronous condenser – mathematical analysis for power developed – hunting and its suppression – methods of starting – applications.

Text Books:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald, Charles Kingsley, Stephen D.Umans, TMH

Reference Books:

1. Performance and design of AC machines – M.G. Say
2. Alternating Current Machines by A.F.Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House
3. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 2010.
4. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee13/preview

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET06	Power Systems-II	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power systems- I

Course Objectives: The student will be able

1. To compute inductance/capacitance of transmission lines and to understand the concepts ofGMD/GMR.
2. To study the short, medium and long length transmission lines, their models and performance.
3. To study the effect of travelling waves on transmission lines.
4. To study the factors affecting the performance of transmission lines
5. To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

Course Outcomes:

1. EAble to understand parameters of various types of transmission lines during different operatingconditions.
2. Able to understand the performance of short, medium and long transmissionlines.
3. Student will be able to understand travelling waves on transmissionlines.
4. Will be able to understand various factors related to charged transmissionlines.
5. Will be able to understand sag/tension of transmission lines and performance of line insulators.

UNIT–I: Transmission Line Parameters (10 Lectures)

Calculation of Resistance,Inductance Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase 2 wire systems– Concept of GMD andGMR –Three phase Inductance calculations for Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors-Numerical Problems

Calculation of Capacitance Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Three phase Capacitance calculations for symmetrical andasymmetrical conductor configuration with and without transposition - NumericalProblems.

UNIT–II: Performance of Short, Medium and Long Transmission Lines (10 Lectures)

Performance of Short, Medium Transmission Lines Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks– Numerical Problems– Mathematical Solutions to estimate regulation and efficiency of all types of lines.

Performance of Long Transmission Lines Long Transmission Line–Rigorous Solution – Interpretation of the Long Line Equations, —Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves -Numerical Problems

UNIT–III: (8 Lectures)

Power System Transients

Types of System Transients - Travelling or Propagation of Surges Def ofIncident, Reflected and Refracted Waves– Attenuation–Distortion– Reflection and Refraction Coefficients Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT–IV: (8 Lectures)

Various Factors governing the Performance of Transmission line

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current

Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss-Radio Interference.

UNIT–V: Sag and Tension Calculations and Overhead Line Insulators

(9 Lectures)

Sag and Tension Calculations

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor–Numerical Problems – Stringing chart and sag template and its applications

Overhead Line Insulators Types of Insulators – String efficiency and Methods for improvement– Numerical Problems – Voltage distribution-Capacitance grading and Static Shielding.–Calculation of string efficiency-

Text Books:

1. Electrical power systems – by C.L.Wadhwa, New Age International (P) Limited, Publishers,1998.
2. Modern Power System Analysis by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2ndEdition.

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies,4thedition
2. Power System Analysis and Design by B.R.Gupta, WheelerPublishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.BhatnagarA.Chakrab DhanpatRai & Co Pvt. Ltd.
4. Electrical Power Systems by P.S.R. Murthy,B.S.Publications.

Web Resources:

1. www.nptel.iitm.ac.in
2. www.electrical4u.com
3. www.easyengineering.net

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET07	Electrical Measurements & Insrumentation	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Basic Electrical Engineering

Course Objectives: The student will be able

1. To study the principle of operation and working of different types of instruments for measurement of Electrical Quantities.
2. To study the working principle of operation of different types of instruments for measurement of power and power factor and Energy meter.
3. To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
4. To understand the principle of operation and working of transducers.
5. To study the principle of operation and working of DVMS, Power analyzer and applications of CRO.

Course Outcomes: After the completion of the course the student should be able to:

1. Choose right type of instrument for measurement of ac and dc Electrical quantities.
2. Choose right type of instrument for measurement of power and power factor.
3. Select right type for measurement of R, L,C.
4. Understand the effectiveness of Transducer.
5. Able to understand Digital Meters.

UNIT–I: Analog Ammeter and Voltmeters (8 Lectures)

Classification – deflecting, control and damping torques,– PMMC, moving iron type and electrostatic instruments, Construction, Torque equation, Range extension, Effect of temperature, Errors and compensations, advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer-construction, theory, errors.

UNIT–II: Analog Wattcmeters and Power Factor Meters and Energy meter. (10 Lectures)

Electrodynamometer type wattmeter (LPF and UPF), Power factor meters and frequency meters: Dynamometer and M.I type (Single phase and three phase), construction, theory, torque equation, advantages and disadvantages. Construction of working principle of energy meters and errors

UNIT–III: Measurements of Electrical parameters (10 Lectures)

DC Bridges: Method of measuring low, medium and high resistance – sensitivity

of Wheat stone's bridge, Kelvin's double bridge for measuring low resistance, Loss of charge method for measurement of high resistance, Megger – measurement of earth resistance - Numerical Problems.

AC Bridges: Measurement of inductance – quality factor, Maxwell's bridge, Hay's bridge, Anderson's bridge, and measurement of capacitance and loss angle, Desauty's bridge, Schering Bridge, Wien's bridge- Numerical Problems.

UNIT–IV: Transducers (9 Lectures)

Definition, Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers, Digital shaft encoders, Hall effect sensors.

UNIT–V: Digital meters (8 Lectures)

Sag and Tension Calculations 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.

Text Books:

1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrickand W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.SawhneyDhanpatRai& Co.Publications.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
3. Electrical Measurements by Buckingham and Price, Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. Electrical Measurements: Fundamentals, Concepts, Applications by Reissland, M.U, New Age International (P) Limited, Publishers.
6. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL04	Electrical Machines - II Laboratory	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Electrical Machines - I

Course Objectives:

1. To control the speed of three phase induction motors.
2. To determine /predetermine the performance three phase and single phase induction motors.
3. To improve the power factor of single phase induction motor .
4. To predetermine the regulation of three–phase alternator by various methods, find Xd/ Xq ratio of alternator and asses the performance of three–phase synchronous motor

Course Outcomes: At the end of the course student can able to

1. Assess the performance of single phase and three phase induction motors.
2. Control the speed of three phase induction motor.
3. Predetermine the regulation of three–phase alternator by various methods.
4. Find the Xd/ Xq ratio of alternator and asses the performance of three–phase synchronous motor.
5. Determine the performance single phase AC series motor.

LIST OF EXPERMENTS

1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance &m.m.f. Methods
4. Regulation of three–phase alternator by Potier triangle method
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of Xd and Xq of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three-phase alternator by loading with three phase induction motor.
10. Power factor improvement of single-phase induction motor by using capacitors and load test on single-phase induction motor.
11. Parallel operation of three-phase alternator.
12. Brake test on single-phase AC series Motor.

13. Starting methods of a capacitor start and capacitor start run single-phase Induction motor.
14. Brake test on single-phase Induction Motor.

Course Code	Course Name	Course Structure			
P21EEL05	Electrical Measurements & Insrumentation Laboratory	L	T	P	C
		0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Electrical Measurements

Course Objectives:

1. To understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
2. To understand the calibration of DC and AC Potentiometers.
3. To understand the testing of CT and PT.
4. To Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer.
5. To understand the measurement of strain, Phase difference and frequency

Course Outcomes: At the end of the course student can able to

1. Measure the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
2. Known the characteristics of transducers.
3. Measure the strains, frequency and phase difference.

LIST OF EXPERMENTS

1. Calibration of dynamometer wattmeter using phantom loading
2. Crompton D.C. Potentiometer - Calibration of PMMC ammeter and PMMC voltmeter
3. Kelvin's double Bridge - Measurement of resistance - Determination of tolerance. Methods
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Calibration of LPF Wattmeter – by direct loading.
7. Equivalent circuit of single phase induction motor
8. testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
9. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
10. Calibration of Energy meter using phantom loading.
11. Measure the reactive power with 3 phase load.

12. LVDT – characteristics.
13. Capacitive transducers characteristics.
14. Piezoelectric transducer characteristics.
15. Measurement of strain using strain gauge.
16. Measurement of phase difference.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES03	Skill Oriented Course-II	1	0	2	2

Internal Marks: 0 External Marks: 50

1. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.
2. For skill oriented/skill advanced course, one theory and two practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.
3. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining three 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.
4. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HOD of the Department.
5. 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. However, the department has to assign mentors in the college to monitor the performance of the students.
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, then the department shall mark overall 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. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition.
7. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency.
8. The credits will be awarded to the student upon producing the successful Course Completion Certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per college norms at the end of the semester.
9. The job-oriented skill courses may be registered at the department or at any accredited external agency.
10. A student shall submit a record/report on the on the list skills learned.

11. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report.
12. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief Controller of Examinations) and internal examiner (course instructor or mentor).
13. There are no internal marks for the job-oriented skill courses.
14. For II-I & II-II Semesters Students can register a course in below domain or any other core domain with prior written approval of Head of the Department.

    (a) Solar Cells
    (b) Electrical Vehicle Design
    (c) Electrical Auto CAD
    (d) Aurdino
    (e) Raspberry pi
    (f) Internet of Things
    (g) AI applications in Electrical Engineering
    (h) Machine Learning applications in Electrical Engineering
    (i) SciLab
    (j) LabView
    (k) MultiSim
    (l) MATLAB
    (m) Simulink
    (n) Octave

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET08	Power Electronics	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Semi Conductor Devices, Mathematics, Control Systems

Course Objectives: The student will be able

1. To study the characteristics of various power semiconductor devices and firing circuits for SCR
2. To Understand the operation of single- phase AC-DC half wave and full–wave converters and perform harmonic analysis of input current
3. TTo Understand the operation of three phase AC-DC half wave and full–wave converters and single-phase AC/AC converters
4. To Understand the operation of different types of DC-DC converters
5. To learn the operation of PWM inverters for voltage control and harmonic mitigation

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

1. Explain the characteristics of various power semiconductor devices and analyze the static and dynamic characteristics of SCR and design firing circuits of SCR. characteristics of power MOSFET and IGBT.
2. Explain the operation of phase-controlled rectifiers.
3. Analyze the operation of three-phase full–wave converters and AC Voltage Controllers.
4. Analyze the operation and design of different types of DC-DC converters
5. Explain the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.

UNIT–I: (8 Lectures)

Power Semi-Conductor Devices: Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design. Static and Dynamic Characteristics of Power MOSFET and Power IGBT.

UNIT–II: (10 Lectures)

Single-phase AC-DC Converters: Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load&RLE load – Continuous conduction and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE load– Continuous and Discontinuous conduction - Harmonic Analysis - Dual converter and its mode of operation -Numerical Problems.

UNIT–III: (10 Lectures)

Three-phase AC-DC Converters & AC – AC Converters: Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis- Numerical Problems .Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage -Single-phase step down and step up Cycloconverter Numerical Problems.

UNIT–IV: (8 Lectures)

DC-DC Converters: Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple – control techniques – Introduction to PWM control -Numerical Problems.

UNIT–V: (9 Lectures)

DC–AC Converters: Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 1200 conduction and 1800 conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Text Books:

1. EPower Electronics: Converters, Applications and Design, Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.
2. Power Electronics: Circuits, Devices and Applications,M. H. Rashid, 2nd edition, Prentice Hall of India, 1998.
3. Power Electronics: Essentials and Applications, L. Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Elements of Power Electronics, Philip T.Krein, 2nd Edition, Oxford University Press, 2017.
2. Power Electronics, Dr. P.S. Bimbhra, 6th Edition, Khanna Publishers, 2018.
3. Thyristorised Power Controllers, R.M.K. Sinha,A. Joshi, S.R. Doradla, G. K. Dubey, 2nd Edition, New Age International (P) Ltd., 2012.
4. Power Electronics, Daniel W. Hart, 1st Edition, McGraw-Hill, 2011.

Web Resources:

1. `https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm`
2. `https://www.electrical4u.com`
3. `http://www.ece.uah.edu`

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET09	Control Systems	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Engineering Mathematics

Course Objectives: The student will be able

1. To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function.
2. To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers. To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
3. To understand basic aspects of design and compensation of LTI systems using Bode diagrams.
4. To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
5. To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

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

1. Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
2. Determine time response specifications of second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.
3. Analyze the stability of LTI systems using frequency response methods.
4. Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode diagrams.
5. Represent physical systems as state models and determine the response. Understand the concepts of controllability and observability.

UNIT–I: (10 Lectures)

M**athematical Modelling of Control Systems:** Classification of control systems- open loop and closed loop control systems and their differences - Feedback characteristics - transfer function of linear system, differential equations of electrical networks translational and rotational mechanical systems - transfer function of DC servo motor- AC servo motor - Mathematical Modelling of synchro transmitter and receiver -block diagram algebra - signal flow graph – reduction using Mason's gain formula.

UNIT–II: (10 Lectures)

Time Response Analysis and Controllers: Time response of first and second order systems – time domain specifications - steady state errors and error constants

- effects of proportional (P) - proportional integral (PI) - proportional derivative (PD) - proportional integral derivative (PID) systems.

Stability Assessment Techniques : The concept of stability – Routh's stability criterion – limitations of Routh's stability, root locus concept – construction of root loci (simple problems) - Effect of addition of Poles and Zeros to the transfer function

UNIT–III: (8 Lectures)

Frequency Response Analysis: Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –Polar plots, Nyquist stability criterion- stability analysis using Bode plots (phase margin and gain margin

UNIT–IV: (7 Lectures)

Classical Control Design Techniques: Lag, lead, lag-lead compensators - physical realisation - design of compensators using Bode plots.

UNIT–V: (10 Lectures)

State Space Analysis of Linear Time Invariant (LTI) Systems: Concepts of state - state variables and state model - state space representation of transfer function -Transfer function from state space representation, solving the time invariant state equations - State Transition Matrix and its properties- concepts of controllability and observability.

Text Books:

1. Control Systems Engineering, I. J. Nagrath, M. Gopal, 5th Edition, New Age International (P) Ltd., 2007.
2. Modern Control Engineering, Katsuhiko Ogata, 5 th edition, Prenties-Hall India Pvt. Ltd., 2010.

Reference Books:

1. Control Systems Principles & Design, M.Gopal, 4th Edition, McGraw-Hill, 2012.
2. Automatic Control Systems, B. C. Kuo, Farid Golnaraghi, 8th Edition, John wiley & sons, 2003

Web Resources:

1. Swayam.gov.in
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm
3. https://www.youtube.com/watch?v=XMfH2P2Fc6Q

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT04	Pulse and Digital Circuits	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electronic Devices and Circuits, Network Analysis.

Course Objectives: The student will be able

1. To understand the Complete Response of R-C and R-L-C transient circuits.
2. Understand the concepts of wave shaping it's for any application.
3. To design various Multivibrators using Transistors and Sampling Gates.
4. To Introduce to Time-base Generators in sweep signal generation.
5. To discuss and realize the Logic Gates using Diodes and Transistors.

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

1. Explain the Complete Response of R-C and R-L-circuit.
2. Analyze the responses of sinusoidal and non-sinusoidal signals to various responses.
3. Demonstrate the concept of switching characteristics of diodes and transistors.
4. Construct the various Multivibrators Using Transistors and demonstrate time base generators.
5. Discuss and realize the Logic Gates using Diodes and Transistors.

UNIT–I: (8 Lectures)

Linear Wave Shaping: High pass, low pass RC circuits, their Response for Sinusoidal, Step, Pulse, Square, and Ramp inputs. High pass RC Network as Differentiator and Low pass RC circuit as an integrator, Attenuators and its application as a CRO, RL and RLC circuits and their response for step input.

UNIT–II: (10 Lectures)

Non-Linear Wave Shaping: Diode as a switch, Piece Wise Linear Diode Characteristics, Diode clippers, Transistor clippers, clipping at two independent levels, Comparators, applications of voltage comparators, Clamping operation, clamping circuits taking source and diode resistances taking into account, Clamping circuit theorem.

UNIT–III: (10 Lectures)

Multivibrators: Transistor as a switch, break down voltages, Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger circuit using BJT.

Sampling Gates: Basic Operating Principles of Sampling Gates, Diode Unidirectional Sampling Gate and Two-Diode Bi-Directional Sampling Gate, Four- Diode gates, Six-Diode Gates, Applications of Sampling Gates.

UNIT–IV: **(8 Lectures)**

Time Base Generators: General features of a time base signal, Methods of generating time base waveform, Sweep generation by UJT, basic principles in Miller and Bootstrap time base generators, Transistor Miller time base generator, Transistor Bootstrap time base generator, Transistor current time base generators.

UNIT–V: **(9 Lectures)**

Logic Families: Realization of digital logic gates with Diode Logic, Transistor Logic, Diode- Transistor Logic, Resistor Transistor Logic Transistor-Transistor Logic, Emitter Coupled Logic, CMOS logic, Comparison of Digital Logic Families.

Text Books:

1. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, Mothiki S Prakash Rao McGraw-Hill, 2nd Edition, 2007.
2. Solid State Pulse circuits - David A. Bell, PHI, 4th Edition, 2002..

Reference Books:

1. Integrated electronics, Jacob Miman, Christos, C. Halkias, 2nd Edition, Tata McGraw Hill Publication, 2017.
2. Pulse and Digital Circuits, A. Anand Kumar, 2nd Edition, PHI, 2005
3. Fundamentals of Pulse and Digital Circuits, Ronald J. Tocci, 3rd Edition, PHI, 2008.

text Web Resources:

1. www.npteliitm.ac.in
2. www.modernelectronics.org
3. www.electronicsforyou.com

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP01	Renewable Energy Sources	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power Systems - I

Course Objectives: The student will be able

1. To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
2. To study solar thermal collections.
3. To study solar photo voltaic systems.
4. To study maximum power point techniques in solar pv and wind energy.
5. To study wind energy conversion systems, Betz coefficient, tip speed ratio, basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

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

1. Analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
2. Explain solar thermal collectors, solar thermal plants.
3. Design solar photo voltaic systems.
4. Develop maximum power point techniques in solar PV and wind energy systems.
5. Explain wind energy conversion systems, wind generators, basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

UNIT–I: (9 Lectures)

Fundamentals of Energy Systems and Solar energy: Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation: Outside earth's atmosphere – Earth surface - Radiation on tilted surfaces.

UNIT–II: (9 Lectures)

Solar Thermal Systems: Liquid flat plate collectors: Performance analysis –Transmissivity– Absorptivity product collector efficiency factor – Collector heat removal factor. Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants..

UNIT–III: (9 Lectures)

Solar Photovoltaic Systems: Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications. System design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique – Hill climbing technique.

UNIT–IV: **(9 Lectures)**

Wind Energy: Sources of wind energy - Wind patterns –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

UNIT–V: **(9 Lectures)**

Tidal, Biomass, fuel cells and geothermal power systems: Tidal power: Basics – Kinetic energy equation. Wave power: Basics – Kinetic energy equation. **Biomass Energy:** Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing. **Fuel cell:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics. **Geothermal:** Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation.

Text Books:

1. Renewable Energy Resources, John Twidell, Tony Weir, 2nd Edition, Taylor and Francis, 2013.

Reference Books:

1. Energy Science: Principles, Technologies and Impacts, John Andrews, Nicholas Alfred Jelley, Nick Jelley, 3rd Edition, Oxford University Press, 2017
2. Renewable Energy, Godfrey Boyle, 3rd Edition, Oxford University Press, 2010.
3. Handbook of Renewable Technology, Ahmed F Zobaa, Ramesh C Bansal, World Scientific, Singapore, 2011.
4. Renewable Energy Technologies: Ocean Thermal Conversion and Other sustainable Energy Option, R. Ramesh, K. Uday Kumar, M. Anandakrishnan, Narosa Publishing House, 1997.
5. Renewable Energy Technologies - A Practical Guide for Beginners, Chetong Singh Solanki, Prentice Hall India Learning Private Ltd., 2008.
6. Non conventional energy source, B.H.khan, 2nd edition, McGraw-Hill, 2009.

text Web Resources:

1. www.npteliitm.ac.in
2. https://www.energy.gov/eere/renewable-energy
3. https://www.edfenergy.com/energywise/renewable-energy-sources

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP02	Energy Audit, Conservation & Management	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power Systems

Course Objectives: The student will be able

1. To understand energy efficiency, scope, conservation and technologies.
2. To design energy efficient lighting systems.
3. To estimate/calculate power factor of systems and propose suitable compensation techniques.
4. To understand energy conservation in Space Heating and Ventilation – Air–Conditioning systems.
5. To calculate life cycle costing analysis and return on investment on energy efficient technologies.

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

1. Explain energy efficiency, conservation and various technologies.
2. Design energy efficient lighting systems.
3. Calculate power factor of systems and propose suitable compensation techniques.
4. Explain energy conservation in Space Heating and Ventilation – Air–Conditioning systems.
5. Calculate life cycle costing analysis and return on investment on energy efficient technologies.

UNIT–I: (10 Lectures)

General Concepts of Energy Auditing: Basic Principles of Energy Audit and management Energy audit – Definitions – Concept – Types of audit – Energy index – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential– Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions –home energy audit.

UNIT–II: (8 Lectures)

Energy Efficient Lighting System: Lighting Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units –Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservations.

UNIT–III: (9 Lectures)

Power factor improvement: Power Factor and energy instruments Power factor – Methods of improvement – Location of capacitors – Power factor with nonlinear loads -Energy Instruments – Smart Watt–hour meter – Data loggers –Pyrometers – Lux meters – Tong testers – Power analyzer.

UNIT–IV: (8 Lectures)

Energy efficiency in Space Heating and Ventilation-Air-Conditioning systems: Space Heating and Ventilation – Air–Conditioning and Water Heating: Introduction – Heating of buildings – Transfer of Heat–Space heating methods – Ventilation and air–conditioning – Insulation–Cooling load – Electric water heating systems – Energy conservation in heating and cooling to domestic loads methods.

UNIT–V: (10 Lectures)

Economic Aspects and Financial Analysis: Economic Aspects and Analysis 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).Computation of Economic Aspects Calculation of simple payback method – Net present worth method, Case study in Energy auditing in home.

Text Books:

1. Energy Management, W.R. Murphy, G. A. Mckay,2nd Edition, Butterworth, Gurgaon Haryana. 2009.
2. Energy Efficient Electric Motors, To John.C, Andreas, 2nd edition, Marcel Dekker Inc Ltd, 2005.

Reference Books:

1. Electric Energy Utilization and Conservation, S. C. Tripathy, Tata McGraw Hill Ltd, 1991.
2. Energy Management, Paul O Callaghan, 1st Edition, Mc–Graw Hill, 1998.
3. Energy Management Hand Book, Steve Doty, W.C.Turner, 8th Edition, Fairmont Press, 2012.
4. Energy Management and Conservation, k v Sharma, P Venkataseshaiah, 0th Edition, I K International Publishing House, 2011.

text Web Resources:

1. https://iare.ac.in/sites/default/files/iare_EAM_lecture%20notes.pdf
2. https://www.jntufastupdates.com/jntuk-r16-3-2-eacm-material-pdf/

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP03	Electrical Machine Modelling	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Machines.

Course Objectives:

1. Unified theory of rotating machines.
2. The concept of phase transformation.
3. Mathematical modeling of machines single phase induction.
4. Develop concepts on mathematical modeling of electrical machines.
5. Analyze BLDC machine and switched reluctance machine based on mathematical modeling of BLDC and SRM.

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

1. Discuss about the basic concepts of machine modeling.
2. Develop mathematical model of dc motor.
3. Acquire knowledge on the abc to dq0 and dq0 to abc ransformations to develop mathematical model of single-phase induction machine..
4. Design control strategies based on dynamic modeling of 3-ph Induction machines and 3-phase synchronous machine.
5. Model synchronous machine and special electrical machines.

UNIT–I: (9 Lectures)

Basic concepts of Modeling: Magnetically coupled circuits, review of basic concepts, magnetizing inductance, electromechanical energy conversion. Basic Two-pole Machine ,representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

UNIT–II: (9 Lectures)

DC Machine Modeling: Mathematical model of separately excited D.C Motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor and Compound Motor-Linearization Techniques for small perturbations.

UNIT–III: (9 Lectures)

Reference frame theory & Modeling of single phase Induction Machines: Linear transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation dq0 to abc -Power equivalence- Mathematical modeling of single phase induction machines Variables observed from various frames of reference.

UNIT–IV: **(9 Lectures)**

Modeling of Three Phase Induction Machine: Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables. Two axis models for induction motor-d-q model based DOL starting of Induction Motors.

UNIT–V: **(9 Lectures)**

Modeling of Synchronous Machine & Special Machines: Circuits model of a 3-phase synchronous motor–Two axis representation of synchronous motor Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame electromagnetic torque-current in terms of flux linkages-three phase synchronous machine model. Modeling of PM Synchronous motor, modeling of BLDC motor and modeling of Switched Reluctance motor.

Text Books:

1. Generalized theory of Electrical Machinery, P.S.Bimbra, 7th Edition, Khanna Publishers, 2021.
2. Analysis of Electric Machinery and Drives Systems, Oleg Wasynczuk, Paul C. Krause, Scott D. Sudhoff, Steven D. Pekarek, 3rd Edition, Wiley-IEEE Press, 2013.
3. Eectric Motor Drives - Modeling, Analysis & Control, R. Krishnan, 1st Edition, Pearson Publications, 2001.

Reference Books:

1. Eectric Motor Drives - Modeling, Analysis & Control, R. Krishnan, PHI Learning Private Ltd, 2009.
2. Analysis of Electric Machinery and Drive Systems, Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, John Wiley & Sons, New York, 2004.
3. Power System Stability & Control, P. Kundur, 5th Edition, Tata Mcgraw Hill, 2008.

text Web Resources:

1. https://nptel.ac.in/courses/108106023
2. https://www.mdpi.com/1996-1073/16/2/654
3. https://ideas.repec.org/a/gam/jeners/v16y2023i2p654-d1026163.html

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP04	Fundamentals of Electrical Vehicles	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Circuits, Engineering Physics

Course Objectives:

1. To familiarize the students with the need and advantages of electric vehicles(EV).
2. To understand various power converters used in electric vehicles.
3. To familiar with different types of motors suitable for electric vehicles.
4. To have knowledge on latest developments in storage systems.
5. now various architecture of hybrid electric vehicles.

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

1. Illustrate different types of electric vehicles.
2. Select suitable power converters for EV applications.
3. Choose an effective motor for EV applications.
4. Analyse a battery management system for EV.
5. Design HEV configuration for a specific application.

UNIT–I: (9 Lectures)

Introduction: Introduction to Fundamentals of Vehicles - Components of conventional vehicles - drawbacks of conventional vehicles – Need for electric vehicles - History of Electric Vehicles – Types of Electric Vehicles – Advantages and applications of Electric Vehicles.

UNIT–II: (9 Lectures)

Power Electronics Converters for EVs: Components of Electric Vehicles– Power Converters - Controller and Electric Traction Motor – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.

UNIT–III: (9 Lectures)

Special Machines for EVs: Motors for Electric Vehicles - Characteristics of traction drive - Requirements of electric machines for EVs – Different motors suitable for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only)

UNIT–IV: (9 Lectures)

Energy Sources for EVs: Energy Sources for Electric Vehicles Batteries - Types of Batteries – Lithium-ion - Nickel-metal hydride - Lead-acid – Comparison of Batteries - Battery Management System – Ultra capacitors – Flywheels – Fuel Cell – it's working

UNIT–V: **(9 Lectures)**

Hybridization of Automobiles: Hybrid Electric Vehicles - Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs - Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples - Merits and Demerits.

Text Books:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003.
2. Electric and hybrid vehicles, Denton Tom, Routledge, 2020.

Reference Books:

1. Power Converters for Electric Vehicles, Kumar L, Ashok, S. Albert Alexander, CRC Press, 2020.
2. Electric Vehicle Machines and Drives: Design - Analysis and Application, Chau - Kwok Tong, John Wiley & Sons, 2015.
3. Batteries for Electric Vehicles: Materials and Electrochemistry, Berg Helena, Cambridge University Press, 2015.
4. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, 2014.

text Web Resources:

1. https://nptel.ac.in/courses/108106170
2. https://www.udemy.com/course/fundamentals-of-electric-vehicles/
3. https://indianinstituteofsolarenergy.com/courses/fundamentals-of-electric-vehicle-technology/

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL06	Power Electronics Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Power Electronics

Course Objectives:

1. To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
2. To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
3. To understand the operation of AC voltage regulator with resistive and inductive Loads.
4. To understand the working of Buck converter, Boost converter
5. To understand the working of series, parallel and PWM inverter.

Course Outcomes: At the end of the course student can able to

1. Analyse characteristics of various power electronic devices and design firing circuits for SCR.
2. Analyse the performance of single–phase ,three–phase full–wave bridge converters with both resistive and inductive loads.
3. Examine the operation of Single-phase AC voltage regulator and Cycloconverter with resistive and inductive loads.
4. Differentiate the working and control of Buck converter and Boost converter.
5. Differentiate the working & control of Square wave inverter and PWM inverter.

LIST OF EXPERMENTS (Any 10 of the following are to be conducted)

1. Study of Characteristics of Thyristor, MOSFET &IGBT.
2. Study of firing circuits for Thyristor.
3. Study of gate drive circuits for IGBT.
4. Single -Phase Half controlled converter with R and RL load.
5. Single -Phase fully controlled bridge converter with R and RL.
6. Single -Phase AC Voltage Regulator with R and RL Loads.
7. Single -Phase square wave bridge inverter with R and RL Loads.
8. Three- Phase fully controlled converter with RL–load..
9. Design and verification of voltages gain of Boost converter.
10. Design and verification of voltages ripple in buck converter.
11. 3-phase AC-AC voltage regulator with R-load.
12. Single -Phase series inverter with R and RL Loads.
13. Single Phase PWM Inverter.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL07	Control Systems Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Control Systems

Course Objectives:

1. Impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors and Synchros.
2. To understand the time response of control system and time domain specifications.
3. o understand the frequency response of control system with and without controllers and compensators.
4. To understand the stability in time and frequency domain using MATLAB and also to study the logic gates using PLC.
5. To understand the concept of transfer function for DC Motor

Course Outcomes: After going through this course, student can able to

1. Analyze the performance and working Magnetic amplifier, D.C and A.C. Servo motors and Synchros.
2. Determine the time domain specifications of given system.
3. Design P,PI,PD,PID controllers & Lag, Lead, Lead-Lag compensators and Evaluate the temperature control of an oven using PID controller.
4. Judge the stability in time & frequency domain using MATLAB and also examine different logic gates using PLC.
5. Determine the transfer function of DC Motor.

LIST OF EXPERMENTS (Any 10 of the following are to be conducted)

1. Time response of Second order system.
2. Characteristics of Synchros.
3. Effect of P, PD, PI, PID Controller on a second order systems.
4. Design of Lag and lead compensation – Magnitude and phase plot.
5. Transfer function of DC motor.
6. Bode Plot, Root locus, Nyquist Plots for the transfer functions of systems up to 5th order using MATLAB
7. Controllability and Observability Test using MAT LAB.
8. Temperature controller using PID.

9. Characteristics of magnetic amplifiers.
10. Characteristics of AC servo motor.
11. Characteristics of DC servo motor.
12. Study and verify the truth table of logic gates and simple Boolean expressions using PLC.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES03	Skill Oriented Course-III	1	0	2	2

Internal Marks: 0 External Marks: 50

Course Prerequisite: No Prerequisite

Course Objectives:

1. To train the students with job oriented skills.

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

1. Apply the job oriented skills learned during the course in real-life problems.
2. Communicate the skills effectively acquired during the course.

Course Objective & Course Outcomes will be vary according to the student's opted course.

1. skill-advanced courses either from the same domain
   (a) Solar Cells
   (b) Electrical Vehicle Design
   (c) Electrical Auto CAD
   (d) Aurdino
   (e) Raspberry pi
   (f) Internet of Things
   (g) AI applications in Electrical Engineering
   (h) Machine Learning applications in Electrical Engineering
   (i) SciLab
   (j) LabView
   (k) MultiSim
   (l) MATLAB
   (m) Simulink
   (n) Octave
2. job-oriented skill courses of inter disciplinary nature
   (a) Python for the AI
   (b) Machine Learning
   (c) Deep Learning
   (d) Data Science
   (e) Artificial Neural Network

(f) Natural Language Processing

(g) Full stack development

(h) Azure

(i) Microsoft Administrator

Course Code	Course Name	Course Structure			
		L	T	P	C
P21XXXXX	Professional Ethics and Human Values	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: None

Course Objectives:

1. To introduce the students to the Human values and help them to lead a peaceful life in the society by contributing to peace and safety in the society.
2. To help the students to know about the history of ethics and importance of social experimentation
3. To specify the students about the importance of their responsibility towards safety and risk as Engineers.
4. To specify the students about the importance of their responsibility as Engineers.
5. To help the student explore the ethical values globally.

Course Outcomes:At the end of the course, student will be able

1. To learn about the different Human values to be maintained by all the people.
2. To learn about the history of ethics and the importance of ethics for professionals and application of ethics in social experimentation.
3. To learn about the responsibilities of engineers for safety and risk.
4. To learn about the responsibilities and rights of engineers.
5. To learn about global work environment with respect to ethics.

UNIT–I: (8 Lectures)

Human Values: Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNIT–II: (10 Lectures)

Engineering Ethics: The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics - Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Engineering and Ethics-Kohlberg's Theory – Gilligan's Argument –Heinz's Dilemma.

Engineering as Social Experimentation: Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT–III: (10 Lectures)

Engineers' Responsibility for Safety and Risk: Safety and Risk, Concept of

Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk Benefit Analysis-Accidents.

UNIT–IV: (8 Lectures)

Engineers' Responsibilities and Rights: Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty - obligations of Loyalty-misguided Loyalty – professionalism and Loyalty - Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self interest, Customs and Religion- Ethical egoism-Collective bargaining Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe examples of Gifts v/s Bribes-problem solving-interests in other companies Occupational Crimes-industrial espionage-price fixing-endangering lives Whistle Blowing-types of whistle blowing-when should it be attempted preventing whistle blowing.

UNIT–V: (9 Lectures)

Global Issues: Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics computers as the instrument of Unethical behaviour-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics - Weapons Development-Ethics and Research-Analysing Ethical Problems in Research-Intellectual Property Rights.

Text Books:

1. Engineering Ethics and Human Values, M.Govindarajan, S.Natarajan, V.S. Senthil Kumar, PHI Learning Pvt. Ltd, 2009.
2. Professional Ethics and Morals, Prof.A.R.Aryasri, Dharanikota Suyodhana,Maruthi Publications.
3. Professional Ethics and Human Values, A.Alavudeen, R.Kalil Rahman, M. Jayakumaran- 1st Edition, Laxmi Publications, 2015.
4. Professional Ethics and Human Values, Prof. D.R. Kiran, 2nd Edition, McGraw Hill, 2014.

Reference Books:

1. Indian Culture, Values and Professional Ethics, PSR Murthy, 2nd Edition, BS Publication, 2013.
2. Ethics in Engineering, Mike W. Martin and Roland Schinzinger, 3rd Edition, Tata McGraw-Hill,2003.
3. Engineering Ethics, Harris, Pritchard and Rabins, India Edition, 5th Edition, Wadsworth Publishing Co Inc, 2013.

text Web Resources:

1. crescent.education/wp-content/.../12/Crescent-human-values-professional-ethics.pdf
2. https://www.crectirupati.com/.../HVPE-MBA-K%20YAMUNA-LECTURE%20NOTES
3. https://lecturenotes.in/subject/576/professional-ethics-and-human-values-pehv
4. https://nptel.ac.in/courses/109104068/30
5. https://onlinecourses.nptel.ac.in/noc18_mg25

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET11	Power System Analysis	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power Systems-I & II

Course Objectives: The student will be able

1. To develop the impedance diagram (p.u) and formation of Ybus .
2. To learn the different load flow methods.
3. To learn the Zbus building algorithm and short circuit calculation for symmetrical faults.
4. To learn the effect of unsymmetrical faults on power system.
5. To learn the stability of power systems and methods to improve stability.

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

1. Draw impedance diagram for a power system network and calculate per unit quantities.
2. Apply the load flow solution to a power system using different methods.
3. Form Zbus for a power system networks and analyse the effect of symmetrical faults.
4. Find the sequence components for power system Components and analyse its effects of unsymmetrical faults.
5. Analyse the stability concepts of a power system.

UNIT–I: (8 Lectures)

Per Unit Representation & Circuit Topology: Per Unit Quantities–Single line diagram– Impedance diagram of a power system –bus incidence matrices – Primitive network representation – Formation of Y– bus matrix by singular transformation and direct inspection methods.

UNIT–II: (9 Lectures)

Power Flow Studies: Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods (Algorithmic approach) – Numerical Problems on 3–bus system only.

UNIT–III: (9 Lectures)

Z–Bus formulation and Symmetrical: Formation of Z–Bus: Partial network– Algorithm for the Modification of Zbus Matrix(with out Mutual Impedance) for different cases– Modification of Z–Bus for the changes in network-Numerical problems.

Symmetrical Fault Analysis: Short Circuit on Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems – Numerical Problems.

UNIT–IV: (10 Lectures)

Symmetrical Components: Concept of symmetrical components – symmetrical

components of unbalanced three phase systems – Power in terms of sequence components – Sequence impedances and Sequence networks of Unloaded generator ," – Construction of Sequence Networks of a power System-Numerical Problems.

Unsymmetrical Fault analysis: Various types of faults: LG– LL– LLG Faults on unloaded alternator, Open Conductor faults -Numerical problems.

UNIT–V: (9 Lectures)

Power System Stability: Elementary concepts of Stability, Steady state – Dynamic and Transient Stabilities – Power Angle Curve - Swing equation – Equal area criterion of stability – Applications of Equal area criterion – Factors affecting transient stability – Methods to improve steady state and transient stability – Numerical problems.

Text Books:

1. Power System Analysis, Grainger and Stevenson, 1st Edition, Tata McGraw Hill, 1994.
2. Modern Power system Analysis, I.J.Nagrath, D .P.Kothari, 3rd edition, Tata McGraw Hill Publishing Company, 2007.

Reference Books:

1. Power System Analysis by HadiSaadat, 3rd edition, Tata McGraw Hill, 2010.
2. Power System Analysis and Design, J.Duncan Glover, M.S.Sarma, T.J.Overbye, 5th edition, Cengage Learning publications, 2011.

text Web Resources:

1. https://nptel.ac.in/courses/108105067
2. https://nptel.ac.in/courses/117105140
3. https://www.classcentral.com/course/swayam-power-system-analysis-14243
4. www.electrical4u.com

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET12	Switch Gear and Protection	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power Systems-II

Course Objectives:

1. To provide the basic principles and operation of various types of circuit breakers.
2. To know the classification, operation and application of different types of electromagnetic protective relays.
3. To explain protective schemes for generator and transformers.
4. To gain the knowledge of various protective schemes used for feeders and bus bars.
5. To explain the principle and operation of different types of static relays.
6. To understand different types of over voltages in a power system and principles of different neutral grounding methods.

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

1. Illustrate the principles of arc interruption for application to high voltage circuit breakers of air -oil - vacuum - SF6 gas type.
2. Analyze the working principle and operation of different types of electromagnetic protective relays.
3. Acquire knowledge of protective schemes for generator and transformers for different fault conditions.
4. Classify various types of protective schemes used for feeders and bus bar protection and types ofstatic relays and digital relays.
5. Analyze the operation of different types of over voltages protective schemes required for insulationco–ordination and types of neutral grounding.

UNIT–I: (9 Lectures)

Circuit Breakers: Application oriented evolution of Switchgear – Fuse, Miniature Circuit Breaker (MCB)– Elementary principles of arc interruption – Restriking Voltage and Recovery voltages – Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Concept of oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– Circuit Breaker ratings and specifications– Concept of Auto reclosing – Application Spectrum Numerical examples

UNIT–II: (9 Lectures)

Electromagnetic Protection: Relay connection, Properties of Relay – Balanced beam type attracted armature relay - induction disc and induction cup relays –Torque equation - Relays classification–Instantaneous, Inverse Time, DMT and

IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

UNIT–III: (9 Lectures)

Generator Protection: Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth faultand inter turn fault protection– Numerical examples.

Transformer Protection: Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

UNIT–IV: (9 Lectures)

Feeder and Bus bar Protection: Over current Protection schemes – PSM - TMS – Numerical examples – Carrier current and three zone distance relay using impedance relays. Protection of bus bars by using Differential protection.

Static Relays & Digital Relay: Static relays: Introduction – Classification of Static Relays – Basic Components of Static Relays, Microprocessor based Digital Relay.

UNIT–V: (9 Lectures)

Protection against over voltage: Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters, Insulation Coordination.

Grounding: Grounded and ungrounded neutral systems – Effects of ungrounded neutral on system performance – Methods of neutral grounding: Solid–resistance– Reactance–Arcing grounds and grounding Practices.

Text Books:

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, 3rd Edition, Tata McGraw Hill Publications, 2022.
2. Power system protection- Static Relays with microprocessor applications, T.S. Madhava Rao, 2nd Edition, Tata McGraw Hill, 2017.

Reference Books:

1. Fundamentals of Power System Protection, Paithankar, S.R.Bhide, 2nd Edition, PHI, 2010.
2. Art & Science of Protective Relaying, C R Mason, Wiley Eastern Ltd, 1966.
3. Protection and Switchgear, Bhavesh Bhalja, R.P. Maheshwari, Nilesh G.Chothani, 2nd Edition, Oxford University Press, 2018.

text Web Resources:

1. https://www.digimat.in/nptel/courses/video/108107167/L03.html
2. https://www.youtube.com/playlist?list=PLLy_2iUCG87BIJ6ZliVIRCx2Crf9_fJMB

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT05	Linear and Digital IC Applications	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electronic Devices and Circuits, Switching Theory and Logic Design

Course Objectives:

1. Understand the basic features of Operational Amplifier and its applications.
2. Analyze the design of Op-Amp based Active Filters, Waveform generators, Functionality of 555 Timer and 565 ICs and their applications.
3. Design of various types of ADCs and DACs.
4. Explain digital IC's and its applications.
5. Learn about different Sequential Logic IC's and Memories.

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

1. Explain the concepts of Operational Amplifier and its features and apply the concepts of Op- Amps in the design of Summing Amplifier, Subtractors, Comparators, differentiators, Integrators and Voltage Regulators.
2. Analyze and design Op-Amp based circuits namely Active Filters, Waveform generators; Design and apply Astable and Mono-stable multi vibrator modes using 555 Timer IC; Conceptualize Phase Locked Loop using 565 IC and explain its applications.
3. Analyze and design DACs and ADCs using various methods of implementation.
4. Explain the structure digital integrated circuits and their applications.
5. Analysis of Sequential logic IC's and Memories.

UNIT–I: (9 Lectures)

OP-Amp Block Diagram (Symbolic Representation), Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, DC and AC Characteristics, Definitions of Input and Output Off-set voltage and currents slow rate, CMRR, PSRR. Features of 741 Op-Amp, General Linear Applications of Op-Amp: Adder, Subtractor - Modes of operation Inverting, Non- Inverting, Differential, Instrumentation Amplifier, Differentiators and Integrators, Nonlinear Applications- Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Design of Voltage Regulator using IC723.

UNIT–II: (9 Lectures)

Applications of OPAMP IC741, IC-555 & IC 565: Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis and Design of 1st order and 2nd order LPF & HPF Butterworth Filters, Waveform Generators – Triangular, Sawtooth, Square Wave, IC555 Timer - Functional Diagram,

Monostable and Astable Operations, Applications, IC565 PLL – Block Schematic, Description of Individual Blocks, Applications.

UNIT–III: (9 Lectures)

Data Converters: Introduction- Basic DAC techniques- weighted resistor DAC, R-2R ladder DAC, Different types of ADCs - Flash type ADC, Successive approximation ADC and dual slope ADC, DAC and ADC Specifications

UNIT–IV: (9 Lectures)

Digital Integrated Circuits: Classification of Integrated Circuits, Comparison of Various Logic Families, Combinational Logic ICs - Specifications and Applications of Binary Parallel Binary adder -Subtractor (74x181), Look Ahead Carry Generator (IC74x182), Decoders (IC74x138), encoders (IC74x148), multiplexers (IC74x151) and demultiplexers (IC74x155), parity circuits (IC74x280), Magnitude comparators (IC74x682).

UNIT–V: (9 Lectures)

Sequential Logic IC's and Memories: Latches (IC74x373) and flip flops IC74x175), Ring Counter (IC74x163), Johnson Counter (IC74LS164.), Design of Modulus N Synchronous Counters (74x102), Shift Registers (IC74x194), LFSR counter (IC74HC164). Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

Text Books:

1. Op-Amps & Linear Integrated Circuits, Ramakanth A. Gayakwad, 4th Edition, PHI, 2003.
2. Digital Design Principles & Practices, John F. Wakerly, 3rd Edition., PHI/ Pearson Education Asia, 2005.
3. VHDL Primer , J. Bhasker, 3rd Edition, Pearson Education/ PHI. 2015.
4. Operational Amplifiers & Linear Integrated Circuits, Sanjay Sharma, 2nd Edition, SK Kataria & Sons, 2010.
5. Linear Integrated Circuits, D. Roy Chowdhury, 2nd Edition., New Age International (p) Ltd, 2003.

Reference Books:

1. Linear Integrated Circuits and Applications, Salivahana, 2nd Edition, McGraw Hill, 2017.
2. Fundamentals of Digital Logic with VHDL Design, Stephen Brown, ZvonkoVranesic, 3rd Edition, McGrawHill, 2017.

text Web Resources:

1. https://swayam.gov.in/nd1_noc20_ee55/preview

2. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.htm
3. https://nptel.ac.in/courses/108/108/108108111/
4. https://nptel.ac.in/courses/117/108/117108040/
5. https://nptel.ac.in/courses/117/106/117106088/

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP05	Power Semiconductor Drives	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Power Electronics, Mathematics, Control Sytems

Course Objectives:

1. To learn the fundamentals of electric drive and different electric braking methods.
2. To analyze the operation of three phase convertercontrolled dc motors and four quadrant operation of dc motors using dual converters.
3. To discuss the converter control of dc motors in various quadrants.
4. To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters, principles of static rotor resistance control and various slip power recovery schemes.
5. To understand the speed control mechanism of synchronous motors.

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

1. Identify the fundamentals of electric drive and different electric braking methods.
2. Analyze the operation of three phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
3. Design the converter control of dc motors in various quadrants of operation.
4. Determine the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters, differentiate the stator side control and rotor side control of three phase induction motor.
5. Examine the speed control mechanism of synchronous motors.

UNIT–I: (10 Lectures)

Fundamentals of Electric Drive: Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods: Dynamic – Plugging – Regenerative methods.

UNIT–II: (8 Lectures)

Controlled Converter Fed DC Motor Drives: Speed controlled techniques – Single and Three phasehalf and fullycontrolled converter fed separately and self-excited DC motor drive – Continuous current operation – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics — Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems. quadrant DC-DC converter fed separately excited and self-excitedDC motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics –Four quadrant operation – Closed loop operation (qualitative treatment only).

UNIT–III: (9 Lectures)

Data Converters: Introduction- Basic DAC techniques- weighted resistor DAC, R-2R ladder DAC, Different types of ADCs - Flash type ADC, Successive approximation ADC and dual slope ADC, DAC and ADC Specifications

UNIT–IV: (9 Lectures)

Control of 3-ϕ Induction Motor Drive - Stator side control of 3-phase Induction motor Drive: Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by voltage source and current source inverter – Comparision of VSI and CSI – Closed loop v/f control of induction motor drives (qualitative treatment only).

Rotor side control of 3-phase Induction motor Drive: Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications

UNIT–V: (9 Lectures)

Control of Synchronous Motor Drives: Separate control & self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (qualitative treatment only).–Variable frequency control–Pulse width modulation.

Text Books:

1. Fundamentals of Electric Drives, G K Dubey, 2nd Edition, Narosa Publications, 2010.
2. Power Semiconductor Drives, S.B.Dewan, G.R.Slemon, A.Straughen, Wiley India, 2009.

Reference Books:

1. Electric Motors and Drives Fundamentals, Types and Apllications, Austin Hughes, Bill Drury, 4th Edition, Newnes, 2013.
2. Thyristor Control of Electric drives, Vedam Subramanyam, Tata McGraw Hill Publications, 1987.
3. Power Electronic Circuits, Devices and applications, M.H.Rashid, 4th Edition, PHI, 2023.
4. Power Electronics Handbook, Muhammad H.Rashid, 4th Edition, Elsevier,2018.

text Web Resources:

1. https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm
2. https://www.electrical4u.com
3. https://www.allaboutcircuits.com/technical-articles/a-review-on-power-semiconductor-devices/

4. https://www.careerride.com/mcq-tag-wise.aspx?Key=Power%20semiconductor%20devices&Id=19

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP06	Utilisation of Electrical Energy	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Machines, Power Electronics and Drives, Power Systems –II

Course Objectives:

1. To study the basic principles of illumination and its measurement and its design.
2. To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
3. To study with the different types of heating and welding techniques.
4. To understand the basic principle of electric traction including speed–time curves of different traction services.
5. To Introduce the concepts of various types of energy storage systems.

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

1. Identify various illumination methods produced by different illuminating sources.
2. Identify a suitable motor for electric drives and industrial applications.
3. Identify most appropriate heating and welding techniques for suitable applications.
4. Distinguish various traction system and determine the tractive effort and specific energy consumption.
5. Validate the necessity and usage of different energy storage schemes for different applications and comparisons.

UNIT–I: (9 Lectures)

Illumination fundamentals: Introduction - terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light.

Various Illumination Methods: Discharge lamps - MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting - Energy conservation.

UNIT–II: (9 Lectures)

Selection of Motors: 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 - Introduction To Energy Efficient Motors.

UNIT–III: (9 Lectures)

Electric Heating: Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding: Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding.

UNIT–IV: **(10 Lectures)**

Electric Traction: 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. 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-Numerical problems.

UNIT–V: **(8 Lectures)**

Introduction to Energy Storage Systems: Need For Energy Storage - Types of Energy Storage-Thermal - Electrical - Magnetic And Chemical Storage Systems - Comparison of Energy Storage Technologies-Applications.

Text Books:

1. Utilization of Electric Energy, E. Openshaw, Taylor, Orient Blackswan, 1971.
2. Art & Science of Utilization of Electrical Energy, Partab, Dhanpat Rai & Sons, 2014.

Reference Books:

1. Utilization of Electrical Power Including Electric drives and Electric Traction, N.V.Suryanarayana, 2nd Edition, New Age International (P) Limited Publishers,2017.
2. TGeneration, Distribution and Utilization of Electrical Energy, C.L. Wadhwa, 3rd Edition, New Age International (P) Limited – Publishers, 2015.

text Web Resources:

1. https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm
2. https://b-ok.cc/book/1268675/9b2a83
3. https://b-ok.cc/book/3558383/6a6c16

Course Code	Course Name	Course Structure			
P21EEP07	Control and Integration of Renewable Energy Source	L	T	P	C
		3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Renewable Energy Sources

Course Objectives:

1. A strong understanding of power systems, their operation and control focused on the issues related to the integration of distributed renewable generation into the network.
2. Strong foundation for power system equipments used for integration.
3. Detailed knowledge about power quality and its management along with approaches for grid stabilization.
4. Deep understanding about integration techniques for RE sources.
5. Deep understanding integration of alternate sources of energy.

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

1. Apply advanced knowledge of electrical power system operations and control to analyse the challenges and opportunities for distributed renewable generation in both large interconnected grid and microgrid settings.
2. Assess renewable energy applications and projects in the context of integration into both the physical and economic electricity markets.
3. Describe the principles and requirements of the next generation future power network, incorporating distributed generation and storage and demand management.
4. Understand the principles, power and limitations of complex power networks incorporating distributed generation and storage.
5. Understanding integration of alternate sources of energy Techniques.

UNIT–I: (9 Lectures)

Introduction: Various techniques of utilizing power from renewable energy sources, concept of nano/micro/mini grid. Need of integrating large renewable energy sources, issues related to integration of large renewable energy sources, rooftop plants. Concept of VPP.

UNIT–II: (9 Lectures)

Power system equipments for grid integration Synchronous generator: Synchronization/integration to existing grid, load sharing during parallel operation, stability (swing equation and solution)

Induction Generator: working principle, classification, stability due to variable speed and counter measures Power

Electronics: need of power electronic equipments in grid integration, converter, inverter, chopper, ac regulator and cyclo converters for AC/DC conversion.

UNIT–III: **(9 Lectures)**

Power quality and management: THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, system protection, grid codes.

UNIT–IV: **(9 Lectures)**

Grid stabilization: Scheduling and dispatch, Forecasting, reactive power and voltage control, frequency control, operating reserve, storage systems. electric vehicles Ancillary services in Indian Electricity Market (regulatory aspect), CERC and CEA orders (technical and safety standards).

UNIT–V: **(9 Lectures)**

Integration of alternate sources of energy: Introduction, principles of power injection: converting technologies, power flow; instantaneous active and reactive power control approach; integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection

Text Books:

1. Integration of Alternative Sources of Energy, Felix A. Farret and M. Godoy Simoes, Wiley- IEEE Press, 2006.
2. Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, 1st Edition, CRC Press (Taylor & Francis group), 2017.

Reference Books:

1. Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York, 2009.
2. Wind Power Integration Connection and System Operational Aspects, B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson, D. Mil borrow, IET Power and Energy Series 50 (IET digital library), 2007.

text Web Resources:

1. www.nptel.iitm.ac.in
2. https://www.pnnl.gov/grid-integration-renewable-energy

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP08	IOT Applications in Electrical Engineering	3	0	0	3

Internal Marks: 30 External Marks: 70

Course Prerequisite: Electrical Circuits, Engineering Physics

Course Objectives:

1. To provide knowledge of basic IoT Network Architectures.
2. To know the IoT Processing, Connectivity and Communication technologies.
3. To provide knowledge of Arduino boards and basic components and Develop skills to design and implement various smart system application
4. To provide knowledge of programming skills, application development and prototyping using Python.
5. To know the knowledge of Raspberry Pi and IoT Applications.

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

1. Understand the basic principles and terminologies of computer networking, network security, WSN, M2M, CPS, sensors and actuators.
2. Describe various data types in IoT applications, connectivity protocols in IoT, communication protocols in IoT.
3. Understand basic concepts of Arduino UNO and Design smart system applications using Arduino UNO.
4. Apply Python programming for Problem solving and application development.
5. Understand the working of Raspberry Pi and develop IoT applications.

UNIT–I: (9 Lectures)

Introduction to IoT: Introduction-Network types-IoT Protocol and Architecture-Network Security- Wireless Sensor Networks (WSN)- Machine-to-Machine (M2M) Communications- Cyber Physical Systems (CPS)- Differentiate between WSN, M2M, and CPS- IoT Sensors and Actuators-Advantages and Disadvantages of IoT.

UNIT–II: (9 Lectures)

IoT Processing, Connectivity and Communication: Data format- Importance of Processing in IoT- Processing Topologies IoT Device Design and Selection Considerations-IEEE 802.15.4-Thread- ISA100.11A- Wireless HART- RFID- LoRaWi-Fi- Bluetooth-Infrastructure Protocols- Discovery Protocols- Data Protocols- Identification Protocols.

UNIT–III: (9 Lectures)

Introduction to Arduino Programming: Introduction-Features of Arduino-Types of Arduino board-Arduino UNO- Arduino IDE overview-Sketch Structure-Data types-Function libraries-Operators in Arduino-Control statement-Loops- Arrays String-Math Library-Random number-Interrupts-Example program: Blink LED-Traffic Control system- Pulse Width Modulation- Analog to Digital Conversion- Wireless

Connectivity to Arduino- Integration of Sensors with Arduino Integration of Actuators with Arduino.

UNIT–IV: (9 Lectures)

Introduction to Python Programming: Introduction to Python- Variables and Data types- Operators-Num Py-mat plot lib Array- Pandas-Lists- Loops- Conditional statements-Functions-Strings-Tuples- Sets-Dictionaries- Array- Data Visualization-File handling.

UNIT–V: (9 Lectures)

Introduction to Raspberry Pi and IoT Applications: Introduction to Raspberry Pi-Basic architecture- Working of Raspberry Pi-Pin configuration- Example program: Blink LED- Capture Image using Raspberry Pi -Implementation of IoT with Raspberry Pi: Sensor and actuator interfaced with Raspberry Pi-IoT application-Speed control of DC and AC machines- Measuring parameters of DC machine, AC machine and solar panel.

Text Books:

1. Introduction to IoT, S. Misra, A. Mukherjee, A. Roy, 1st Edition, Cambridge University Press, 2022.
2. ntroduction to Industrial Internet of Things and Industry 4.0, S. Misra, C. Roy, A. Mukherjee, CRC Press, 2021.
3. Building Arduino Projects for the Internet of Things Experiments with Real-World Applications, Adeel Javed, Apress, 2016.
4. Think Python, Allen B. Downey, 2nd Edition, O'Reilly learning Platform, 2016.
5. Python Programming an Introduction to Computer Science, John Zelle, Tom Sumner, 3rd Editionm, Independent Publisher, 2012.
6. nternet of things: Principles and Paradigms, Rajkumar Buyaa and Amir V Dastjerdi, Morgan Kaufmann, 2016.
7. Internet of Things: A Hands On Approach, A Bahga & V Madisetti Orient Blackswan Private Limited, 2015.

Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Cisco Press, 2017.
2. Learning Python, Mark Lutz, 4th Edition, O'Reilly, 2009.
3. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, 1st Edition, Wiley, 2013.
4. The Internet of Things: Keyapplications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 1st Edition, Wiley, 2012.

text Web Resources:

1. http://digimat.in/nptel/courses/video/108108123/L37.html
2. https://www.electricaltechnology.org/2016/07/internet-of-things-iot-and-its-applications-in-electrical-power-industry.html
3. https://www.quora.com/Is-the-IoT-course-best-suited-for-an-electrical-engineering-graduate

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL08	Electrical Simulation Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Electrical Simulation Lab

Course Objectives:

1. To simulate integrator circuit, differentiator circuit, Boost converter, Buck converter, full convertor and PWM inverter.
2. To simulate transmission line by incorporating line, load and transformer models.
3. To perform transient analysis of RLC circuit.

Course Outcomes: After going through this course, student can able to

1. Able to simulate integrator circuit, differentiator circuit, Boost converter, Buck converter, full convertor and PWM inverter.
2. Able to simulate transmission line by incorporating line, load and transformer models.
3. Able to perform transient analysis of RLC circuit.

LIST OF EXPERMENTS (Any 10 of the following are to be conducted)

1. Simulation of transient response of RLC circuits a. Response to pulse input b. Response to step input c. Response to sinusoidal input
2. Analysis of three phase circuit representing the generator transmission line and load. a. Balanced b. Unbalanced
3. Simulation of single–phase full converter using RLE loads
4. Single phase AC voltage controller using RL loads
5. Stability Analysis of Linear Time Invariant Systems using MATLAB
   a. Bode Plot
   b. Nyquist Plot
   c. Root Locus Plot
6. a.Simulation of Boost converters
   b.Simulation of Buck converters
7. a.Integrator circuits using op–amp
   b. Differentiator circuits using op–amp
8. Simulation of single-phase inverter with PWM control
9. Simulation of Dynamic Systems-Single area Power Systems- using SIMULINK

10. a. PSpice Simulation of DC Circuits Thevenin's Equivalent
    b. PSpice Simulation of DC circuits Transfer function
11. Simulation of three phase full converter using MOSFET and IGBTs
12. Simulation of D.C separately excited motor using transfer function approach

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL09	Power Systems Lab	0	0	3	1.5

Internal Marks: 15 External Marks: 35

Course Prerequisite: Power Systems and power system operation and control.

Course Objectives:

1. To understand the fault analysis of the 3 – phase transformer and 3-phasealternator.
2. To determine the ABCD parameters of transmission lines, dielectric strength of the transformer oil and to calibrate the tong tester.
3. To identify the earth fault.
4. To analyze the AC and DC load flow studies.
5. To control the load frequency of two area systems and to understand the economic load dispatch.

Course Outcomes: After going through this course, student can able to

1. Understand the fault analysis of the 3 – phase transformer and 3-phasealternator.
2. Determine the ABCD parameters of transmission lines, dielectric strength of the transformer oil and to calibrate the tong tester.
3. Identify the earth fault.
4. Analyze the AC and DC load flow studies.
5. Control the load frequency of two area systems and to understand the economic load dispatch.

LIST OF EXPERMENTS

(Any 6 of the following are to be conducted)

1. Sequence impedances of 3-PhaseTransformer.
2. Sequence impedances of 3-Phase Alternator by Fault Analysis.
3. Sequence impedances of 3-Phase Alternator by Direct method.
4. ABCD parameters of Transmission line.
5. Load flow studies using Gauss-seidel method.
6. Load flow studies using N-R method.
7. Dielectric strength of Transformer oil.
8. Calibration of Tong Tester.

(Any 6 of the following are to be conducted)

1. Over current relay with earth fault.

2. Over voltage relay with earth fault.
3. DC Load flow studies in Power systems.
4. Transient Stability Analysis.
5. Two area load frequency control with & without controller.
6. Economic load dispatch with & without losses.
7. V-I Characteristics of Solar PV system.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES04	Skill Oriented Course-IV	1	0	2	2

Internal Marks: 0 External Marks: 50

Course Prerequisite: No Prerequisite

Course Objectives:

1. To train the students with job oriented skills.

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

1. Apply the job oriented skills learned during the course in real-life problems.
2. Communicate the skills effectively acquired during the course.

Course Objective & Course Outcomes will be vary according to the student's opted course.

1. skill-advanced courses either from the same domain
   (a) Solar Cells
   (b) Electrical Vehicle Design
   (c) Electrical Auto CAD
   (d) Aurdino
   (e) Raspberry pi
   (f) Internet of Things
   (g) AI applications in Electrical Engineering
   (h) Machine Learning applications in Electrical Engineering
   (i) SciLab
   (j) LabView
   (k) MultiSim
   (l) MATLAB
   (m) Simulink
   (n) Octave
2. job-oriented skill courses of inter disciplinary nature
   (a) Python for the AI
   (b) Machine Learning
   (c) Deep Learning
   (d) Data Science
   (e) Artificial Neural Network

(f) Natural Language Processing

(g) Full stack development

(h) Azure

(i) Microsoft Administrator

Course Code	Course Name	Course Structure			
		L	T	P	C
P21XXXXX	Design Thinking for Innovation	2	0	0	0

Internal Marks: 30 External Marks: 70

UNIT–I: Design thinking Evolution

Definitions and stories. Design thinking Importance, and Impact-History and Evolution of Design Thinking, - Three Space of Innovation in Design Thinking- knowledge funnel - Design Thinking Process, -Design thinking mindset for innovation

UNIT–II: Building confidence, Mindset and Building Team

Myths of Innovation- Myths of Creativity-Creative Confidence-Innovators DNA - 5 forces of growth (SEPIA),- 5 frictional forces (DCAFE),- 3 capacity levers (VAL)-Building Design Teams.

UNIT–III: Empathy-Define

Initial Problem Description - beginner's mindset-5whys,- persona development-Empathy mapping-interview with empathy and stories collection-Question the critical assumptions -Reframe Problem Definition – (PoV) point of view- how might we

UNIT–IV: Ideation

Ideation and Visualization- Brainstorming-SCAMPER-Mind mapping-sketch –structure idea-Storyboard-Customer Co-Creation-Provocation-Role-play

UNIT–V: Prototyping -Testing

Step-by-step prototyping & low fidelity prototyping -Testing Prototyping -feedback capturing grid, conduct A/B Testing-Experiment grid, user retrospective board-Create a Pitch of the prototype

Text Books:

1. An AVA Book, "Design Thinking", AVA Publishing, 2010
2. Dr.BalaRamaduri, "Karmic Design Thinking", 2020, ISBN:978-9354190100

Reference Books:

1. proach", 3rd edition, Springer, 2007
2. Tom Kelley, Jonathan Littman, "Ten Faces in Innovation", Currency Books, 2006
3. Liedtka, Jeanne and Ogilvie, Timothy, Ten Tools for Design Thinking
4. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses, and Ecosystems by Michael Lewrick
5. The Myths of Innovation by Scott Berkun, Publisher(s): O'Reilly Media, IncISBN: 9781449389628

6. The Myths of Creativity: The Truth About How Innovative Companies and People Generate Great Ideas, D BurkusJossey-Bass, San Francisco, CA (2014), 214 pp, ISBN: 978-1-118-61114-2
7. Creative Confidence: Unleashing the Creative Potential within Us All by (Author), David Kelley(Author)
8. The innovator's DNA: mastering the five skills of disruptive innovators Author: Dyer, JeffGregersen, Hal B, 1958-Christensen, Clayton MPublished: Boston, Mass: Harvard Business Press, [2011]
9. Collective Genius: The Art and Practice of Leading Innovation, Authors: Linda A Hill, Greg Brandeau, Emily Truelove, Kent Lineback
10. Change by Design, by Tim Brown
11. Unmukt-Science and Art of Design Thinking Authors Arun Jain School of Design Thinking 2019
12. The Design Thinking Play Book by Michael Lewrick, Patrick Link& Larry Leifer, Wiley Press,2018
13. The Design of Business: Why Design Thinking Is the Next Competitive Advantage. Martin, R. (2009). Boston, MA: Harvard Business Press.

Online Resources:

1. https://www.interaction-design.org/literature/topics/design-thinking
2. https://www.interaction-design.org/literature/article/how-to-develop-an-empathic-approach-in-design-thinking
3. https://medium.com/dc-design/what-is-human-centered-design-6711c09e2779
4. https://think.design/user-design-research/user-testing/
5. Mentor-DesignThinking.pdf (aim.gov.in)
6. Mentor-DesignThinking.pdf (aim.gov.in)