



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION
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/APSCH E 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 character 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 7th semester, he/she has to register for external examination through offline

mode in last semester of the programme (i.e., 8th 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 sub-questions. For each question there will be an “either” “or” choice, which means that there will be two questions from each unit and the student should answer either of the two questions.
 - (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
≥ 80 ≤ 89	≥ 40 ≤ 44	Excellent	S	9
≥ 70 ≤ 79	≥ 35 ≤ 39	Very Good	A	8
> 60 ≤ 69	≥ 30 ≤ 34	Good	B	7
≥ 50 ≤ 59	≥ 25 ≤ 29	Fair	C	6
≥ 40 ≤ 49	≥ 20 ≤ 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,

$$CGPA = \frac{19.5 \times 6.9 + 19.5 \times 7.8 + 21.5 \times 5.6 + 21.5 \times 6.0 + 21.5 \times 6.3 + 21.5 \times 8.0 + 23 \times 6.4 + 12 \times 7.5}{160} = 6.75$$

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	≥ 7.75 (without any supplementary appearance)	From the CGPA secured from 160 credits
First Class	≥ 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	≥ 7.75 (without any supplementary appearance)	From the CGPA secured from 121 credits
First Class	≥ 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
- Flourey 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.	
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Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student.

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	 6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	 1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing	 2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	 5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	 10 Months	+	Rs. 50,000/-

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

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY



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 ELECTRONICS AND COMMUNICATION 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	P21BST02	Applied Physics	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	P21BSL01	Applied Physics 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	P21BST04	Applied Chemistry	3	0	0	3
2	P21BST06	Numerical Methods & Vector calculus	3	0	0	3
3	P21EST08	Network Analysis	3	0	0	3
4	P21EST11	Electronic Devices and Circuits	3	0	0	3
5	P21EST13	Data Structures	3	0	0	3
6	P21BSL03	Applied Chemistry 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
Total Credits						19.5

DEPARTMENT OF ELECTRONICS AND COMMUNICATION 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	P21ECT01	Signals and Systems	3	0	0	3
3	P21ECT02	Switching Theory and Logic Design	3	0	0	3
4	P21ECT03	Electronic Circuit Analysis	3	0	0	3
5	P21EET04	Pulse and Digital Circuits	3	0	0	3
6	P21ECL01	Switching Theory and Logic Design Lab	0	0	3	1.5
7	P21ECL02	Analog Circuit Lab	0	0	3	1.5
8	P21ECL03	Signals and Systems Lab	0	0	3	1.5
9	P21ECS01	Certificate course being offered by industries/ professional bodies/ APSSDC or any other accredited bodies.	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	P21ECT08	Random Variables and Stochastic Process	3	0	0	3
2	P21ECT07	Analog & Digital Communications	3	0	0	3
3	P21ECT05	Linear and Digital IC Applications	3	0	0	3
4	P21ECT06	ElectroMagnetic Waves & Transmission Lines	3	0	0	3
5	P21MBT01	Managerial Economics and Financial Analysis	3	0	0	3
6	P21ECL04	Analog & Digital Communications Laboratory	0	0	3	1.5
7	P21ECL05	Linear and Digital IC Applications Laboratory	0	0	3	1.5
8	P21ECP01	Mini Project	0	0	2	1.5
9	P21ECS02	Certificate course being offered by industries/ professional bodies/ APSSDC or any other accredited bodies.	1	0	2	2
Total Credits						21.5
Internship 2 Months (Mandatory) during summer vacation						

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

III Year - I Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21ECT10	MicroProcessor and MicroController	3	0	0	3
2	P21EET09	Control Systems	3	0	0	3
3	P21ECT09	Digital Signal Processing	3	0	0	3
4	P21ECEXX	Professional Elective-I	3	0	0	3
5	P21XXXXX	Open Elective-I	3	0	0	3
6	P21ECL07	MicroProcessor and MicroController Lab	0	0	3	1.5
7	P21ECL06	Digital Signal Processing Lab	0	0	3	1.5
8	P21ECS03	Certificate course being offered by industries/ professional bodies/ APSSDC or any other accredited bodies.	1	0	2	2
9	P21XXXXX	Design Thinking for Innovation	2	0	0	0
10	P21ECI01	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	P21ECE01	Wired & Wireless Transmission Devices
2	P21ECE02	Biomedical Engineering
3	P21ECE03	Nano Electronics

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

III Year - II Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21ECT11	Microwave & Radar Engineering	3	0	0	3
2	P21ECT12	Internet of Things	3	0	0	3
3	P21ECT13	VLSI Design	3	0	0	3
4	P21ECEXX	Professional Elective-II	3	0	0	3
5	P21XXXXX	Open Elective-II	3	0	0	3
6	P21ECL08	Microwave Engineering Lab	0	0	3	1.5
7	P21ECL09	IOT Lab	0	0	3	1.5
8	P21ECL10	VLSI Lab	0	0	3	1.5
9	P21ECS04	Certificate course being offered by industries/ professional bodies/ APSSDC or any other accredited bodies.	1	0	2	2
10	P21XXXXX	Intellectual Property Rights	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	P21ECE04	Digital Image Processing
2	P21ECE05	Optical Fiber Communication
3	P21ECE06	Analog IC Design

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE

IV Year - I Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21ECEXX	Professional Elective-III	3	0	0	3
2	P21ECEXX	Professional Elective-IV	3	0	0	3
3	P21ECEXX	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	P21ECS04	Skill Advanced Oriented /Soft Skill Course	1	0	2	2
8	P21ECI02	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	P21ECE07	Microstrip Antennas
2	P21ECE08	Cellular and Mobile Communications
3	P21ECE09	Satellite Communications
3	P21ECE10	Wireless Sensor Networks

Professional Elective - IV		
S.No	Course Code	Course Title
1	P21ECE11	Artificial Neural Networks
2	P21ECE12	Machine Learning for Signal Processing
3	P21ECE13	Electronic Measurements and Instrumentation
3	P21ECE14	Speech Processing

Professional Elective - V		
S.No	Course Code	Course Title
1	P21ECE15	Embedded Systems
2	P21ECE16	Embedded and Realtime Operating Systems
3	P21ECE17	Low Power VLSI Design
3	P21ECE18	Digital IC Design

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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IV Year - II Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21ECPXX	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

(10 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 Jordan 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} , $\sin ax$, $\cos ax$, polynomials in x , $e^{ax}V(x)$, $x^n V(x)$ 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, 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, 22nd Edition, 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
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, semi-conductors 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:

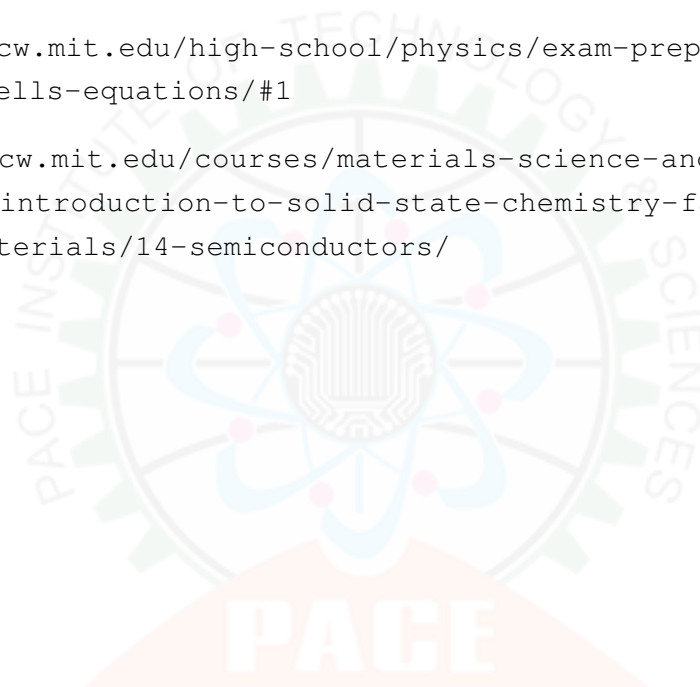
1. A Textbook of Engineering Physics by Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand.
2. Optics by Ajoy Ghatak, Tata McGraw-Hill Publishing company limited
3. Introduction to Electrodynamics by David Griffiths, Cambridge University Press
4. Introduction to Quantum physics by Eisberg and Resnick.

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 Learning.

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
P21EST01	Engineering Graphics	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Nil

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**(7 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 CAD/CIM 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: Nil

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			
		L	T	P	C
P21HSL01	English Language Communication Skills Lab	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

(3 Sessions)

- A. Introduction to Phonetics
Consonant sounds
Vowel sounds – Pure Vowels & Diphthongs
- B. Greeting, Introducing & taking leave and Ice – Breaking Activity

EXERCISE-II

(2 Sessions)

- A. Structure of Syllables - Plural markers & Past tense Markers
- B. JAM Session & Situational Dialogues

EXERCISE-III

(2 Sessions)

- A. Word Stress & Rules of 'r' pronunciation

B. Role play, Giving Directions & Story Narration

EXERCISE-IV

(2 Sessions)

- 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

(3 Sessions)

- 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
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. Implement the concept of resonance in LCR circuit and sonometer.
3. HM to Analyze 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. Madhusudhanrao, "Engineering Physics lab manual" 1st edition, Sciotech Publication, 2015.



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 $\text{distance} = ut + \frac{1}{2}at^2$ 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: $1 + x + x^2 + x^3 + \dots + x^n$
- 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:
- Addition of Two Matrices.
 - 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:
- To insert a sub-string in given main string from a given position.
 - 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
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 Publishing Co. (Latest edition).

Reference Books:

1. K. Seshamaheshwaramma and Mridula Chugh, "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=PLzW3118TEXrpqo3jRarGr9ao-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
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 to

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. 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. Interpret 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, 22nd Edition, 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
P21EST08	Network Analysis	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Applied Physics

Course Objectives: The student will be able

1. To understand the basic concepts on R,L, C circuits and Network topology
2. To analyze the behavior of AC circuits and steady state analysis in RLC circuits.
3. To understand the concept of coupled circuits & resonance
4. To understand the network theorems for analysis of networks
5. To analyze the performance of two port networks

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

1. Gain the knowledge on basic network elements and network topology concepts.
2. Analyze the behavior of AC circuits and steady state analysis in RLC circuits.
3. Explain the magnetic circuits with dot rule and different types of resonance
4. Understand to minimize of electrical networks by using different network theorems.
5. Analyze the different types of two port network parameters

UNIT-I:

(9 Lectures)

Introduction to Electrical Circuits: Basic Definitions, Types of Network elements, Ohms Law, R-L-C Parameters - Types of energy sources, Source transformation, Kirchhoff's laws, series, parallel, Star-Delta conversion, Mesh analysis and Nodal analysis, Numerical Problems

Network Topology: Network Topology: Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, Principal of Duality with examples, basic tie set schedule, basic cut set schedule. Numerical- problems.

UNIT-II:

(9 Lectures)

A.C Fundamentals: Average Values, R.M.S, Form Factor, Peak Factor for different Periodic Wave Forms, Types of powers, power factor, Significance of J operator.

Steady State Analysis of A.C Circuits: Response to sinusoidal excitation - pure resistance, pure inductance, pure capacitance, impedance concept, series R-L, R-C, R-L-C circuits, Star-Delta conversion, numerical problems.

UNIT-III:

(9 Lectures)

COUPLED CIRCUITS: Basic Definitions, Faradays laws of electromagnetic induction, Self inductance, Mutual inductance, Coefficient of coupling, Analogy between electrical and magnetic circuits, analysis of coupled circuits, Dot rule.

RESONANCE: Introduction, Definition of Q , Series and parallel resonance, tank circuit, bandwidth of series and Parallel resonance, comparison between series and parallel circuits, numerical problems.

UNIT-IV:

(9 Lectures)

NETWORK THEOREMS: Superposition theorem, Thevinin's theorem, Norton's theorem, Maximum Power Transfer theorem, Milliman's theorem, Reciprocity theorem, Compensation theorem.

UNIT-V:

(9 Lectures)

TWO PORT NETWORKS: Two port network parameters, Z-parameters, Y-parameters, Transmission parameters, h-parameters, Inverse h-parameters, Inverse Transmission parameters, Relationship between parameter sets, series and Parallel connection of two port networks, Cascading of two port networks

Text Books:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, 3rd Edition, 2000.
2. Network Analysis by K.Satya Prasad and S Sivanagaraju, Cengage Learning
3. Electric Circuit Analysis by Hayt and Kimmarle, TMH

Reference Books:

1. Network lines and Fields by John. D. Ryder 2nd edition, Asia publishing house.
2. Basic Circuit Analysis by Dr.Cunninghan, Jaico Publishers.
3. Network Analysis and Filter Design by Chadha, Umesh Publications.
4. Circuit Theory (Analysis and Synthesis) by A.chakrabarthy, Dhanpat Rai&co.

Web Resources:

1. www.allaboutcircuits.com/textbook/

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST11	Electronic 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(Shunt 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 V_{BE} , I_c , 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:** The student will be able to

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
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^H metry method).
9. Determination of isoelectric point of amino acids using p^H metry 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
P21ESL05	Electronic Devices and Circuits Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Engineering Physics

Course Objectives: The objective of this lab is

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

Equipment 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			
		L	T	P	C
P21ESL06	Data Structures Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: C- Programming

Course Objectives: The objective of this lab is

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
P21BST08	Transformation Techniques and Differential Equations	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 multi-variable 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 (10 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, 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, 22nd Edition, 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.

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
P21ECT01	Signals and Systems	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Basic knowledge of Vectors, Integration, Differentiation, Complex Numbers

Course Objectives: The student will be able

1. To explain about signals and perform various operations on it and to summarize the sampling.
2. To build Trigonometric and Exponential Fourier series of various signals.
3. To develop Fourier transforms for various signals.
4. To analyze the linear systems in time and frequency domains.
5. To solve Laplace transforms and z-transforms for various signals.

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

1. Characterize the signals and systems and principles of vector spaces, Concept of orthogonality.
2. Analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform and Laplace transform.
3. Apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.
4. Understand the relationships among the various representations of LTI systems
5. Understand the Concepts of convolution, correlation, Energy and Power density spectrum and their relationships.
6. Apply z-transform to analyze discrete-time signals and systems.

UNIT-I:

(9 Lectures)

Introduction: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: Time-shifting, Time-scaling, Amplitude-shifting, Amplitude-scaling. Problems on classification and characteristics of signals and systems. Complex, Exponential and sinusoidal signals, Singularity functions and related functions: Impulse function, Step function signum function and ramp function.

UNIT-II:

(9 Lectures)

Orthogonal Functions: Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

Fourier Series: Fourier series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum; Applications of Fourier series.

UNIT-III:**(9 Lectures)**

Fourier Transform: Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, Fourier transforms involving impulse function, Introduction to Hilbert Transform; Applications of Fourier Transform.

Sampling Techniques: Sampling theorem, Graphical and analytical proof for Band Limited Signals, Types-impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing.

UNIT-IV:**(9 Lectures)**

Analysis of Linear Systems: Linear system, Impulse response, Response of a linear system, Linear time invariant (LTI) system, Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Transfer function of a LTI system. Filter characteristics of linear systems. Cross-correlation and auto-correlation of functions, Properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation.

UNIT-V:**(9 Lectures)**

Laplace Transforms: Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, Constraints on ROC for various classes of signals, Properties of L. T's, Relation between L. T's, and F.T. of a signal.

Z-Transforms: Fundamental difference between continuous-time and discrete-time signals, Discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

Text Books:

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edition, 1997
2. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2nd Edition, 2003.
3. Signals and Systems- Sanjay Sarma, 2013

Reference Books:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition, 2011
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2nd Edition, 2015

3. Signals and Systems – K Raja Rajeswari, B Visweswara Rao, PHI, 2nd Edition, 2014
4. Signals and Systems – A. Anand Kumar, PHI, 1st Edition, 2011

Web Resources:

1. nptel.ac.in/courses/108101039/mathematics/node3.html
2. www.tutorialspoint.com/signals_and_systems/signals_sampling_theorem
3. www.dspguide.com/ch3/2.htm



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT02	Switching Theory and Logic Design	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: The Pre-requisites for this Course is Basic Mathematics.

Course Objectives: The student will be able

1. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
2. To Theorems and functions of Boolean algebra and behavior of logic gates.
3. To understand concepts of combinational circuits.
4. To implement simple logical operations using combinational logic circuits
5. To develop advanced sequential circuits.

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

1. Classify different number systems and apply to generate various codes.
2. Use the concept of Boolean algebra in minimization of switching functions
3. Design different types of combinational logic circuits.
4. Apply knowledge of flip-flops in designing of Registers and counters
5. The operation and design methodology for synchronous sequential circuits and algorithmic state machines.

UNIT-I:

(9 Lectures)

NUMBER SYSTEMS AND BOOLEAN CODES: Decimal, Binary, Dettol and Hexadecimal number systems and their arithmetic operations, Conversion of one number system to another number system. Boolean codes: Binary, BCD, Gray and Ex-3 codes and their arithmetic operations; ASCII code; 1's and 2's complement of a binary number and their arithmetic operations. Error Detecting and Correcting Codes- Parity code, Hamming code.

BOOLEAN FUNCTIONS: Boolean algebra, Theorems, Properties; Boolean Functions- Representation in SOP and POS forms; Conversion from one to another form; Standard and canonical forms of representation of functions; Minimization of Boolean functions using Boolean Properties and K-maps (Up to 5-variable) both in SOP and POS forms.

UNIT-II:

(9 Lectures)

LOGIC GATES: Types of basic logic gates and their truth tables; Realization of basic gates using Discrete components; Universal Gates, XOR and XNOR gates, Functions realization using Multilevel NAND-NOR gates; Positive and Negative logic Systems.

COMBINATIONAL CIRCUITS-I: Definition, Half Adder, Half Subtractor, Full Adder, Full Subtractor; N-bit Binary Parallel Adder, Subtractors, Adder/ Subtractor; BCD Adder/Subtractor, Carry look-ahead adder..

UNIT-III: (9 Lectures)

COMBINATIONAL CIRCUITS-II: Design of encoder, Decoder, Multiplexer and Demultiplexers; Design of higher order circuits using lower order ones; Priority encoder, Comparator (up to 4-bit); BCD to seven segment decoder.

INTRODUCTION OF PLD's: Design of PLA, PAL, PROM.

UNIT-IV: (9 Lectures)

SEQUENTIAL CIRCUITS I: Definition; Types of Sequential circuits (Synchronous and Asynchronous), Basic memory element; Types of Clock Signals; Clocked Latch; Types of Flip-flops- R-S; D, T, J-K and Master-Slave JK flip-flops with their circuits, Truth table and Excitation tables; Conversion of one flip-flop to another flip-flop.

SEQUENTIAL CIRCUITS II: Counters- Asynchronous, Synchronous and Ripple counters; Special Counters- Ring and Johnson Counters, Shift registers- Buffer register, 4-bit Shift register, Bi-directional shift register, Universal shift register.

UNIT-V: (9 Lectures)

FINITE STATE MACHINES: State table, State diagrams, Trees, Reduction of state table; Design of Synchronous circuits using state tables; Sequential Machines- Moore and Mealy; Sequence generator and detector.

Text Books:

1. Switching and finite automata theory Zvi.KOHAVI, Niraj.K.Jha 3rd Edition, Cambridge University Press, 2009
2. Digital Design by M.Morris Mano, Michael D Ciletti, 4th edition PHI publication, 2008
3. Switching theory and logic design by Hill and Peterson, Mc-Graw Hill TMH edition, 2012.
4. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson, 2013.

Reference Books:

1. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers, 2006
2. Digital electronics by R S Sedha. S.Chand & company limited, 2010
3. Switching Theory and Logic Design by A. Anand Kumar, PHI Learning Pvt Ltd, 2016.
4. Digital logic applications and design by John M Yarbough, Cengage Learning, 2006

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT03	Electronic Circuit Analysis	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electronic Devices and Circuits

Course Objectives: The student will be able to

1. Familiarize the student with the analysis and design of different amplifier circuits (single stage) using BJTs.
2. Understand the analysis multistage amplifier circuits using BJTs and analysis of MOS amplifier circuits.
3. Understand the concepts of feed back in amplifiers and emphasis on feedback amplifiers (ckts of different implementing different topologies) and oscillators.
4. Familiarize with different power amplifier circuits using BJT and designing the power amplifier.
5. Learn about various tuned amplifiers and their frequency responses.

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

1. Analysis of various transistor amplifier circuits using h-parameters
2. Analysis of various multi stage transistor amplifier circuits using h-parameters at low frequencies and at high frequencies.
3. Analysis of concepts of both positive and negative feedback in electronic circuits and construct & analysis of oscillator circuits to generate signals in various frequency ranges.
4. Analysis of different types of power amplifiers for practical applications of desired specifications.
5. Analysis of different tuned amplifiers circuits.

UNIT-I:

(8 Lectures)

Single Stage Amplifiers: Transistor hybrid model, determination of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CE, CB and CC amplifiers using exact hybrid model and Analysis of CE, CB and CC amplifiers using simplified hybrid model, Analysis of CE amplifier with emitter resistance using simplified hybrid model, Miller's theorem.

UNIT-II:

(12 Lectures)

Multistage Amplifiers: Analysis of Cascaded RC coupled BJT amplifiers, Cascode Amplifier, Darlington Pair, Different Coupling Schemes used in Amplifiers – RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier.

BJT Amplifiers-Frequency Response: The Hybrid pi model –Common Emitter Transistor Model, CE Short Circuit current gain, current gain with resistive load. MOS Amplifiers: Basic Concepts, MOS Small signal model, Common source amplifier with resistive load.

UNIT-III:**(9 Lectures)**

Feedback Amplifiers: Concepts of feedback, Classification of feedback amplifiers, General characteristics of negative feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations, Illustrative examples.

Oscillators: Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge and crystal Oscillators, Stability of Oscillators

UNIT-IV:**(8 Lectures)**

Large Signal Amplifiers: Classification of amplifiers, Class A Large signal amplifiers, Transformer Coupled Class A Audio Power amplifier, Efficiency of class A amplifier, Class B amplifier, Efficiency of class B Amplifier, class B Push pull Amplifier, Complementary Symmetry Class B Push Pull Amplifier, Distortion of Power Amplifiers, Thermal Stability and Heat sinks

UNIT-V:**(8 Lectures)**

TUNED AMPLIFIERS: Introduction, Q Factor, Small signal Tuned Amplifiers, Effect of Cascading Single tuned Amplifiers on bandwidth, Effect of Cascading Double Tuned Amplifiers on Bandwidth, Stagger Tuned Amplifiers, Stability of tuned amplifiers.

Text Books:

1. Integrated Electronics – by J. Millman and C.C. Halkias, -1991 ed 2008 TMH
2. Electronic Devices and Circuits – by G K Mithal, Kanna Publications, 23rd Edition, 1988.
3. Electronic Devices and Circuits – by B.P. Singh, Rekha Singh, Pearson, 2nd Edition, 2013.

Reference Books:

1. Electronic Devices and Circuits Theory- Robert L. Boylestad and Louis Nashelsky, PHI, 9th Edition, 2008
2. Micro Electronic Circuits – by Sedra A.S. and K.C. Smith, Oxford University Press, 5th Edition, 2013
3. Electronic Circuit Analysis-- by K. Lal Kishore, BS Publications/BSP Books; 4th Edition, 2016

Web Resources:

1. electronicspost.com/single-stage-transistor-amplifier/
2. www.niu.edu/remotelab/samplegui/tunedamp.shtml
3. www.npteliitm.ac.in

4. www.modernelectronics.org

5. www.electronicstheory.com



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. To 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: (9 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: (9 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: (9 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:**(9 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.

Web Resources:

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

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL01	Switching Theory and Logic Design Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. Verification of Logic gates
2. Implementation all individual gates with Universal gates NAND & NOR.
3. Design a circuit for the given canonical form, draw the circuit diagram & Verify the De- Morgan laws.
4. Construct Half adder & full adder using half adder and verify truth table.
5. Design and study the Half Subtractor and verify the truth table.
6. Design a combinational logic circuit for 4x1 MUX and verify the truth table.
7. Design a combinational logic circuit for 1x4 DE-MUX and verify the truth table.
8. Design and implementation of BCD to excess-3 code converter and vice versa using logic gates.
9. Design and implementation of binary to gray code converter and vice versa using logic gates
10. Verification of the truth table of basic flipflops with synchronous & a synchronous modes.
11. Construct 7 Segment Display Circuit Using Decoder and 7 Segment LED and test it.
12. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL02	Analog Circuit Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Electronic Devices and Circuits

Course Objectives: The objective of this lab is

1. Frequency response of single stage amplifier.
2. How frequency response varies by applying negative feedback on amplifiers.
3. Different frequency sinusoidal signal generation.
4. Generation and processing of sinusoidal signals.
5. Generation of waveforms using various multivibrator circuits.

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

1. Simulate and evaluate single-stage and two-stage amplifiers
2. Realize the given performance using feedback amplifiers
3. Design and test Oscillator circuits using BJT.
4. Implement and simulate the performance of power amplifiers
5. Design and analyze various multivibrator circuits

Part A:(Simulation)

List of Experiments :(Minimum of Ten Experiments has to be performed)

1. Single stage CE Amplifier.
2. Voltage-Series Feedback Amplifier
3. RC Phase Shift/Wien Bridge Oscillator
4. Hartley/Colpitt's Oscillator
5. Two Stage RC Coupled Amplifier
6. Complementary Symmetry Class B Push-Pull Power Amplifier

Part B:(Hardware)

1. Non-Linear wave shaping – Clippers.
2. Non-Linear wave shaping – Clampers.
3. Astable Multivibrator.
4. Monostable Multivibrator.
5. Schmitt Trigger.
6. Sampling Gates.

Equipment Required:

Hardware:

1. Regulated Power supplies
2. Analog /Digital Storage Oscilloscopes
3. Analog /Digital Function Generators
4. Active & Passive Electronic Components

Software:

1. Multisim/ Equivalent Industrial Standard Licensed simulation software tool.
2. Computer Systems with required specifications



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL03	Signals and Systems Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Objectives: The objective of this lab is

1. To learn in MATLAB software.
2. To perform some basic operations on signals
3. To analyze the given signal in both time and frequency domain
4. To implement cross-correlation, convolution and autocorrelation functions on the system.
5. To develop the given LTI system and finding the output response and stability of system.

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

1. Generation of some basic signals and able to do some basic operations on signals.
2. Analysis of signals both in time and frequency domain
3. Calculation of system response to the given input signal.
4. Observation of system stability using transform theory.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. Write a MATLAB code to perform basic operations on matrices using MATLAB
2. Write a MATLAB program to generate various signals & sequences (periodic & aperiodic) such as unit impulse, unit step, square, sawtooth, triangular, sinusoidal, ramp and sinc using MATLAB
3. Write a MATLAB program to perform operations on signals & sequences such as addition, multiplication, scaling, shifting, computation of energy and average power using MATLAB
4. Write a MATLAB program to find even & odd parts of signal/sequence and real & imaginary parts of signal using MATLAB
5. Write a MATLAB program to perform convolution between signals and sequences using MATLAB
6. Write a MATLAB program to perform autocorrelation and cross correlation between signals and sequences using MATLAB
7. Write a MATLAB program to find the fourier transform of a given signal and plot its magnitude and phase spectrum using MATLAB

8. Locating the zeros and poles and plotting the pole-zero maps in S-plane and Z-plane for the given transfer function
9. Write a MATLAB program to verify Sampling theorem for a given continuous signal using MATLAB
10. Write a MATLAB program to verify Linearity and Time Invariance properties of a given system using MATLAB
11. Write a MATLAB program to compute unit sample, unit step and sinusoidal responses of the given LTI system and verify its physical reliability and stability using MATLAB

Equipement Required:

1. PC
2. MATLAB



Course Code	Course Name	Course Structure			
		L	T	P	C
P21MCT03	Environmental Science	2	0	0	0

Internal Marks: 100

Course Prerequisite: Basic knowledge about sciences up to intermediate or equivalent level.

Course Objectives: The student will be able to

1. Overall understanding of the natural resources
2. Basic understanding of the ecosystem and its diversity
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities
4. An understanding of the environmental impact of developmental activities
5. Awareness on the social issues, environmental legislation and global treaties

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

1. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web
2. The natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources
3. Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices
4. The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity
5. Social issues both rural and urban environment and the possible means to combat the challenges and environmental assessment stages involved in EIA and the environmental audit.

UNIT-I:

(9 Lectures)

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES: Definition, Scope and Importance– Need for Public Awareness. Renewable energy Resources, Solar energy-solar cells, solar batteries, wind energy, wind mills, ocean energy, tidal energy and nonrenewable energy resources: LPG, water gas, producer gas. World food problems, degradation and Soil erosion - overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging and salinity.

UNIT-II:

(8 Lectures)

ECOSYSTEMS: Concept of an ecosystem. – Structure, Components and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Ecological pyramids - Food chains, food webs and Introduction, types, characteristic features, structure and function of

the following ecosystem: a. Forest ecosystem. b. Grassland ecosystem c. Desert ecosystem d. Aquatic – River and Lake Ecosystems.

UNIT-III:**(8 Lectures)**

BIODIVERSITY AND ITS CONSERVATION: Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India –Value of biodiversity: consumptive use, Productive use, social, ethical and aesthetic values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-IV:**(9 Lectures)**

ENVIRONMENTAL POLLUTION: Definition, Cause, Effects and Control measures of : a. Air Pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Nuclear hazards.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes

Disaster management: floods, earthquake, cyclone and landslides.

UNIT-V:**(8 Lectures)**

SOCIAL ISSUES AND THE ENVIRONMENT: From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting and watershed management –Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies Population growth – Impacts on society, variation among nations. Environmental Impact Assessment (EIA) and Environmental Protection Acts.

Text Books:

1. Text book of Environmental Studies for Undergraduate Courses by ErachBharucha for University Grants Commission, Universities Press, 2005.
2. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi, 2008.

Reference Books:

1. Environmental Science & Engineering by Dr. A. Ravikrishnan, Hitech Publishing Company Pvt. Ltd. 2013.
2. Perspectives in Environmental Studies, Second edition, AnubhaKoushik and C.P. Koushik, New Age International (P) Limited, Publishers, 2004.

Online References:

1. Environmental Science - Oxford Research Encyclopedia
2. Environmental Science - Museum of Science and Industry
3. Collegesat.du.ac.in/UG/Envinromental%20Studies_ebook.pdf

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT08	Random Variables and Stochastic Processes	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Simple geometry theory, Multiple integration and differentiation

Course Objectives: The objective of this course is

1. To give students an introduction to elementary probability theory, in preparation for courses on statistical analysis, random variables and stochastic processes.
2. To mathematically model the random phenomena with the help of probability theory concepts.
3. To introduce the important concepts of random variables and stochastic processes.

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

1. Apply the specialized knowledge in probability theory and random processes to solve practical engineering problems.
2. Gain some knowledge in various probability distribution and density functions and solve the major noise removal problems in communication systems.
3. Apply the theory of stochastic processes student will able to determine the temporal and spectral characteristics of random signals response of a given linear system.
4. Describe the concept of random processes and determine mean and correlation of random processes.
5. Understand the concept of random processes in frequency domain and determine the relation between correlation and power spectral density function.

UNIT-I:

(9 Lectures)

Random Variables: Introduction to Random Variable, Types of Random Variables, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties.

UNIT-II:

(9 Lectures)

Operations on One Random Variable: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function.

UNIT-III:

(9 Lectures)

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties Joint Distribution, Marginal Distribution Functions, Conditional

Distribution and Density, Statistical Independence, Sum of Two Random Variables. Central Limit Theorem: Unequal Distribution, Equal Distributions.

Operations on Multiple Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties.

UNIT-IV:

(9 Lectures)

Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes.

UNIT-V:

(9 Lectures)

Random Processes – Spectral Characteristics: The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function.

Text Books:

1. Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles, TMH, 4th Edition, 2001.
2. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S. Unnikrishna, PHI, 4th Edition, 2002.

Reference Books:

1. Probability Theory and Stochastic Processes – B. Prabhakara Rao, BS Publications, 1st Edition, 2012.
2. Probability and Random Processes with Applications to Signal Processing, Henry Stark and John W. Woods, Pearson Education, 3rd Edition, 2002.
3. An Introduction to Random Signals and Communication Theory, B.P. Lathi, International Textbook, 1st Edition, 1968.
4. Probability Theory and Random Processes, P. Ramesh Babu, McGrawHill, 1st Edition, 2014.

Web References:

1. ewww.ee.iitb.ac.in
2. nptel.ac.in
3. ocw.usu.edu
4. www.smartworld.com

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT07	Analog & Digital Communications	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Signals and Systems, Probability Theory

Course Objectives: The objective of this course is to

1. Familiarize with various techniques for analog modulation and demodulation of signals distinguish the figure of merits of various analog modulation methods
2. Develop the ability to classify and understand various Angle Modulation techniques
3. Gain the knowledge on noise and its impact on the performance of communication systems
4. Familiarize with various digital modulation techniques and calculation of their error probabilities
5. Compute and analyze Block codes, cyclic codes and convolution codes.

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

1. Explain the spectral characteristics, generation and detection Techniques of Amplitude modulation techniques
2. Explain the spectral characteristics, generation and detection Techniques of Angle modulation techniques
3. Illustrate different types of noise and predict its effect on Analog communication Systems
4. Describe the generation and detection methods of various digital Modulation schemes
5. Analyze the concepts of error control coding

UNIT-I: (9 Lectures)

Analog Modulation – Introduction to Analog communication systems, Need of modulation, Types- AM, SSB, DSB-SC, VSB - Time domain and frequency domain description, Single tone modulation, Power relations, Generation & Detection techniques, AM Transmitters, AM Receivers-Super-heterodyne receiver, AGC. Illustrative problems.

UNIT-II: (9 Lectures)

Angle Modulation: Phase and Frequency Modulation, Narrow band and Wideband FM, Carson's rule, Indirect and direct method of FM generation, Detection of FM, PM generation and detection. Phase locked loop, Comparison of FM and AM, FM Transmitters, FM Super-heterodyne receiver. Illustrative problems.

UNIT-III: (9 Lectures)

Noise in Analog Communication system: Noise in AM system, Noise in SSB & DSB system, Noise in Angle Modulation system, Pre-emphasis and de-emphasis techniques. Illustrative problems.

Pulse Modulation: Types of Pulse modulations- PAM, PWM, PPM-Generation & Detection of signals.

UNIT-IV:

(9 Lectures)

Digital Modulation Systems: Introduction to digital communication system, Base-band and Bandpass signals. Sampling process; Quantization Process; Quantization Noise; Pulse-Code Modulation; Noise Considerations in PCM Systems; Differential Pulse-Code Modulation, Delta modulation, Adaptive delta modulation, Amplitude, Phase and frequency shift keying schemes (ASK, FSK, PSK, QPSK). Introduction to M-array modulation schemes, Matched filter receiver and optimum receiver. Illustrative problems.

UNIT-V:

(9 Lectures)

Information theory and Error control Coding: Measure of information, Entropy, Information rate, Source coding theorem, Channel capacity, Shannon-Hartley law, Error control Codes-Linear codes, Cyclic codes, Convolution Coding-encoder, decoder-Exhaustive search and sequential method. Illustrative problems.

Text Books:

1. Simon Haykin and Michael Moher, "An Introduction to Analog & Digital Communications", 2nd Ed., Wiley, (2007).
2. Tomasi, Wayne, "Electronics Communication Systems Fundamentals through advanced", 5th Edition, Pearson Education, 2009.
3. B.P. Lathi, "Modern Digital & Analog Communications Systems", 2e, Oxford University Press
4. Communication Systems (Analog and Digital) by Dr. Sanjay Sharma.

Reference Books:

1. Bruce Carlson, Paul B. Crilly and Janet C. Rutledge, "Communication Systems: An Introduction to Signals and Noise in Electrical Communications", 4th Edition, McGraw- Hill, (2002).
2. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, (2001)
3. Nevio Benvenuto, Roberto Corvaja, Tomaso Erseghe, and Nicola Laurenti, "Communication Systems: Fundamentals and Design Methods", John Wiley & Sons, (2006).
4. Sam Shanmugam, K, "Digital and Analog Communication Systems", Wiley publisher (2006).

5. R. P. Singh, S. Sapre, "Communication Systems: Analog and Digital", Tata McGraw-Hill, 2nd edition.

Web References:

1. analogcommunication4u.blogspot.com/p/lesson-plan.html
2. www.electronics-notes.com
3. https://swayam.gov.in/nd1_noc20_ee17/preview
4. https://www.tutorialspoint.com/digital_communication/digital_communication_quadrature_phase_shift_keying.htm



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: The student will be able to

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:

(11 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:

(7 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: (6 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: (15 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, TMH.
2. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, Zvonko Vranesic, McGrawHill, 3rd Edition.

Web References:

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
P21ECT06	Electromagnetic Waves and Transmission Lines	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Three-Dimensional Coordinate Systems, Vector Calculus**Course Objectives:** The student will be able to

1. Recognize and classify the basic Electrostatic theorems and laws.
2. Classify the basic Magneto static theorems and laws.
3. Establish the proof and estimate the polarization features, reflection and transmission coefficients for UPW propagation
4. Explain the characteristics of transmission lines and its losses
5. Analyze the transmission lines and their parameters using the Smith Chart and learn about striplines

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

1. Display an understanding of fundamental electromagnetic laws and concepts
2. Write Maxwell's equations in integral, differential and phasor forms and explain their physical meaning.
3. Analyze the Wave Equations for good conductors and good dielectrics
4. Derive the expressions for input impedance of transmission lines.
5. Analyze impedance matching by stubs using smith charts also analyze the planar striplines.

UNIT-I:**(9 Lectures)**

Electrostatics: Review of Co-ordinate Systems, Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.

UNIT-II:**(9 Lectures)**

Magneto Statics : Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy. Illustrative Problems.

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Conditions at a Boundary Surface: Dielectric- Dielectric and Dielectric-Conductor Interfaces. Illustrative Problems.

UNIT-III:**(9 Lectures)**

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics–Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization, Skin depth, Illustrative Problems.

UNIT-IV:**(9 Lectures)**

Transmission Lines - I : Types, Parameters, T& π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Loading - Types of Loading. Illustrative Problems.

UNIT-V:**(9 Lectures)**

Transmission Lines – II : Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. Low loss radio frequency lines and UHF Transmission lines, UHF Lines as Circuit Elements; Impedance Transformations $\frac{\lambda}{4}$, $\frac{\lambda}{2}$, $\frac{\lambda}{8}$ Lines –. Smith Chart – Construction and Applications, Quarter wave transformer, Stub Matching-single & double, Illustrative Problems.

Planar Transmission Lines: Electromagnetic fields in striplines, microstriplines, and co-planar waveguides.

Text Books:

1. Electromagnetic Waves and Radiating Systems– E. C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.
2. Principles of Electromagnetics – Matthew N.O. Sadiku and S.V. Kulkarni, Oxford University Press, Asian 6th Edition, 2015.
3. Transmission Lines and Networks – Umesh Sinha, Satya Prakashan, Tech. India Publications, New Delhi, 1st Edition, 2001.
4. Electromagnetic Fields And Waves- K. D. Prasad, 2001

Reference Books:

1. Engineering Electromagnetics – Nathan Ida, Springer (India) Pvt. Ltd., New Delhi, 2nd Edition, 2005.
2. Networks, Lines and Fields – John D. Ryder, PHI, 2nd Edition, 1999.
3. Engineering Electromagnetics– William H. Hayt Jr. and John A. Buck, TMH, 7th Edition, 2006.
4. Electromagnetic Field Theory and Transmission Lines – G.S.N. Raju, Pearson Education, 3rd Edition, 2009.

Web References:

1. science.nasa.gov/ems/
2. physics.info/em-waves
3. nptel.ac.in/courses/117101056



Course Code	Course Name	Course Structure			
		L	T	P	C
P21MBT01	Managerial Economics and Financial Analysis	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Nil

Course Objectives: The student will be able to

1. The Learning objective of this Unit is to understand the concept and nature of Managerial Economics and its relationship with other disciplines, Concept of Demand and Demand forecasting.
2. The Learning objective of this Unit is to understand the concept of Production function, Input Output relationship, different Cost Concepts and Concept of Cost-Volume-Profit Analysis.
3. The Learning Objective of this Unit is to understand the Nature of Competition, Characteristics of Pricing in the different market structure and significance of various pricing methods and to know the different forms of Business organization
4. The Learning objective of this Unit is to understand the different Accounting Systems preparation of Financial Statements and uses of different tools for performance evaluation
5. The Learning objective of this Unit is to understand the concept of Capital, Capitalization, Capital Budgeting and to know the techniques used to evaluate Capital Budgeting proposals by using different methods

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

1. The Learner is equipped with the knowledge of estimating the Demand for a product and the relationship between Price and Demand.
2. One should understand the Cost Concepts for decision making and to estimate the least cost combination of inputs.
3. One has to understand the nature of different markets and Price Output determination under various market conditions and with the knowledge of different Business Units.
4. The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis.
5. The Learner is able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

UNIT-I:

(8 Lectures)

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics-Scope of Managerial Economics and its relationship with other subjects-Concept of Demand, Types of Demand, Determinants of Demand-Demand Schedule, Demand Curve, Law of Demand and its limitations-Elasticity

of Demand-Types of Elasticity of Demand and Measurement-Demand forecasting and its Methods.

UNIT-II: (10 Lectures)

Production and Cost Analyses: Concept of Production function-Cobb-Douglas Production Function – Law of one Variable proportions-Isoquants and Isocosts and choice of Least cost factor combination-Concepts of Returns to Scale and Economics of Scale-Different Cost Concepts: Opportunity Costs, Explicit Costs and Implicit Costs -Fixed Costs, Variable Costs and Total Costs - Cost Volume Profit analysis - Determination of Break-Even Point (Simple Problem) Managerial Significance and limitations of Breakeven point.

UNIT-III: (8 Lectures)

Introduction to Markets and Types of Business Organization: Market Structures: Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly – Features – Price and Output Determination– Other Methods of Pricing: Average Cost Pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing. Features and Evaluation of Sole Trader – Partnership – Joint Stock Company –Private Public Partnership - State/Public Enterprises and their forms – Business Cycles – Meaning and Features – Phases of Business Cycle.

UNIT-IV: (10 Lectures)

Introduction to Accounting & Financing Analysis: Introduction to Double Entry Systems – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements (Simple Problems) GST basic concepts and Slab rates.

UNIT-V: (10 Lectures)

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Meaning of Capital Budgeting-Time value of Money-Methods of appraising Project profitability: Traditional methods (pay back period, accounting rate of return) and Modern Methods (Discounted cash flow method, Net present value method, internal rate of return method and profitability index).

Text Books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011.
2. Dr. N. Appa Rao, Dr. P. Vijay Kumar: ‘Managerial Economics and Financial Analysis’, Cengage Publications, New Delhi – 2011.
3. Prof. J.V.Prabhakara rao, Prof. P. Venkatarao. ‘Managerial Economics and Financial Analysis’, Ravindra Publication.
4. Vanitha Agarwal : Managerial Economics, Pearson Publications 2011.

Reference Books:

1. V. Maheswari : Managerial Economics, Sultan Chand.
2. Suma Damodaran : Managerial Economics, Oxford 2011.

3. Dr. B. Kuberudu and Dr. T. V. Ramana : Managerial Economics & Financial Analysis, Himalaya Publishing House 2011.
4. Sanjay Dhameja : Financial Accounting for Managers, Pearson.
5. Maheswari : Financial Accounting, Vikas Publications.
6. S. A. Siddiqui & A. S. Siddiqui : Managerial Economics and Financial Analysis, New Age International Publishers, 2012.

Web References:

1. <https://lecturenotes.in/subject/566/managerial-economics-and-financial-analysis-mefa>
2. <https://nptel.ac.in/courses/110101005/>
3. <https://www.crectirupati.com/sites/default/files/.../MEFA%20lecture%20notes.pdf>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL05	Analog & Digital Communication Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

List of Experiments (Twelve experiments to be done)

The objective of this lab is to Develop and Analyze the output signal of Part A: Analog Communications

1. Amplitude Modulation and Demodulation.
2. DSB SC - Modulation and Demodulation.
3. Spectrum Analysis of Modulated signal using Spectrum Analyzer
4. Pre-emphasis & De-emphasis circuits.
5. Frequency Modulation - Modulation and Demodulation.
6. By Implementation of Sampling Theorem
7. PAM, PWM, PPM- Modulation and Demodulation.

Part B: Digital Communications

1. Pulse code modulation, Differential pulse code modulation.
2. Delta modulation.
3. ASK, FSK, PSK.
4. Differential phase shift keying.
5. Source Encoder and Decoder
6. Channel coding-
 - (a) Linear Block Code-Encoder and Decoder
 - (b) Binary Cyclic Code – Encoder and Decoder
 - (c) Convolution Code – Encoder and Decoder

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL04	Linear and Digital IC Applications Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

PART – A (minimum 6 experiments) Design and Verify the functionality of the following:

1. Study of OP AMPs - IC 741, IC 555, IC 565, IC 566, - functioning, parameters and Specifications.
2. OP AMP Applications – Adder, Subtractor, Comparator Circuits.
3. Integrator and Differentiator Circuits using IC 741.
4. Active Filter Applications – LPF, HPF (first order)
5. Function Generator using OP AMPs.
6. (a) IC 555 Timer - Monostable Operation Circuit.
(b) IC 555 Timer - Astable Operation Circuit.
7. Schmitt Trigger Circuits – using IC 741
8. Design of Frequency Multiplier using PLL IC 565
9. Voltage Regulator using IC 723.

PART – B (minimum 6 experiments using VHDL)

1. Design of all gates using VHDL. -74XX.
2. Write VHDL programs for the following circuits, check the waveforms and the hardware generated
 - (a) Half adder, Half Subtractor
 - (b) Full adder , Full Subtractor
3. Write VHDL programs for the following circuits, check the waveforms and the hardware generated- multiplexer -74X151 and 2x4 Demultiplexer-74X155.
4. Write VHDL programs for the following circuits, check the wave forms and the hardware generated -3-8 Decoder -74138 & 8-3 Encoder- 74X148
5. Write a VHDL program for a 4-bit comparator (74x85))and check the wave forms and the hardware generated
6. Write a VHDL program for D FLIP-FLOP and check the wave forms and the hardware generated
7. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
 - (a) register
 - (b) shift register
8. Write a VHDL program for a Decade counter –IC 7490 and check the wave-forms and the hardware generated

9. Write a VHDL program for a parity generator/Checker and check the wave forms and the hardware generated.

Additional Experiments:

1. OPAMP characteristics and parameter measurement
2. Weighted resistor 4-bit DAC using IC 741
3. Priority Encoder using 74XX Series.
4. Simulation of Synchronous up-down counter.

Equipment Required:**For Part - A**

1. Regulated Power Supply (0-30V)
2. Cathode Ray Oscilloscope (20MHz)
3. Multimeters
4. Kits for the above experiments or the following components
 - (a) ICs- 741, 555, 723, 7805, 7809, 7912.
 - (b) Resistors, Capacitors.
 - (c) Breadboards

For Part - B

1. Computer with Xilinx software, ISE 14.7
2. Note: Minimum 12 experiments are to be conducted (Minimum 6 experiments from each part are to be conducted)

For Software Simulation

1. Computer Systems
2. LAN Connections (Optional)
3. Operating Systems
4. VHDL/ VERILOG
5. FPGAS/CPLDS (Download Tools)

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT10	Microprocessors and Microcontrollers	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Semiconductor Devices and Circuits, Switching Theory and Logic Design

Course Objectives: The student will be able to

1. To acquire knowledge on microprocessors and microcontrollers.
2. Understand Interfacing of 8086, With memory and other peripherals
3. Understand Interfacing of 8086, With memory and other peripherals
4. Study the features 8051 microcontroller and programming.
5. Study the features of ARM cortex-M3 and its programming.

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

1. Describe the microprocessor capability in general and explore the evaluation of microprocessors.
2. Demonstrate programming skills in assembly language for processors.
3. Describe 8086 interfacing with different peripherals and implement programs.
4. Describe hardware concepts, development of programs for 8051 microcontroller and interfacing.
5. Describe hardware concepts and program develop for ARM cortex-M3.

UNIT-I: (10 Lectures)

Introduction: Basic Microprocessor architecture, Harvard and Von Neumann architectures with examples, Microprocessor Unit versus Microcontroller Unit, CISC and RISC architectures.

8086 ARCHITECTURE: Main features, Register Organization, Pin diagram/ description, 8086 microprocessor family, internal architecture, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration. and a d v a n c e d microprocessors.

UNIT-II: (8 Lectures)

8086 PROGRAMMING: Program development steps, Instructions, addressing modes, assembler directives, writing Simple Programs with an assembler, assembly language program development tools.

UNIT-III: (9 Lectures)

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, stepper motor, A/D and D/A converters, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, Need for 8259 programmable interrupt controllers.

UNIT-IV:**(9 Lectures)****Intel 8051 MICROCONTROLLER:**

Architecture, Hardware concepts, Input/output ports and circuits, external memory, counters/timers, serial data input/output, interrupts. Assembly language programming: Instructions, addressing modes, simple programs. Interfacing to 8051: A/D and D/A Convertors, Stepper motor interface, keyboard, LED and & 7-segment display, LCD Interfacing, Traffic light controls.

UNIT-V:**(9 Lectures)****ARM Architectures and Processors:**

ARM Architecture, ARM Processors Families, ARM Cortex-M Series Family, ARM Cortex-M3 Processor Functional Description, functions and interfaces, Programmers Models, ARM Cortex- M3 programming – Software delay, Programming techniques, Loops, Stack and Stack pointer, subroutines and parameter passing, parallel I/O, Nested Vectored Interrupt Controller – functional description and NVIC programmers' model.

Text Books:

1. "Advanced Microprocessor and Peripherals" by A.K Ray, K.M.Bhurchandhi, , Tata McGraw Hill Publications, 2nd Ed., 2006.
2. "The 8051 Microcontrollers and Embedded systems Using Assembly and C" by Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; Pearson 2-Edition, 2011.
3. "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors" by JosephYou.

Reference Books:

1. "Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach in English" by Dr. Alexander G. Dean, Published by Arm Education Media, 2017.
2. "Microprocessors and Interfacing – Programming and Hardware" by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition, 1994.
3. Cortex -M3 Technical Reference Manual.

Web References:

1. https://onlinecourses.nptel.ac.in/noc20_ee42/preview
2. <https://ict.iitk.ac.in/courses/microprocessors-and-microcontrollers/>

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)**

Mathematical 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

text Web Resources:

1. <https://archive.nptel.ac.in/courses/107/106/107106081/>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT09	Digital Signal Processing	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Signals and Systems

Course Objectives: The student will be able

1. Impart the knowledge of key discrete-time signals & systems.
2. Introduce the methods of time domain and frequency domain implementation.
3. Understand the characteristics of digital filters and the design of digital IIR and FIR filters.
4. Demonstrate an understanding of multi-rate signal processing.
5. Introduce the concepts of DSP in real-time applications.

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

1. Illustrate digital signals, systems and their significance.
2. Apply the transformation tools to signals and analyze their significance and applications.
3. Design various digital filters and analyze their frequency response.
4. Apply the Multi-rate Processing concepts in sampling rate conversions.
5. Apply the signal processing algorithms for real-time applications.

UNIT-I: (9 Lectures)

Introduction: Introduction to Digital Signal Processing: Discrete-time signals & sequences, Classification of Discrete-time systems, stability, the causality of LTI systems, Invertibility, Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete-time signals and systems.

UNIT-II: (9 Lectures)

Discrete Fourier Series & Fourier Transforms: Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, computation of DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

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: (9 Lectures)

Design Of IIR & FIR Digital Filters & Realizations: Review of Z-transforms, Basic structures of IIR systems, Transposed forms, Basic structures of FIR systems, System function. Analog filter approximations – Butter worth and Chebyshev,

Design of IIR Digital filters from analog filters, Analog and Digital frequency transformations, Design of FIR Digital Filters using Window Techniques, Comparison of IIR & FIR filters.

UNIT-IV:**(9 Lectures)**

Multi-rate Digital Signal Processing: Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion, Multistage Implementation of Sampling Rate Conversion

UNIT-V:**(9 Lectures)**

Application of Digital Signal Processing: Role of Digital Signal Processing in Speech Processing, Radar Communications, medical field, Sonar.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A.V. Oppenheim and R.W. Schaffer, PHI
3. Digital Signal Processors-Architecture, Programming and Applications, B.Venkataramani, M. Bhaskar, TATA McGraw Hill, 2002

Reference Books:

1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006
2. Digital Signal Processing: MH Hayes, Schaum's Outlines, TATA Mc-Graw Hill, 2007.
3. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra L. Harris, Thomson, 2007.

Web Resources:

1. <https://nptel.ac.in/courses/117/102/117102060/>
2. https://www.tutorialspoint.com/digital_signal_processing/digital_signal_processing_pdf_version.html

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE01	Wired & Wireless Transmission Devices	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electromagnetic Waves and Transmission Lines**Course Objectives:**

1. To Understand the transmission of EM waves through rectangular waveguides.
2. To Analyze the concepts of antenna radiation parameters.
3. To Evaluate the field components of wire antennas. And to understand Design antenna array Configurations.
4. Design non-resonant radiators and Design VHF, UHF and microwave antennas.
5. Distinguish the characteristics of radio wave propagation.

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

1. To understand about rectangular wave guide and its propagation through fields and mode analysis
2. To know basic understanding about antenna fundamentals and its parameters
3. To understand different types of array antennas and their configuration
4. To design analyze different types of VHF,UHF and microwave antennas
5. To know characteristics of radio wave propagations

UNIT-I:**(9 Lectures)**

MICROWAVE TRANSMISSION LINES: Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides– TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths, and Impedance Relations; power Transmission and power Losses in Rectangular Guide, Impossibility of TEM mode. Related Problems.

MICROSTRIP LINES– Introduction, Z₀ Relations, Effective Dielectric Constant, Losses, Q factor

UNIT-II:**(9 Lectures)**

ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – single wire, 2 wires, dipoles, Current Distribution on a thin wire antenna. Antenna Parameters - Radiation Patterns, Patterns in Principal Planes, Main Lobe and Side Lobes, Beam widths, Polarization, Radiation Intensity, Directivity, Gain Antenna Apertures, Aperture Efficiency, Effective Height, illustrated Problems.

UNIT-III:**(9 Lectures)**

THIN LINEAR WIRE ANTENNAS: Retarded Potentials, Radiation from Small Electric Dipole, Quarter wave Monopole and Half Wave Dipole – Current Distributions, Evaluation of Field Components, Power Radiated, Radiation Resistance, Beam widths, Directivity, Effective Area and Effective Height, Antenna Theorems – Applicability and Proofs for equivalence of directional characteristics, Loop Antennas: Small Loops - Field Components, Concept of short magnetic dipole, D and Rr relations for small loops.

ANTENNA ARRAYS: Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, End-fire Arrays, Binomial Arrays, Arrays with Parasitic Elements. Yagi-Uda Arrays, Folded Dipoles and their characteristic.

UNIT-IV:**(9 Lectures)**

NON-RESONANT RADIATORS: Introduction, Traveling wave radiators, long wire antennas, Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics. Helical Antennas, Geometry, basic properties

VHF, UHF AND MICROWAVE ANTENNAS: Reflector Antennas: Corner Reflectors. Parabolic Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Cassegrain Feeds. Horn Antennas – Types, Optimum Horns, Lens Antennas – Geometry, Features, Dielectric Lenses and Zoning, Applications

UNIT-V:**(9 Lectures)**

WAVE PROPAGATION: Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation–Characteristics, Fundamental Equation for Free Space Propagation, Basic Transmission Loss Calculations, Space Wave Propagation–Mechanism, LOS and Radio Horizon, Tropospheric Wave Propagation – Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations.

ANTENNA MEASUREMENTS – Patterns, Set Up, Distance Criterion, Directivity, VSWR, Impedance and Gain Measurements (Comparison, Absolute and 3-Antenna Methods)

Text Books:

1. Balanis, Constantine A. Antenna theory: analysis and design. John wiley & sons, 2016.
2. Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
3. Pozar, David M. Microwave engineering. John wiley & sons, 2011.

Reference Books:

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.

2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.

Web Resources:

1. <https://archive.nptel.ac.in/courses/108/101/108101092/>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE02	Bio Medical Engineering	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Engineering Physics, Biological sciences and Electronic devices & Circuits

Course Objectives:

1. Study the principles of electronics used in designing various diagnostic equipment and recordings of ECG, EEG and EMG.
2. Learn the principles of bio-electrodes and transducers.
3. Explain the activities and measurement of Cardiovascular and Respiratory system.
4. Explore different patient care and monitoring equipment and the technical details with exposure to the hospitals and health care industry.
5. Gain the Knowledge on health care equipment and advanced technologies.

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

1. Demonstrate the principles of electronics used in designing various diagnostic equipment and analyze ECG, EEG and EMG recordings for disorder identification.
2. Understand principles of bio-electrodes and transducers.
3. Acquire the knowledge on activities and measurement of Cardiovascular and Respiratory system.
4. Understand about different streams in Biomedical Engineering with greater emphasis on health care equipment's and the advanced technologies such as Telemedicine, Telemetry, Medical Imaging, etc.
5. Examine different patient care and monitoring equipment and provide a better technical support & usage with exposure to the hospitals and health care industry.

UNIT-I:

(9 Lectures)

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION: Age of Biomedical Engineering, Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Physiological System of the Body, Problems Encountered in Measuring a Living System, Sources of Bioelectric Potentials, Muscle, Bioelectric Potentials, Sources of Bioelectric Potentials, Resting and Action Potentials, Propagation of Action Potential, Bioelectric Potentials-ECG, EEG and EMG, Evoked Responses.

UNIT-II:

(9 Lectures)

ELECTRODES AND TRANSDUCERS: Introduction, Electrode Theory, Biopotential Electrodes, Examples of Electrodes, Basic Transducer Principles, Biochemi-

cal Transducers, The Transducer and Transduction Principles, Active Transducers, Passive Transducers, Transducers for Biomedical Applications, Pulse Sensors, Respiration Sensor, Transducers with Digital Output.

UNIT-III:**(9 Lectures)**

CARDIOVASCULAR SYSTEM AND MEASUREMENTS : The Heart and Cardiovascular System, Electro Cardiograph, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Measurement of Heart Sound, Plethysmography. X-RAY AND RADIOISOTOPE INSTRUMENTATION: Generation of Ionizing radiation, instrumentation for diagnostic X-rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy.

UNIT-IV:**(9 Lectures)**

DIAGNOSTIC TECHNIQUES AND BIO-TELEMETRY: Principles of Ultrasonic Measurement, Ultrasonic Imaging, Ultrasonic Applications of Therapeutic Uses, Ultrasonic Diagnosis, X-Ray and Radio-Isotope Instrumentations, CAT Scan, Emission Computerized Tomography, MRI, Introduction to Biotelemetry, Physiological Parameters Adaptable to Biotelemetry, The Components of Biotelemetry System, Implantable Units, Telemetry for ECG Measurements during Exercise, Telemetry for Emergency Patient Monitoring.

UNIT-V:**(9 Lectures)**

PATIENT CARE AND MONITORING: Elements of Intensive-Care Monitoring, Patient Monitoring Displays, Diagnosis, Calibration and Repair ability of Patient-Monitoring Equipment, Pacemakers, Defibrillators, Other Instrumentation for Monitoring Patients, Organization of the Hospital for Patient-Care Monitoring.

MEASUREMENTS IN THE RESPIRATORY SYSTEM: The Physiology of the Respiratory System, Tests and Instrumentation for the Mechanics of Breathing, Respiratory Therapy Equipment.

Text Books:

1. "Bio-Medical Electronics and Instrumentation", Onkar N. Pandey, Rakesh Kumar, Katson Books.
2. "Bio-Medical Instrumentation", Cromewell, Wiebell, Pfeiffer.

Reference Books:

1. "Introduction to Bio-Medical Equipment Technology", 4th Edition, Joseph J. Carr, John M. Brown, Pearson Publications.
2. "Hand Book of Bio-Medical Instrumentation", Khandapur. McGrawHill.

Web Resources:

1. www.embs.org/about-biomedical-engineering/
2. www.biomedicaltechnology.eu/
3. <https://biomedical-engineering-online.biomedcentral.com/>
4. <https://bmes.org/biomedicalengineeringsociety>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE03	Nano Electronics	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Engineering Physics, Electronic devices & Circuits.

Course Objectives: Students undergoing this course are exposed to:

1. Study the types of nanotechnology, atomic structure, molecular technology and preparation of nano materials.
2. Understand the fundamentals of nano electronics and its properties.
3. Demonstrate the quantum transport devices.
4. Familiarize the students with the concepts of carbon nano tubes.
5. Gain knowledge for studying molecular electronics and fundamentals.

Course Outcomes: The students will be able to

1. Obtain the skills in nanotechnology, molecular technology and the preparation of nano materials.
2. Understand the fundamental concepts of Nanoelectronics.
3. Analyze the principles of silicon MOSFET and Quantum Transport Devices.
4. Demonstrate the working principle of carbon nano tubes.
5. Explore the knowledge of molecular electronics.

UNIT-I:

(9 Lectures)

INTRODUCTION TO NANOTECHNOLOGY: Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics from microelectronics towards bio-molecule electronics. **MOLECULAR NANOTECHNOLOGY:** Electron Microscope – Scanning Electron Microscope – Atomic Force Microscope – Scanning Tunneling Microscope. Nanomaterials: Preparation – Plasma Arcing – Chemical Vapor Deposition – Sol-Gels – Electrode Position – Ball Milling – Applications of Nanomaterials.

UNIT-II:

(9 Lectures)

FUNDAMENTALS OF NANOELECTRONICS: Fundamentals of logic devices:- Requirements – dynamic properties – threshold gates; physical limits to computations; concepts of logic devices:- classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain. Ultimate computation:- power dissipation limit – dissipation in reversible computation – the ultimate computer.

UNIT-III:

(9 Lectures)

SILICON MOSFETs & QUANTUM TRANSPORT DEVICES: Silicon MOSFETS -

Novel materials and alternate concepts:- fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts.

QUANTUM TRANSPORT DEVICES BASED ON RESONANT TUNNELING: Electron tunneling – resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applications- Single electron devices – applications of single electron devices to logic circuits.

UNIT-IV:

(9 Lectures)

CARBON NANOTUBES: Fullerenes - types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs – Nanotube for memory applications – prospects of all carbon nanotube nanoelectronics.

UNIT-V:

(9 Lectures)

MOLECULAR ELECTRONICS: Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices.

Text Books:

1. Michael Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.
2. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003.
3. T. Pradeep, NANO: The Essentials – Understanding Nanoscience and Nanotechnology, TMH, 2007.

Reference Books:

1. M.Ziese and M.J Thornton(Eds.)”Spin Electronics “, Springer-verlag 2001.
2. M.Dutta and M.A Stroschio Edited by “Quantum Based Electronic Devices and systems”, world Scientific, 2000.

Web Resources:

1. <https://www.edx.org/course/fundamentals-nanoelectronics-part-b-purduex-nano521x>.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL07	Microprocessor and Microcontrollers Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

List of the Experiments / Programs

Part A: (Minimum of 5 Experiments has to be performed)

8086 ASSEMBLY LANGUAGE PROGRAMMING AND INTERFACING.

1. Introduction to MASM/TASM, KEIL
2. Programs for 16 -bit arithmetic operations (using Various Addressing Modes).
 - (a) Addition of n-BCD numbers.
 - (b) Multiplication and Division operations.
3. Program for sorting an array.
4. Program for Factorial of given n-numbers.
5. Interfacing ADC to 8086
6. Interfacing DAC to 8086.
7. Interfacing stepper motor to 8086.

Part B: (Minimum of 5 Experiments has to be performed)

8051 ASSEMBLY LANGUAGE PROGRAMMING AND INTERFACING.

1. Finding number of 1's and number of 0's in a given 8-bit number
2. Average of n-numbers.
3. Program and verify Timer/ Counter in 8051.
4. Interfacing of Switches and LEDs
5. Interfacing Traffic Light Controller to 8051.
6. UART operation in 8051
7. Interfacing LCD to 8051.

Part C: (Minimum of 2 Experiments has to be performed)

Conduct the following experiments using

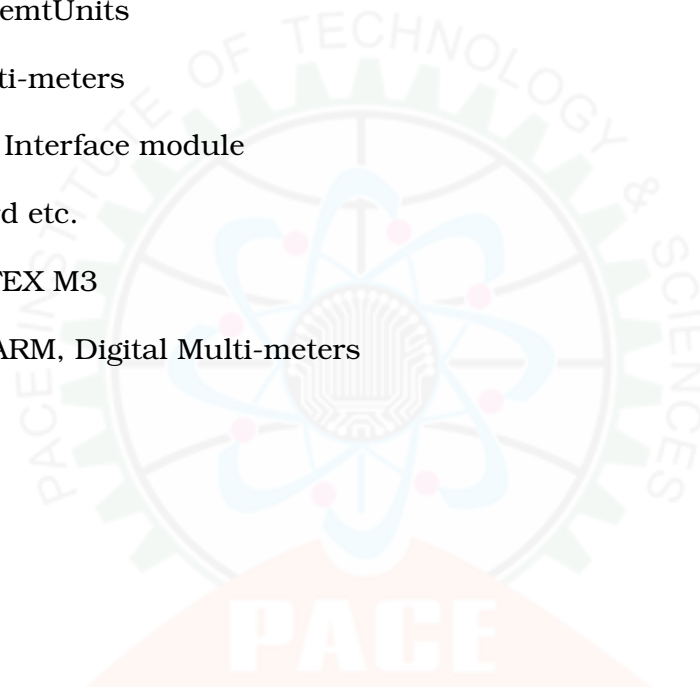
ARM CORTEX M3 PROCESSOR USING KEIL MDK ARM

1. Write an assembly program to multiply of 2 16-bit binary numbers.
2. Write an assembly program to find the sum of first 10 integers numbers.

3. Write a program to toggle LED every second using timer interrupt

Equipment Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits
5. ADC module, DAC module
6. Stepper motor module
7. Key board module
8. LED, 7-SegmentUnits
9. Digital Multi-meters
10. ROM/RAM Interface module
11. Bread Board etc.
12. ARM CORTEX M3
13. KEIL MDKARM, Digital Multi-meters



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL06	Digital Signal Processing Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Signals and Systems Lab

Course Objectives: The student will be able to

1. Revise MATLAB software & basic operations.
2. Implement Linear and Circular Convolution
3. Obtain frequency domain information.
4. Apply FIR and IIR filters.
5. Apply multi-rate concepts to real-time applications.

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

1. Calculate linear and circular convolution of discrete signals.
2. Sketch the magnitude and phase response of the discrete time signal's DFT, IDFT and FFT.
3. Develop algorithms for designing and implementing FIR and IIR filters with standard techniques.
4. Analyze the Multi-rate signal processing algorithms.

List of Experiments: (Minimum of Ten Experiments has to be performed)

1. Write a MATLAB program to obtain the Linear Convolution of two finite-length sequences.
2. Write a MATLAB program to obtain the Circular Convolution of two finite-length sequences.
3. Write a MATLAB program to find the Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT) of a given Discrete-Time signal.
4. Write a MATLAB program to obtain the N-Point FFT of a sequence.
5. Write a MATLAB program to compute the power density spectrum of a sequence.
6. Write a MATLAB program to design the following Butterworth filters
 - (a) Low Pass Filter
 - (b) Band Pass Filter
7. Write a MATLAB program to design the following Chebyshev filters
 - (a) Low Pass Filter

- (b) Band Pass Filter
8. Write a MATLAB program to design an FIR filter using the following Rectangular window.
- (a) Low Pass Filter
(b) Band Pass Filter
9. Write a MATLAB program to design an FIR filter using the following Triangular window.
- (a) Low Pass Filter
(b) Band Pass Filter
10. Write a MATLAB program to perform decimation and interpolation of a given signal.
11. Write a MATLAB program to verify Sampling theorem for a given continuous signal
12. Write a MATLAB program to convert the sampling rate of a given signal by using decimation and interpolation.
13. Write a MATLAB program to perform audio processing using simple signal processing algorithms.

Equipement Required:

1. PC
2. MATLAB

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, Inc ISBN: 9781449389628

6. The Myths of Creativity: The Truth About How Innovative Companies and People Generate Great Ideas, D Burkus Jossey-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, Jeff Gregersen, Hal B, 1958-Christensen, Clayton M Published: 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)

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE11	Microwave and Radar Engineering	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electromagnetic Waves and Transmission Lines, Wired and Wireless Transmission Devices

Course Objectives: The Course should enable the students to:

1. Understand the transmission Through Microwave Tubes.
2. Analyze the concepts of wave guides and its application
3. Understand different types of radars and its applications.
4. Design concept of tracking and different tracking techniques
5. Distinguish about various components of radar receivers and their performances

Course Outcomes: The student will be able to

1. understand about Microwave tubes and Helix TWTS and Microwave Solid state Devices
2. Know basic understanding about waveguides and its application
3. Understand the different types of radars and its applications.
4. Understand the concept of tracking and different tracking techniques.
5. Understand the various components of radar receiver and its performance.

UNIT-I: (10 Lectures)

Microwave tubes (qualitative treatment only): Microwave Tubes (qualitative treatment only): cavities, re-entrant cavities, two cavity klystrons-structure, velocity modulation and bunching process, reflex klystrons-structure, principle of working.

HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT.M-TYPE TUBES Introduction, Cross-field effects, Magnetrons – 8-Cavity Cylindrical Travelling WaveMagnetron.

Microwave Solid State Devices: introduction, classification, applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, LSA Mode of operation.

UNIT-II: (8 Lectures)

Waveguided Components and Its Applications: Waveguide attenuators – resistive card, rotary vane types, scattering matrix parameters: definition, properties, salient features -s- parameters of two port, three port, and four port networks. 2 Hole, Bethe Hologtypes

UNIT-III: (9 Lectures)

Basics of Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Receiver Noise, Illustrative Problems

CW AND FMCW Radar: Doppler Effect, CW Radar – Block Diagram, Non-zero IF Receiver, Applications of CW radar. Range and Doppler Measurement, Block Diagram and characteristics, FM-CWaltimeter.

MTI and Pulse Doppler Radar: Introduction, Principle, MTI Radar with – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers, Blind Speeds.

UNIT-IV:

(9 Lectures)

Tracking Radar: tracking with radar, sequential lobing, conical scan, mono pulse tracking radar-amplitude comparison mono pulse (one- and two- coordinates), phase comparison mono pulse, tracking in range, acquisition and scanning patterns, comparison of trackers.

UNIT-V:

(9 Lectures)

Radar Receivers –Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width Changes, Series versus parallel feeds, Applications, Advantages and Limitations.

Text Books:

1. Introduction to Radar Systems, 3rd edition – M.I. Skolnik, TMH Ed., 2005
2. Radar Engineering – GSN Raju, IK International
3. Pozar, David M.Microwave engineering. Johnwiley & sons,2011.

Reference Books:

1. Antenna Theory-C.A.Balanis, John Wiley & Sons, 3rd Ed.,2005.
2. Antennas and Wave Propagation–K. D. Prasad, Satya Prakashan, Tech India Publications, New Delhi,2001.

Web References:

1. <https://archive.nptel.ac.in/courses/108/101/108101092/>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT12	Internet of Things	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Computer Architecture & Organization , Microprocessors & Micro controllers, Python programming.

Course Objectives: The Course should enable the students to:

1. Learn the basic design of Internet of Things.
2. Understand the Programming concepts with Arduino.
3. Describe the IoT and Machine –to–Machine similarity.
4. Understand the design and development concepts of Internet of things.
5. Learn about connecting IoT physical devices and end points.

Course Outcomes: The student will be able to

1. Able to understand the applications of Internet of Things and Able to understand building blocks of Internet of Things and characteristics
2. Design some Arduino based prototypes.
3. Discriminate the similarity between IoT and M2M
4. Develop design methodology for IoT system design.
5. Illustrate how to connect IoT physical devices and end points.

UNIT-I: (9 Lectures)

Introduction to IoT: Introduction to Internet of Things ,Physical Design of IOT ,Logical Design of IOT,IOT Levels .Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Health & Life Style.

UNIT-II: (9 Lectures)

Programming with Arduino :Introduction to Arduino, Arduino UNO-Architecture, Arduino IDE Fundamentals of Arduino Programming, Arduino Interfacing –LED, Displays and sensors.

UNIT-III: (9 Lectures)

IoT AND M2M: Introduction to M2M,difference between IoT and M2M,software defined networking (SDN) and network function virtualization (NFV)for IoT. IoT system

management: Need for IOT Systems Management, Simple Network Management Protocol (SNMP), Network Operator Requirements.

UNIT-IV: (9 Lectures)

Developing Internet of Things: Introduction ,IOT Design Methodology, case study on IoT Systems for weather monitoring. Logical Design using Python : Introduction ,Python Data , Types & Data Structures ,Control Flow, Functions ,Modules, Packages, File Handling ,Data/Time operations ,Classes, Python Packages for IOT.

UNIT-V:**(9 Lectures)**

IOT Physical Devices & Endpoints: What is an IOT Device ,Exemplary Device: Raspberry Pi— About the Board ,Interfaces-serial,SPI,I2C,and Programming Raspberry Pi, Other IOT Devices

Text Books:

1. Matt Richardson , Shawn Wallace,—Getting Started with Raspberry Pi, O'Reilly (SPD), 3RD Edition,2014.
2. Simon Monk—Programming Arduino : Getting Started with Sketches ,Second Edition (ELECTRONICS),2016.

Reference Books:

1. Ardian McEwen, Hakim Cassimally,—Designing the Internet of Things, Jhon Wiley and Sons 2014.
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things : Enabling Technologies, Platforms, and Use Cases", CRC Press ,2017.3.'Beginning Arduino "Michal Mc Roberts, Second Edition.

Web References:

1. <https://www.coursera.org/specializations/iot>
2. https://spoken-tutorial.org/tutorial-search/?_foss=Arduino&search_language=English
3. https://onlinecourse.swyam2.ac.in/aic20_sp40/preview
4. <https://online.stanford.edu/course/ee284a-introduction-internet-things>
5. https://onlinecourses.nptl.ac.in/noc20_cs66/preview

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT13	VLSI Design	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Semiconductor Devices and Circuits, Switching Theory and Logic Design, Linear and Digital IC Applications.

Course Objectives: The Course should enable the students to:

1. Basic characteristics of MOS transistor and examines various possibilities for configuring inverter circuits and aspects of latch-up are considered.
2. Design processes are aided by simple concepts such as stick and symbolic diagrams but the key element is a set of design rules, which are explained clearly.
3. Basic circuit concepts are introduced for MOS processes we can set out approximate circuit parameters which greatly ease the design process.
4. CMOS combinational and Data path subsystem
5. FPGA architectures and various structures explained and

Course Outcomes: The student will be able to

1. Explain various MOS transistor characteristics and fabrication process techniques.
2. Develop stick diagrams for various MOS circuits and distinguish design rules.
3. Design basic MOS circuits with circuit concepts along with scaling concepts.
4. Explain CMOS combinational and sequential logic circuit design.
5. Distinguish various FPGA architectures and logic synthesis

UNIT-I:

(9 Lectures)

Introduction and Basic Electrical Properties of MOS Circuits: Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. I_{ds} versus V_{ds} Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

UNIT-II:

(9 Lectures)

MOS and Bi-CMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout, $2\mu m$ Double Metal, Double Poly, CMOS/BiCMOS rules, $1.2\mu m$ Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter, Symbolic Diagrams-Translation to Mask Form.

UNIT-III:**(9 Lectures)**

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, Some area Capacitance Calculations, The Delay Unit, Inverter Delays, Driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers.

Scaling of MOS Circuits: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Switch logic, Gate logic.

UNIT-IV: CMOS Combinational and Data Path Subsystem: (9 Lectures)

Static CMOS Design: Complementary CMOS, Rationed Logic, Pass-Transistor Logic. Dynamic

CMOS Design: Dynamic Logic-Basic Principles, Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates.

Data Path Subsystem: Subsystem Design, Barrel Shifters, Adders, ALUs, Multipliers, Parity Generators, Comparators, Zero/one Detectors, Counters.

Memory Array Subsystem: SRAM, DRAM, ROM, Seral acces Memory

UNIT-V:**(9 Lectures)**

FPGA Design: FPGA design flow, Basic FPGA architecture, FPGA Technologies, FPGA families- Altera Flex 8000FPGA, Altera Flex 10FPGA, Xilinx XC4000 series FPGA, Xilinx Spartan XL FPGA, Xilinx Spartan II FPGAs, Xilinx Vertex FPGA. Case studies: FPGA Implementation of Half adder and full adder. Introduction to Synthesis: Logic Synthesis, RTL Synthesis, High Level Synthesis

Text Books:

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and SholehEshraghian, Prentice-Hall of India Private Limited, 2005 Edition
2. CMOS Digital Integrated Circuits Analysis and Design- Sung-Mo Kang, Yusuf Leblebici, Tata McGraw-Hill Education, 2003.
3. CMOS VLSI DESIGN: ACircuit and system Perspective, Neil H.E WASTE David Harris,Ayan, Benerjee, 3rd ED,Pearson 2009.

Reference Books:

1. Advanced Digital Design with the Verilog HDL, Michael D.Ciletti, Xilinx Design Series, Pearson Education
2. Analysis and Design of Digital Integrated Circuits in Deep submicron Technology, 3'rd edition, David Hodges.

Web References:

1. <https://nptel.ac.in/courses/117/101/117101058/>
2. https://www.tutorialspoint.com/vlsi_design/index.htm

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE05	Optical Fiber Communication	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Objectives: The Course should enable the students to:

1. To realize the significance of optical fiber communications.
2. To understand the construction and characteristics of optical fiber cable.
3. To develop the knowledge of optical signal sources and power launching.
4. To identify and understand the operation of various optical detectors.
5. To under the design of optical systems and WDM.

Course Outcomes: The student will be able to

1. Understand and analyze the constructional parameters of optical fibers.
2. be able to design the optical system.
3. Estimate the losses due to attenuation, absorption, scattering and bending.
4. Compare various optical detectors and choose suitable one for different applications.
5. Able to demonstrate the design of WDM

UNIT-I: (10 Lectures)

OPTICAL FIBER COMMUNICATIONS: Historical development, the general system, advantages of Optical fiber communications. Optical fiber wave guides- Ray theory transmission, Modes in Planar guide, phase and group velocity, cylindrical Fiber -Modes. Fiber materials, Fiber Fabrication techniques, fiber optic cables, Classification of Optical Fibers: Single mode fibers, Graded Index fibers.

UNIT-II: (10 Lectures)

SIGNAL DISTORTION IN OPTICAL FIBERS: -Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode Dispersion, Intermodal dispersion, pulse broadening. Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return Loss, Optical Fiber Splicing.

UNIT-III: (10 Lectures)

OPTICAL SOURCES: Intrinsic and extrinsic material-direct and indirect band gaps-LED - LED structures-surface emitting LED-Edge emitting LED-quantum efficiency and LED Power- light source materials-modulation of LED. LASER diodes - modes and threshold conditions-Rate equations-external quantum Efficiency-resonant frequencies-structures and radiation patterns- single mode laser-external Modulation-temperature effects.

UNIT-IV:**(9 Lectures)**

SOURCE TO FIBER POWER LAUNCHING: Source to fiber power launching, Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers

UNIT-V:**(9 Lectures)**

OPTICAL SYSTEM DESIGN: Considerations, Component choice, Multiplexing, Point-to-point links, System considerations, Link power budget with examples. Rise time budget with examples. WDM –Passive DWDM Components-Elements of optical networks.

Text Books:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

Reference Books:

1. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
2. Fiber Optic Communication Systems – Govind P. Agarwal, John Wiley, 3rd Edition, 2004.

Web References:

1. <https://archive.nptel.ac.in/courses/108/106/108106167/>
2. https://www.trumpf.com/en_INT/solutions/applications/optical-communication
3. <https://www.youtube.com/watch?v=OQUupuqT-GI>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE04	Digital Image Processing	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Signals and Systems, Digital Signal Processing

Course Objectives: The Course should enable the students to:

1. Study the image fundamentals and mathematical transforms necessary for image processing.
2. Acquire knowledge about simple image enhancement techniques in the Spatial and Frequency domain.
3. Understanding of color models, type of image representations and related statistics.
4. Study image segmentation and compression techniques.
5. Introduce wavelets and multi-resolution techniques for image processing.

Course Outcomes: The student will be able to

1. Demonstrate knowledge about the fundamentals of digital image and its processing.
2. Apply image enhancement techniques for improving the quality of images.
3. Analyze pseudo and full-color image processing techniques.
4. Elucidate the mathematical modelling of image segmentation and compression.
5. Apply multi-resolution techniques for image processing.

UNIT-I:

(10 Lectures)

Digital Image Fundamentals: Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, an introduction to the mathematical tools used in Digital Image Processing.

UNIT-II:

(9 Lectures)

Image Enhancements and Filtering: Gray level transformations, histogram equalization and specifications, Fundamentals of Spatial Filters, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Two-dimensional DFT and its inverse, The basics of filtering in the Frequency Domain, Image smoothing using frequency domain filters, Image sharpening using frequency domain filters, Selective filtering.

UNIT-III:

(9 Lectures)

Color Image Processing: Color fundamentals, Color models: RGB, YUV, HSI; Pseudo color Image Processing Color transformations, Color image smoothing and sharpening, Image segmentation based on color.

UNIT-IV: (9 Lectures)

Image Segmentation: Fundamentals, point, line, edge detection, thresholding, region -based segmentation.

Image Compression: Fundamentals, Some basic compression Methods, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Block transform coding.

UNIT-V: (9 Lectures)

Wavelets and Multi-resolution Processing: Image pyramids, subband coding, Multi-resolution expansions, wavelet transforms in one dimensions & two dimensions, Wavelet coding.

Applications: Image Processing applications in satellite, sonar, radar and medical areas

Text Books:

1. R.C.Gonzalez and R.E. Woods, "Digital Image Processing", Second Edition, Pearson Education.
2. Anil Kumar Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India.

Reference Books:

1. S Jayaraman, S Esakkirajan, T Veerakumar, Digital Image Processing, MC-GRAW HILL Publications, 2010.
2. S.Sridhar, Digital Image Processing, Oxford University Press, 2016.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Thomson learning, Second Edition, 2001.

Web References:

1. <https://nptel.ac.in/courses/117105079>
2. <https://nptel.ac.in/courses/117105135>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECE06	Analog IC Design	3	0	0	3

Internal Marks: 30

External Marks: 70

Prerequisites: Electronics Devices and Circuits, Integrated Circuits & Applications

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

1. Understand the concepts of electrical MOS transistor.
2. Analyze different types of current mirrors
3. Demonstrate one stage and two stage CMOS operational amplifiers.
4. Demonstrate on MOS design circuits.
5. Demonstrate of dynamic logic circuits.

UNIT-I: Basic introduction about MOS Circuits (10 Lectures)

Basic electrical properties of MOS and CMOS circuits, MOS and CMOS circuit design processes, Basic circuit concepts, scaling of MOS circuits-qualitative and quantitative analysis with proper illustrations and necessary derivations of expressions

UNIT-II: (10 Lectures)

Analog CMOS Sub-Circuits: Basic current mirrors, Cascode current mirrors, Active current mirrors, Current mirror with Beta Helper, Degeneration, Cascade current, Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures. Design of CMOS Op Amps

UNIT-III: (10 Lectures)

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic

UNIT-IV: (5 Lectures)

Operational Amplifiers General considerations, One-stage op-amps, Cascode op-amps, Folded cascode op-amp topology, two-stage op-amps, gain boosting, comparison.

UNIT-V: (9 Lectures)

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

Text Books:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, TMH, 2007.
2. D. A. John, Ken Martin, Analog Integrated Circuit Design, 2nd Edition, John Wiley, 1997.

Reference Books:

1. Paul R Gray, Robert G Meyer, Analysis and Design of Analog Integrated Circuits, 4th Edition, John Wiley and Sons, 2009.
2. Gregorian, Temes, Analog MOS Integrated Circuits, 1st Edition, John Wiley, 1986.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL09	Internet of Things Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Objectives: The student will be able to

1. Develop an IOT enabled technologies which are cost effective and socially relevant.
2. Study the field of IOT based application development

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

1. Design the IOT simple projects for basic application with sensors.
2. Develop of IoT module using hardware and software components.
3. Understand the IOT tested which is an open and developing ecosystem of edge devices, Communication protocols ,cloud-based platforms
4. Implement control devices and data monitoring in real-time and take necessary actions.

MINIMUM TWELVE EXPERIMENTS TO BE CONDUCTED:

PART-A (Any 6 Experiments)

ARDUINO BASED EXPERIMENTS :

1. LED Blink and pattern
2. 7 Segment Display
3. LM35 Temperature sensor
4. Controlling Two Actuators Using Arduino
5. Iot Based Air Pollution Control System
6. Ultrasonic Distance measurement
7. IR Sensor Based Security System.

PART-B (Any 6 Experiments)

RASPBERRY Pi BASED EXPERIMENT

1. Think Speak Based DHT Sensor Monitoring
2. Node Red Based IOT Configuration
3. AWS IOT Basic Configuration
4. Alexa based Home Automation System

5. Dht11 sensor Data To Cloud
6. A Heart Rate Monitoring System
7. AWS Based DHT Sensor

Equipement Required:**For Part-A**

1. Arduino Uno
2. 9/12V Battery
3. Computer with Arduino IDE software
4. Jumper cables
5. Center tapped transformer (230/6-0-6V)(As required)

For Part-B

1. Raspberry Pi
2. 9/12V Battery
3. Computer with Raspberry Pi IDE software
4. Jumper cables
5. Center tapped transformer (230/6-0-6V)(As required)
6. 16 x2 LCD display

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECL10	VLSI Design Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Note The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the following experiments using 130nm technology with the Industry standard EDA Tools.

List of Experiments:

1. Design and Implementation of an Inverter
2. Design and Implementation of an Universal Gates
3. Design and Implementation of Full Adder
4. Design and Implementation of Full Subtractor
5. Design and Implementation of Encoder
6. Design and Implementation of Decoder
7. Design and Implementation of SR-Latch
8. Design and Implementation of D-Latch
9. Design and Implementation asynchronous counter
10. Design and Implementation of static RAM cell
11. Design and Implementation of 8 bit DAC using R-2R latter network

Software Required:

1. Mentor Graphics Software / Equivalent Industry Standard Software.
2. Personal computer system with necessary software to run the programs and to implement.