Jawaharlal Nehru Technological University Anantapur

(Established by Govt. of A.P., Act. No. 30 of 2008)

Ananthapuramu–515 002 (A.P) India

Academic Regulations (R20) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the Academic Year **2020-2021** onwards)

and

Academic Regulations (R20) for B.Tech (Lateral Entry Scheme)

(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year **2021-2022** onwards)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERISTY ANANTAPUR

AMENDMENT
in
B.TECH. R20 ACADEMIC REGULATIONS
(As per AICTE guidelines)

Applicable for the Regular Students admitted from the academic year 2021-22 onwards and for the Lateral Entry Students admitted from 2022-23 onwards

1. The course on Universal Human Values which was offered as a non-credit mandatory course will now be carrying 03 credits

   This is compulsory subject for all UG Degree Course in Engineering & Technology, with 03 exclusive credits. Hence the overall credits of curriculum are 163 credits instead of 160 credits for regular and 124 credits instead of 121 for lateral entry students.

   It is offered in 3rd semester for all the disciplines of Engineering & Technology

2. Environmental Science which is a non-credit mandatory course will now be offered in 5th semester for all disciplines of Engineering & Technology

1. **Award of the Degree**
a) **Award of the B.Tech. Degree**

A student will be declared eligible for the award of the B.Tech. degree if he/she fulfils the following:

i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).

ii) Registers for 160 credits and secures all 160 credits.

b) **Award of B.Tech. degree with Honours/Minor**

A student will be declared eligible for the award of the B.Tech. with Honours/Minor if he/she fulfils the following:

i) Student secures additional 20 credits fulfilling all the requisites of a B.Tech. program i.e., 160 credits

ii) A student is permitted to register either for Honours or a Minor but not for both. Registering for Honours/Minor is optional.

iii) Honours/Minor is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

3. **Courses of study:**

The following courses are offered at present as specializations for the B. Tech. program for non-autonomous, constituent & affiliated colleges from 2020-21

S. No.	Name of the Program	Program Code
1.	Civil Engineering	01
2.	Electrical and Electronics Engineering	02
3.	Mechanical Engineering	03
4.	Electronics and Communication Engineering	04
5.	Computer Science and Engineering	05
6.	Information Technology	12
7.	Food Technology	27
8.	Artificial Intelligence & Data Science	30
9.	Computer Science and Engineering (Artificial Intelligence)	31
10.	Computer Science and Engineering (Data Science)	32
11.	Computer Science and Engineering (Artificial Intelligence & Machine Learning)	33
12.	Computer Science and Engineering (IoT)	35

and any other course as approved by the authorities of the University from time to time.

4. Admissions:

Admission to the B. Tech Program 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 based on the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or 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.

5. Program related terms:

    a) Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

    Credit definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
2 Hrs. Practical (Lab) per week	1 credit

    b) Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

    c) Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses.

6. Structure of the Undergraduate Programme

All courses offered for the undergraduate program (B. Tech.) are broadly classified as follows:

S.No.	Category	Code	Breakup of Credits (Total 160)
1.	Humanities and Social Science including Management courses	HS	10.5
2.	Basic Science courses	BS	21
3.	Engineering Science Courses	ES	24
4.	Professional Core Courses	PC	51
5.	Professional Elective Courses	PE	15
6.	Open Elective Courses	OE	12
7.	Skill Oriented Courses	SC	10
8.	Internship, Project work	PR	16.5
9.	Non-credit Mandatory Courses	MC	Non credit

7. Course Classification:

All subjects/ courses offered for the undergraduate programme in E&T (B.Tech. degree programmes) are broadly classified as follows. The University has followed the guidelines issued by AICTE/UGC.

S.No.	Broad Course Classification	Course Category	Description
1.	Foundation Core Courses	Foundation courses	Includes mathematics, physics and chemistry Courses; fundamental engineering courses; humanities, social sciences and management courses
2.	Core Courses	Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
3.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include interdisciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering
4.	Project & Internships	Project	B.Tech. Project or Major Project
		Internships	Summer Internships – Community based and Industry Internships Industry oriented Full Semester Internship
5.	Audit Courses	Mandatory noncredit courses	Covering subjects of developing desired attitude among the learners

8. Programme Pattern

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

ii.   Each academic year of study is divided into two semesters.

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

iv.   There shall be mandatory student induction program for freshers, with a three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.

v.   All undergraduate students shall register for NCC/NSS/ activities. A student will be required to participate in an activity for two hours in a week either in third or fourth semester. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet based on participation, attendance, performance, and behaviour. If a student gets an unsatisfactory grade, he/she shall repeat the above activity in the subsequent years, to complete the degree requirements

vi.   Courses like Environmental Sciences, Universal Human Values, Indian Constitution, Design Thinking for Innovation and Employability Skills is offered as non-credit mandatory courses for all branches.

vii.   Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

viii.   Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in an emerging area within the chosen field of study.

ix. Student can opt for any open elective other than open elective offered by his/her own department. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to that of their departmental core/elective courses.

x. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.

xi. Students shall undergo mandatory summer internships, for a minimum of six weeks duration at the end of second and third year of the programme. There shall also be mandatory full internship in the final semester of the programme along with the project work.

xii. Undergraduate degree either with Honours or a Minor is introduced by the University for the students having good academic record

xiii. Each college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

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

xv. Preferably 25% course work for the theory courses in every semester shall be conducted in the blended mode of learning.

9. Evaluation Process

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical subject. Summer Internships shall be evaluated for 50 marks, Full Internship &Project work in final semester shall be evaluated for 200 marks, mandatory courses with no credits shall be evaluated for 30 mid semester marks.

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.

ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.

iii) If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B)

iv) If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of 'T' for theory subject and 'P' for practical subject.

a) Continuous Internal Evaluation

i) For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective paper with 20 objective type questions (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.

ii) Objective paper shall be set for maximum of 20 bits for 10 marks. Subjective paper shall contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer one from each either-or type question. Each question carries 5 marks.

Note:

- The objective paper with 20 objective type questions shall be prepared in line with the quality of competitive examinations questions.
- The subjective paper shall contain 3 either or type questions of equal weightage of 5 marks. Any fraction shall be rounded off to the next higher mark.
- The objective paper shall be conducted either online or offline by the respective institution on the day of subjective paper test.
- If conducted offline, the midterm examination shall be conducted first by distribution of the Objective paper, simultaneously marking the attendance, after 20 minutes the answered objective paper shall be collected back. The student is not allowed to leave the examination hall.
  Then the descriptive question paper and the answer booklet shall be distributed. After 90minutes the answered booklets are collected back.
- The assignment shall contain numerical problems/software development. If subject is purely descriptive and does not have any numerical problems, then essay type question/term paper shall be given. It should be continuous assessment throughout the semester. There shall be five assignments one for each unit and the average marks shall be considered.

iii) If the student is absent for the mid semester examination, no re-exam shall be conducted and mid semester marks for that examination shall be considered as zero.

iv) First midterm examination shall be conducted for I, II units of syllabus with one either or type question from each unit and third either or type question from both the units. The second midterm examination shall be conducted for III, IV and V units with one either or type question from each unit.

v) Final mid semester marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage given to the better mid exam and 20% to the other. For Example:

> Marks obtained in first mid: 25
> Marks obtained in second mid: 20
> Final mid semester Marks: (25x0.8) + (20x0.2) = 24

If the student is absent for any one midterm examination, the final mid semester marks shall be arrived at by considering 80% weightage to the marks secured by the student in the appeared examination and zero to the other. For Example:

> Marks obtained in first mid: Absent
> Marks obtained in second mid: 25
> Final mid semester Marks: (25x0.8) + (0x0.2) =20

b) End Examination Evaluation:
End examination of theory subjects shall have the following pattern:
i) There shall be 6 questions and all questions are compulsory.
ii) Question I shall contain 10 compulsory short answer questions for a total of 20marks such that each question carries 2 marks.
iii) There shall be 2 short answer questions from each unit.
a) In each of the questions from 2 to 6, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question.

End examination of theory subjects consisting of two parts of different subjects, for Example: Basic Electrical &Electronics Engineering shall have the following pattern:
i) Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.
ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1mark.
iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question

b) For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the regularity/record/viva and 15 marks for the internal test. The end examination shall be conducted by the concerned laboratory teacher and a senior expert in the subject from the same department.

In a practical subject consisting of two parts (Eg: Basic Electrical &Electronics Engineering Lab), the end examination shall be conducted for 35 marks in each part. Mid semester examination shall be evaluated as above for 30 marks in each part and final mid semester marks shall be arrived by considering the average of marks obtained in two parts.

c) For the subject having design and/or drawing, such as Engineering Drawing, the distribution of marks shall be 30 for mid semester evaluation and 70 for end examination.

Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weightage of 80% to better mid marks and 20% for the other. The subjective paper shall contain 3 either or type questions of equal weightage of 5 marks. There shall be no objective paper in mid semester examination. The sum

of day-to-day evaluation and the mid semester marks will be the final sessional marks for the subject.

The end examination pattern for Engineering Graphics, shall consists of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination. However, the end examination pattern for other subjects related to design/drawing is mentioned along with the syllabus.

d) There shall be no external examination for mandatory courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a re-examination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.

e) The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

10. Skill oriented Courses

i) There shall be five skill-oriented courses offered during III to VII semesters.

ii) Out of the five skill courses two shall be skill-oriented courses from the same domain. Of the remaining three skill courses, one shall be a soft skill course and the remaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.

f) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/assignments/viva/mid semester test. The end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the subject nominated by the principal.

iii) The Head of the Department shall identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The marks/grades shall be assigned to the students by the above committee based on their performance.

iv) 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 or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from

the agency. A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.

v) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the University at the beginning of the semester. The principal of the respective college shall forward such proposals to the University for approval.

vi) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the University.

11. MOOCs through SWAYAM Platform:

There shall be five professional elective courses and four open elective courses, which are Choice Based Credit Courses (CBCC), offered from V semester onwards. Among them, one elective course shall be pursued through MOOCs. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the student's assignment submissions given by SWAYAM. The student needs to earn a certificate by passing the exam. The student shall be awarded the credits assigned in the curriculum only by submission of the certificate. Examination fee, if any, will be borne by the student.

A Student must complete the SWAYAM MOOC course in all respects on or before 5 / 6 / 7 semester. Students' MOOC course score in terms of marks/grade/credits will be counted in their 5/6/7 semester marks sheet as the case may be. Students who have qualified in the proctored examinations conducted by the SWAYAM and apply for credit transfer as specified are exempted from appearing internal as well as external examination (for the specified equivalent credit course only) conducted by the university.

Necessary amendments in rules and regulations regarding adoption of SWAYAM MOOCS courses would be proposed from time to time.

Credit Equivalence for SWAYAM MOOCs Courses:
    Courses of 04 weeks duration: 01 Credit
    Courses of 08 weeks duration: 02 Credits
    Courses of 12 weeks duration: 03 Credits
    Courses of 16 weeks duration: 04 Credits

12. Credit Transfer Policy

Adoption of MOOCs is mandatory for all students, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per University Grants

Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University shall allow up to a maximum of 40% of the total courses being offered in a particular Programme in a semester through the Online Learning courses through SWAYAM platform (www.swayam.gov.in).

i) The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

ii) The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in the platform.

iii) Student registration for the MOOCs shall be only through the institution, it is mandatory for the student to share necessary information with the institution

iv) Credit transfer policy will be applicable to the Professional & Open Elective courses offered by the university under Choice Based Credit System (CBCS).

v) The institution shall select the courses to be permitted for credit transfer through SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum as it may otherwise lead to duplication and repetition of the same course

vi) The University/institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

vii) The institution shall also ensure that the student has to complete the course and produce the course completion certificate as per the academic schedule given for the regular courses in that semester

viii) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

ix) The university shall ensure no overlap of SWAYAM MOOC exams with that of the university examination schedule. In case of delay in SWAYAM results, the university will re-issue the marks sheet for such students.

x) Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

xi) The institution shall submit the following to the examination section of the university:

    a) List of students who have passed MOOC courses in the current semester along with the certificates of completion.

    b) Undertaking form filled by the students for credit transfer.

xii) The university shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall also be permitted to register for MOOCs offered through online platforms other than SWAYAM / NPTEL. In such cases, credit transfer shall be

permitted only after seeking approval of the University at least three months prior to the commencement of the semester.

13. Mandatory Internships
Summer Internships:

Two summer internships either onsite or virtual each with a minimum of six weeks duration, done at the end of second and third years, respectively are mandatory. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Hydel and thermal power projects, software MNCs or any industries in the areas of concerned specialization of the Undergraduate program. One of the two summer internships shall be society oriented and shall be completed in collaboration with government organizations/NGOs & others. The student shall register for the internship as per course structure after commencement of academic year.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate from industry 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. 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 University.

Full Semester Internship and Project work:

In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) 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. 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 University and is evaluated for 140 marks

The College 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.

14. **Guidelines for offering a Minor**

The main objective of Minor in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B. Tech. programme. Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department and as defined by the respective department offering Minor program.

i) Minor is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) Minor programs shall be offered in emerging technologies by the respective departments or in collaboration with the relevant industries/agencies.

iii) A student shall earn additional 20 credits in the specified area to be eligible for the award of B.Tech. degree with Minor. This is in addition to the credits essential for obtaining the Undergraduate Degree in Major Discipline (i.e., 160 credits).

iv) A student is permitted to register for a Minor offered by a department other than the parent department and as defined by the respective department offering Minor program.

v) A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline

vi) A student is permitted to register for Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.

vii) The courses offered under Minor can have theory as well as laboratory component. If a course comes with a lab component, that component is to be cleared separately

viii) The Concerned Principal of the college shall arrange separate class work and timetable of the courses offered under various Minor programs.

ix) Courses that are used to fulfil the student's primary major may not be double counted towards the Minor. Courses with content substantially equivalent to courses in the student's primary major may not be counted towards the Minor.

x) Students can complete the courses offered under Minor either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria defined for credit mobility. If the courses under Minor are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses

xi) The attendance for the registered courses under Minor and regular courses offered for Major degree in a semester are to be considered separately.

xii) A student shall maintain an attendance of 75% in all registered courses of Minor to be eligible for attending semester end examinations.

xiii) A student detained due to lack of attendance and having backlogs in regular B. Tech program shall not be permitted to continue Minor

xiv) A student registered for Minor in a discipline shall pass in all subjects that constitute the requirement for the Minor degree programme. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Minor degree programme.

xv) If a student drops or is terminated from the Minor program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xvi) The Minor in a discipline will be mentioned in the degree certificate as Bachelor of Technology in XXX with Minor in YYY. For example, Bachelor of Technology in Mechanical Engineering with Minor in Machine Learning.

Enrolment into a Minor:

i) The enrolment of student into a Minor is based on the percentage of marks obtained in the major degree program.

ii) Percentage of marks shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 60% of marks without any backlog subjects will be permitted to register for a Minor.

iii) If a student is detained due to lack of attendance in either Major or Minor program, registration shall be cancelled

iv) Minimum strength required for offering a Minor offline in a discipline is considered as 20% of the sanctioned intake. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department satisfying the criteria for credit mobility.

v) Transfer of credits from a particular Minor to regular B. Tech. and vice-versa shall not be permitted

vi) Minor is to be completed simultaneously with Major degree program.

Registration for Minor:

i) The institution will announce specialization, eligibility and courses offered by the departments under Minor and seek registrations in IV Semester, after the results of III Semester are announced.

ii) The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to

register the courses under Minor.

iii) The selected students shall submit their willingness to the principal through his/her parent department which shall be forwarded to the concerned departments offering Minor. Both parent department and department offering minor shall maintain the record of student pursuing the Minor.

iv) The students enrolled in the minor courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

v) There is no fee for registration of subjects under Minor program offered in offline at the respective institutions.

15. Guidelines for offering Honours

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honours is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) A student shall earn additional 20 credits for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 160 credits).

iii) A student is permitted to register for Honours in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honours from V Semester onwards.

iv) The Concerned Principal of the college shall arrange separate class work and timetable of the courses offered under Honours program.

v) Courses that are used to fulfil the student's primary major may not be double counted towards the Honours. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honours.

vi) Students can complete the courses offered under Honours either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honours are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses

vii) The attendance for the registered courses under Honours and regular courses offered for Major degree in a semester are to be considered separately.

viii) A student shall maintain an attendance of 75% in all registered courses under

Honours to be eligible for attending semester end examinations.

ix) A student registered for Honours shall pass in all subjects that constitute the requirement for the Honours degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honours degree programme.

x) If a student drops or is terminated from the Honours program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xi) The Honours will be mentioned in the degree certificate as Bachelor of Technology (Honours) in XXX. For example, B.Tech. (Honours) in Mechanical Engineering

Enrolment into Honours:

i) Students of a Department/Discipline are eligible to opt for Honours program offered by the same Department/Discipline

ii) The enrolment of student into Honours is based on the percentage of marks obtained in the major degree program. Percentage of marks shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 70% without any backlog subjects will be permitted to register for Honours.

iii) If a student is detained due to lack of attendance either in Major or in Honours, registration shall be cancelled

iv) Minimum strength required for offering Honours offline is considered as 20% of the sanctioned intake. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department satisfying criteria for credit mobility.

v) Transfer of credits from Honours to regular B. Tech degree and vice-versa shall not be permitted

vi) Honours is to be completed simultaneously with a Major degree program.

Registration for Honours:

i) The institution will announce courses offered by the departments under Honours before the start of the semester.

ii) The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honours.

iii) The selected students shall submit their willingness to the Principal through his/her parent department offering Honours. The parent department shall maintain the record of student pursuing the Honours.

iv) The students enrolled in the Honours courses will be monitored continuously.

An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

v) There is no fee for registration of subjects for Honours program offered in offline at the respective institutions.

15. Attendance Requirements:

i) A student shall be eligible to appear for the University external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.

iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the University.

iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.

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

vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

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

16. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 14.

i) A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per university norms.

ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any *decimal* fraction should be *rounded off* to *lower* digit) up to in the subjects that have been studied up to III semester from the following examinations, irrespective of whether the candidate takes the end examination or not as per the normal course of study.

> One regular and two supplementary examinations of I Semester
> One regular and one supplementary examination of II Semester
> One regular examination of III semester

iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any *decimal* fraction should be *rounded off* to *lower* digit) in the subjects that have been studied up to V semester from the

following examinations, irrespective of whether the candidate takes the end examination or not as per the normal course of study.

One regular and four supplementary examinations of I Semester.

One regular and three supplementary examinations of II Semester.

One regular and two supplementary examinations of III Semester.

One regular and one supplementary examination of IV Semester.

One regular examination of V Semester.

And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.

iv) When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

17. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	Grade	Grade points Assigned
≥ 90	S (Superior)	10
$\geq 80 < 90$	A (Excellent)	9
$\geq 70 < 80$	B (Very Good)	8
$\geq 60 < 70$	C (Good)	7
$\geq 50 < 60$	D (Average)	6
$\geq 40 < 50$	E (Pass Average)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For noncredit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA = \Sigma\ (C_i \times G_i)/\Sigma\ C_i$$

where, C_i is the number of credits of the ith subject and G_i is the grade point scored by the student in the ith course.

i) The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

$$CGPA = \Sigma\ (C_i \times S_i)/\ \Sigma\ C_i$$

where "S_i" is the SGPA of the ith semester and C_i is the total number of credits up to that semester.

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

iii) While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.
Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D and F.

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/she shall be placed in one of the following four classes:

Class Awarded	Percentage of Marks to be secured
First Class with Distinction	≥70%
First Class	< 70% ≥ 60%
Second Class	< 60% ≥ 50%
Pass Class	< 50% ≥ 40%

19. **With–holding of Results**

If the candidate has any dues not paid to the university or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld, and the candidate will not be allowed/promoted into the next higher semester. The issue of awarding degree is liable to be withheld in such cases.

20. **Transitory Regulations**

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have

been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, subject to Section **2** and they will follow the academic regulations into which they are readmitted.

21. Minimum Instruction Days for a Semester:

The minimum instruction days including exams for each semester shall be 90 days.

22. 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.

23. Student Transfers:

Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh and the University from time to time.

24. General Instructions:

a. The academic regulations should be read as a whole for purpose of any interpretation.
b. Malpractices rules-nature and punishments are appended.
c. Where the words "he", "him", "his", occur in the regulations, they also include "she", "her", "hers", respectively.
d. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
e. The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls witheffect from the dates notified by the University.

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ACADEMIC REGULATIONS (R20)
FOR B.TECH. (LATERAL ENTRY SCHEME)

*(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year **2021-2022** onwards)*

1. Award of B.Tech. Degree

A student admitted in Lateral Entry Scheme (LES) will be declared eligible for the award of the B.Tech degree if the student fulfils the following academic regulations:

   a) Pursues a course of study for not less than three academic years and not more than six academic years.
   b) Registers for *121* credits and secures all *121* credits from II to IV year of Regular B. Tech. program.

2.
Students, who fail to fulfil the requirement for the award of the degree within six consecutive academic years from the year of admission, shall forfeit their seat.

3. Minimum Academic Requirements:

The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.**4**

   i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.
   ii. A student shall be promoted from third year to fourth year only if the student fulfils the academic requirements of securing 40% of credits (any *decimal* fraction should be *rounded off* to *lower* digit) from the following examinations, irrespective of whether the candidate takes the end examination or not as per the normal course of study.
       a. One regular and two supplementary examinations of III semester.
       b. One regular and one supplementary examination of IV semester.
       c. One regular examination of V semester.

   And in case if student is already detained for want of credits for particular academic year, the student may make up the credits through supplementary exams of the above exams before the commencement of IV year I semester class work of next year.

4. Course Pattern

   4.1. The entire course of study is three academic years on semester pattern.
   4.2. A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

4.3. When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

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

6. There shall be a bridge course in Mathematics with zero credits in III semester for all disciplines. The course work is conducted for 20 Hrs in the semester and there shall be no examination conducted for the course.

5. Lateral Entry Students shall compulsorily pursue mandatory non-credit courses Environmental Science and Universal Human Values either in III semester or IV semester.

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RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
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 for four consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of 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 four consecutive semesters from class work and all University examinations, if his involvement is established. Otherwise, the candidate is debarred for two consecutive semesters from class work and all University 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 University 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 only.
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. If the candidate physically assaults the invigilator/ officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University 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

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.
		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.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations, depending on the recommendation of the committee.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
3. A show cause notice shall be issued to the college.
4. Impose a suitable fine on the college.
5. Shifting the examination centre from the college to another college for a specific period of not less than one year.

Note:-

Whenever the performance of a student is cancelled in any subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfil all the norms required for the award of Degree.

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Jawaharlal Nehru Technological University Anantapur

(Established by Govt. of A.P., Act. No. 30 of 2008)

Ananthapuramu–515 002 (A.P) India

First Year B.Tech

Course Structures and Syllabi under R20 Regulations

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Semester-0

Induction Program: 3 weeks
(Common for All Branches of Engineering)

S.No	Course No	Course Name	Category	L-T-P-C
1		Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2		Career Counselling	MC	2-0-2-0
3		Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4		Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5		Proficiency Modules & Productivity Tools	ES	2-1-2-0
6		Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7		Remedial Training in Foundation Courses	MC	2-1-2-0
8		Human Values & Professional Ethics	MC	3-0-0-0
9		Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10		Concepts of Programming	ES	2-0-2-0

Electronics & Communication Engineering

**Semester - 1 (Theory - 5, Lab - 4)**
S.No	**Course No**	**Course Name**	**Category**	**L-T-P/D**	**Credits**
1.	20A54101	Linear Algebra and Calculus	BS	3-0-0	3
2.	20A56201T	Applied Physics	BS	3-0-0	3
3.	20A52101T	Communicative English	HS	3-0-0	3
4.	20A02101T	Fundamentals of Electrical Circuits	ES	3-0-0	3
5.	20A03101T	Engineering Drawing	ES	1-0-0/2	2
6.	20A03101P	Engineering Graphics Lab	ES	0-0-2	1
7.	20A56201P	Applied Physics Lab	BS	0-0-3	1.5
8.	20A52101P	Communicative English Lab	HS	0-0-3	1.5
9.	20A02101P	Fundamentals of Electrical Circuits Lab	ES	0-0-2	1.5
				Total	**19.5**

**Semester – 2 (Theory – 5, Lab – 5)**
S.No	**Course No**	**Course Name**	**Category**	**L-T-P**	**Credits**
1.	20A54201	Differential Equations and Vector Calculus	BS	3-0-0	3
2.	20A51101T	Chemistry	BS	3-0-0	3
3.	20A05201T	C-Programming & Data Structures	ES	3-0-0	3
4.	20A04101T	Electronic Devices & Circuits	ES	3-0-0	3
5.	20A03202	Engineering Workshop	LC	0-0-3	1.5
6.	20A05202	IT Workshop	LC	0-0-3	1.5
7.	20A05201P	C-Programming & Data Structures Lab	ES	0-0-3	1.5
8.	20A51101P	Chemistry Lab	BS	0-0-3	1.5
9.	20A04101P	Electronic Devices & Circuits Lab	ES	0-0-3	1.5
10	20A99201	Environmental Science	MC	3-0-0	0.0
				Total	**19.5**

B.Tech (ECE)– I Sem	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(20A54101) LINEAR ALGEBRA & CALCULUS
(Common to All Branches of Engineering)

Course Objectives:

- This course will illuminate the students in the concepts of calculus and linear algebra.
- 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.

UNIT -1

Matrices

Rank of a matrix by echelon form, normal form. Solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigenvectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix.

Learning Outcomes:

At the end of this unit, the student will be able to

- Solving systems of linear equations, using technology to facilitate row reduction determine the rank, eigen values and eigenvectors (L3).
- Identify special properties of a matrix, such as positive definite, etc., and use this information to facilitate the calculation of matrix characteristics; (L3)

UNIT -2

Mean Value Theorems

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof) related problems.

Learning Outcomes:

At the end of this unit, the student will be able to
- Translate the given function as series of Taylor's and Maclaurin's with remainders (L3)
- Analyze the behaviour of functions by using mean value theorems (L3)

UNIT -3

Multivariable Calculus

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

At the end of this unit, the student will be able to
- Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies. (L3)
- Acquire the Knowledge maxima and minima of functions of several variable (L1)
- Utilize Jacobian of a coordinate transformation to deal with the problems in change of variables (L3)

UNIT -4

Multiple Integrals

Double integrals, change of order of integration, change of variables. Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates. Finding areas and volumes using double and triple integrals.

Learning Outcomes:

At the end of this unit, the student will be able to
- Evaluate double integrals of functions of several variables in two dimensions using Cartesian and polar coordinates (L5)
- Apply double integration techniques in evaluating areas bounded by region (L4)
- Evaluate multiple integrals in Cartesian, cylindrical and spherical geometries (L5)

UNIT -5

Beta and Gamma functions

Beta and Gamma functions and their properties, relation between beta and gamma functions, evaluation of definite integrals using beta and gamma functions.

Learning Outcomes:

At the end of this unit, the student will be able to
- Understand beta and gamma functions and its relations (L2)
- Conclude the use of special function in evaluating definite integrals (L4)

Text Books:
1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

Reference Books:
1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
4. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
5. Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press
6. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
7. R.L. Garg Nishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education

8. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education
9. H. k Das, Er. RajnishVerma, Higher Engineering Mathematics, S. Chand.
10. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

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

- Develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- Utilize mean value theorems to real life problems (L3)
- Familiarize with functions of several variables which is useful in optimization (L3)
- Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional coordinate systems (L5)
- Students will become familiar with 3- dimensional coordinate systems and also learn the utilization of special functions

B.Tech (ECE)– I Sem   **L   T   P   C**
                                                                          3   0   0   3

20A56201T   APPLIED PHYSICS
(ECE, EEE, CSE, AI & DS,CSE (AI), CSE(IoT), CSE (Data Science), CSE(AI & ML) & IT)

Course Objectives

- To make a bridge between the physics in school and engineering courses.

- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications

- To understand the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, study of propagation of light wave through optical fibres along with engineering applications.

- To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.

- To enlighten the concepts of Quantum Mechanics and to provide fundamentals of de'Broglie waves, quantum mechanical wave equation and its applications, the importance of free electron theory and band theory of solids.

- Evolution of band theory to distinguish materials, basic concepts and transport phenomenon of charge carriers in semiconductors. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

Unit-I:

Wave Optics
Interference- Principle of superposition – Interference of light – Conditions for sustained interference - Interference in thin films (Reflection Geometry) – Colors in thin films – Newton's Rings – Determination of wavelength and refractive index.
Diffraction- Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit and N-slits (qualitative) – Grating spectrum.

Polarization- Introduction – Types of polarization – Polarization by reflection, refraction and double refraction - Nicol's Prism - Half wave and Quarter wave plates with applications.

Learning Outcomes:

At the end of this unit, the student will be able to
- Explain the need of coherent sources and the conditions for sustained interference (L2)
- Identify engineering applications of interference (L3)
- Analyze the differences between interference and diffraction with applications (L4)
- Illustrate the concept of polarization of light and its applications (L2)
- Classify ordinary polarized light and extraordinary polarized light (L2)

Unit-II:

Lasers and Fiber optics
Lasers- Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms – Nd-YAG laser – He-Ne laser – Applications of lasers.

Fiber optics- Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture – Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers – Propagation Losses (qualitative) – Applications.

Learning Outcomes:

At the end of this unit, the student will be able to
- Understand the basic concepts of LASER light Sources (L2)
- Apply the concepts to learn the types of lasers (L3)
- Identifies the Engineering applications of lasers (L2)
- Explain the working principle of optical fibers (L2)
- Classify optical fibers based on refractive index profile and mode of propagation (L2)
- Identify the applications of optical fibers in various fields (L2)

Unit-III:

Dielectric and Magnetic Materials

Dielectric Materials- Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarizations (Qualitative) – Lorentz internal field – Clausius-Mossotti equation.

Magnetic Materials- Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and Permeability – Origin of permanent magnetic moment – Classification of magnetic materials: Dia, para & Ferro-Domain concept of Ferromagnetism (Qualitative) – Hysteresis – Soft and Hard magnetic materials.

Learning Outcomes:

At the end of this unit, the student will be able to
- Explain the concept of dielectric constant and polarization in dielectric materials (L2)
- Summarize various types of polarization of dielectrics (L2)
- Interpret Lorentz field and Claussius- Mosotti relation in dielectrics(L2)
- Classify the magnetic materials based on susceptibility and their temperature dependence (L2)
- Explain the applications of dielectric and magnetic materials (L2)
- Apply the concept of magnetism to magnetic devices (L3)

Unit IV:

Quantum Mechanics, Free Electron Theory and Band theory of Solids
Quantum Mechanics- Dual nature of matter – Schrodinger's time independent and dependent wave equation – Significance of wave function – Particle in a one-dimensional infinite potential well.

Free Electron Theory- Classical free electron theory (Merits and demerits only) – Quantum free electron theory – Equation for electrical conductivity based on quantum free electron theory – Fermi-Dirac distribution – Density of states – Fermi energy.

Band theory of Solids- Bloch's Theorem (Qualitative) – Kronig-Penney model (Qualitative) – E vs K diagram – Classification of crystalline solids – Effective mass of electron – m^* vs K diagram – Concept of hole.

Learning Outcomes:

At the end of this unit, the student will be able to
- Explain the concept of dual nature of matter (L2)
- Understand the significance of wave function (L2)
- Interpret the concepts of classical and quantum free electron theories (L2)
- Explain the importance of K-P model
- Classify the materials based on band theory (L2)
- Apply the concept of effective mass of electron (L3)

Unit – V:

Semiconductors and Superconductors
Semiconductors- Introduction – Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors – Density of charge carriers – Dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents – Einstein's equation – Direct and indirect band gap semiconductors – Hall effect – Hall coefficient – Applications of Hall effect.
Superconductors- Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory – Josephson effects (AC and DC) – High T_c superconductors – Applications of superconductors.

Learning Outcomes:

At the end of this unit, the student will be able to
- Classify the energy bands of semiconductors (L2)
- Interpret the direct and indirect band gap semiconductors (L2)
- Identify the type of semiconductor using Hall effect (L2)
- Identify applications of semiconductors in electronic devices (L2)
- Explain how electrical resistivity of solids changes with temperature (L2)
- Classify superconductors based on Meissner's effect (L2)
- Explain Meissner's effect, BCS theory & Josephson effect in superconductors (L2)

Text books:
1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering Physics – B.K. Pandey and S. Chaturvedi, Cengage Learning.

Reference Books:
1. Engineering Physics – Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
4. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill

Course Outcomes

- Study the different realms of physics and their applications in both scientific and technological systems through physical optics. (L2)
- Identify the wave properties of light and the interaction of energy with the matter (L3).
- Asses the electromagnetic wave propagation and its power in different media (L5).
- Understands the response of dielectric and magnetic materials to the applied electric and magnetic fields. (L3)
- Study the quantum mechanical picture of subatomic world along with the discrepancies between the classical estimates and laboratory observations of electron transportation phenomena by free electron theory and band theory. (L2)
- Elaborate the physical properties exhibited by materials through the understanding of properties of semiconductors and superconductors. (L5)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– I Sem   **L   T   P   C**

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(20A52101T) COMMUNICATIVE ENGLISH
(Common to All Branches of Engineering)

Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

UNIT -1

Lesson: On the Conduct of Life: William Hazlitt
Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions. **Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others. **Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces of information. **Reading for Writing :**Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.

Learning Outcomes

At the end of the module, the learners will be able to
- Understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- Ask and answer general questions on familiar topics and introduce oneself/others
- Employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- Recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- Form sentences using proper grammatical structures and correct word forms

UNIT -2

Lesson: The Brook: Alfred Tennyson
Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts. **Speaking:** Discussion in pairs/small groups on specific topics followed by short structured

talks. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

Learning Outcomes

At the end of the module, the learners will be able to
- Comprehend short talks on general topics
- Participate in informal discussions and speak clearly on a specific topic using suitable discourse markers
- Understand the use of cohesive devices for better reading comprehension
- Write well structured paragraphs on specific topics
- Identify basic errors of grammar/ usage and make necessary corrections in short texts

UNIT -3

Lesson: The Death Trap: Saki
Listening: Listening for global comprehension and summarizing what is listened to. **Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed   **Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing, Paragraph Writing **Grammar and Vocabulary:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Learning Outcomes

At the end of the module, the learners will be able to
- Comprehend short talks and summarize the content with clarity and precision
- Participate in informal discussions and report what is discussed
- Infer meanings of unfamiliar words using contextual clues
- Write summaries based on global comprehension of reading/listening texts
- Use correct tense forms, appropriate structures and a range of reporting verbs in speech and writing

UNIT-4

Lesson: Innovation: Muhammad Yunus
Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Letter Writing: Official Letters/Report Writing **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; Voice - Active & Passive Voice

Learning Outcomes

At the end of the module, the learners will be able to
- Infer and predict about content of spoken discourse
- Understand verbal and non-verbal features of communication and hold formal/informal conversations
- Interpret graphic elements used in academic texts
- Produce a coherent paragraph interpreting a figure/graph/chart/table
- Use language appropriate for description and interpretation of graphical elements

UNIT -5

Lesson: Politics and the English Language: George Orwell
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Reading: Reading for comprehension. Writing: Writing structured essays on specific topics using suitable claims and evidences. Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Learning Outcomes

At the end of the module, the learners will be able to
- Take notes while listening to a talk/lecture and make use of them to answer questions
- Make formal oral presentations using effective strategies
- Comprehend, discuss and respond to academic texts orally and in writing
- Produce a well-organized essay with adequate support and detail
- Edit short texts by correcting common errors

Text Book:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. Oxford Learners Dictionary, 12th Edition, 2011
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

Course Outcomes

- Retrieve the knowledge of basic grammatical concepts
- Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
- Apply grammatical structures to formulate sentences and correct word forms
- Analyze discourse markers to speak clearly on a specific topic in informal discussions
- Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
- Create a coherent paragraph interpreting a figure/graph/chart/table

Web links

www.englishclub.com
www.easyworldofenglish.com
www.languageguide.org/english/
www.bbc.co.uk/learningenglish
www.eslpod.com/index.html
www.myenglishpages.com

B.Tech (ECE) – I Sem   **L   T   P   C**
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(20A02101T) FUNDAMENTALS OF ELECTRICAL CIRCUITS

Course Objectives:

To make the student learn about

- Basic characteristics of R, L, C parameters, their Voltage and Current Relations and Various combinations of these parameters.
- The Single Phase AC circuits and concepts of real power, reactive power, complex power, phase angle and phase difference
- Series and parallel resonances, bandwidth, current locus diagrams
- Network theorems and their applications
- Network Topology and concepts like Tree, Cut-set , Tie-set, Loop, Co-Tree

Unit- 1

Introduction to Electrical & Magnetic Circuits

Electrical Circuits: Circuit Concept – Types of elements - Source Transformation-Voltage - Current Relationship for Passive Elements. Kirchhoff's Laws – Network Reduction Techniques- Series, Parallel, Series Parallel, Star-to-Delta or Delta-to-Star Transformation. Examples

Magnetic Circuits: Faraday's Laws of Electromagnetic Induction-Concept of Self and Mutual Inductance-Dot Convention-Coefficient of Coupling-Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits, MMF Calculations.

Learning Outcomes:

At the end of this unit, the student will be able to
- To know about Kirchhoff's Laws in solving series, parallel, non-series-parallel configurations in DC networks
- To know about voltage source to current source and vice-versa transformation in their representation
- To understand Faraday's laws
- To distinguish analogy between electric and magnetic circuits
- To understand analysis of series and parallel magnetic circuits

Unit- 2

Network Topology

Definitions – Graph – Tree, Basic Cutset and Basic Tieset Matrices for Planar Networks – Loop and Nodal Methods of Analysis of Networks & Independent Voltage and Current Sources – Duality & Dual Networks. Nodal Analysis, Mesh Analysis.

Learning Outcomes:

At the end of this unit, the student will be able to
- To understand basic graph theory definitions which are required for solving electrical circuits

- To understand about loop current method
- To understand about nodal analysis methods
- To understand about principle of duality and dual networks
- To identify the solution methodology in solving electrical circuits based on the topology

Unit- 3

Single Phase A.C Circuits

R.M.S, Average Values and Form Factor for Different Periodic Wave Forms – Sinusoidal Alternating Quantities – Phase and Phase Difference – Complex and Polar Forms of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation- Resonance - Phasor diagrams - Concept of Power Factor- Concept of Reactance, Impedance, Susceptance and Admittance-Apparent Power, Active and Reactive Power, Examples.

Learning Outcomes:

At the end of this unit, the student will be able to
- To understand fundamental definitions of 1-ϕ AC circuits
- To distinguish between scalar, vector and phasor quantities
- To understand voltage, current and power relationships in 1-ϕ AC circuits with basic elements R, L, and C.
- To understand the basic definitions of complex immittances and complex power
- To solve 1-ϕ AC circuits with series and parallel combinations of electrical circuit elements R, L and C.

Unit- 4

Network Theorems

Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer, Millmann's, Tellegen's, and Compensation Theorems for D.C and Sinusoidal Excitations.

Learning Outcomes:

At the end of this unit, the student will be able to
- To know that electrical circuits are 'heart' of electrical engineering subjects and network theorems are main part of it.
- To distinguish between various theorems and inter-relationship between various theorems
- To know about applications of certain theorems to DC circuit analysis
- To know about applications of certain theorems to AC network analysis
- To know about applications of certain theorems to both DC and AC network analysis

Unit- 5

Three Phase A.C. Circuits

Introduction - Analysis of Balanced Three Phase Circuits – Phase Sequence- Star and Delta Connection - Relation between Line and Phase Voltages and Currents in Balanced Systems - Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems. Analysis of Three Phase Unbalanced Circuits - Loop Method - Star Delta Transformation Technique – for balanced and unbalanced circuits - Measurement of Active and reactive Power – Advantages of Three Phase System.

Learning Outcomes:

At the end of this unit, the student will be able to
- To know about advantages of 3-ϕ circuits over 1-ϕ circuits
- To distinguish between balanced and unbalanced circuits
- To know about phasor relationships of voltage, current, power in star and delta connected balanced and unbalanced loads
- To know about measurement of active, reactive powers in balanced circuits
- To understand about analysis of unbalanced circuits and power calculations

Text Books:

1. Fundamentals of Electric Circuits Charles K. Alexander and Matthew. N. O. Sadiku, Mc Graw Hill, 5th Edition, 2013.

2. Engineering circuit analysis William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 7th Edition, 2006.

Reference Books:

1. Circuit Theory Analysis & Synthesis A. Chakrabarti, Dhanpat Rai & Sons, 7th Revised Edition, 2018.

2. Network Analysis M.E Van Valkenberg, Prentice Hall (India), 3rd Edition, 1999.

3. Electrical Engineering Fundamentals V. Del Toro, Prentice Hall International, 2nd Edition, 2019.

4. Electric Circuits- Schaum's Series, Mc Graw Hill, 5th Edition, 2010.

5. Electrical Circuit Theory and Technology John Bird, Routledge, Taylor & Francis, 5th Edition, 2014.

Course Outcomes:

After completing the course, the student should be able to do the following

- Given a network, find the equivalent impedance by using network reduction techniques and determine the current through any element and voltage across and power through any element.
- Given a circuit and the excitation, determine the real power, reactive power, power factor etc,.
- Apply the network theorems suitably
- Determine the Dual of the Network, develop the Cut Set and Tie-set Matrices for a given Circuit. Also understand various basic definitions and concepts.

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B.Tech (ECE) – I Sem   **L   T   P/D   C**
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(20A03101T) ENGINEERING DRAWING
(Common to All Branches of Engineering)

Course Objectives:

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.

Unit: I

Introduction to Engineering Drawing: Principles of Engineering Drawing and its significance-Conventions in drawing-lettering - BIS conventions.
   a)Conic sections including the rectangular hyperbola- general method only,
   b) Cycloid, epicycloids and hypocycloid c) Involutes

Learning Outcomes:

At the end of this unit the student will be able to
- Understand the significance of engineering drawing
- Know the conventions used in the engineering drawing
- Identify the curves obtained in different conic sections
- Draw different curves such as cycloid, involute and hyperbola

Unit: II

Projection of points, lines and planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.

Learning Outcomes:

At the end of this unit the student will be able to
- Understand the meaning of projection
- Know how to draw the projections of points, lines
- Differentiate between projected length and true length
- Find the true length of the lines

Unit: III

Projections of solids: Projections of regular solids inclined to one or both planes by rotational or auxiliary views method.

Learning Outcomes:

At the end of this unit the student will be able to
- Understand the procedure to draw projection of solids
- Differentiate between rotational method and auxillary view method.
- Draw the projection of solid inclined to one plain
- Draw the projection of solids inclined to both the plains

Unit: IV

Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.

Learning Outcomes:

At the end of this unit the student will be able to
- Understand different sectional views of regular solids
- Obtain the true shapes of the sections of prism
- Draw the sectional views of prism, cylinder, pyramid and cone

Unit: V

Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

Learning Outcomes:

At the end of this unit the student will be able to
- Understand the meaning of development of surfaces
- Draw the development of regular solids such as prism, cylinder, pyramid and cone
- Obtain the development of sectional parts of regular shapes

Text Books:
1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.

Reference Books:
1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2009
2. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000
3. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009
4. K.C.John, Engineering Graphics, 2/e, PHI, 2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

Course Outcomes:
After completing the course, the student will be able to
- Draw various curves applied in engineering. (l2)
- Show projections of solids and sections graphically. (l2)
- Draw the development of surfaces of solids. (l3)

Additional Sources
Youtube: http-sewor,Carleton.cag,kardos/88403/drawings.html conic sections-online, red woods.edu

B.Tech (ECE)– I Sem **L T P C**
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(20A03101P) ENGINEERING GRAPHICS LAB
(Common to All Branches of Engineering)

Course Objectives:

- Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modeling.
- Instruct graphical representation of machine components.

Computer Aided Drafting:

Introduction to AutoCAD: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions.

Dimensioning principles and conventional representations.

Orthographic Projections: Systems of projections, conventions and application to orthographic projections - simple objects.

Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids.

Text Books:
1. K. Venugopal, V.Prabhu Raja, Engineering Drawing + Auto Cad, New Age International Publishers.
2. Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with Auto Cad, PHI Learning, Eastern Economy editions.

Reference Books:
1. T. Jayapoovan, Engineering Graphics using Auto Cad, Vikas Publishing House
2. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
3. Linkan Sagar, BPB Publications, Auto Cad 2018 Training Guide.
4. K.C.John, Engineering Graphics, 2/e, PHI, 2013
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.

Course Outcomes:

After completing the course, the student will be able to

- Use computers as a drafting tool. (L2)
- Draw isometric and orthographic drawings using CAD packages. (L3)

Additional Sources

1. Youtube: http-sewor,Carleton.cag, kardos/88403/drawings.html conic sections-online, red woods.edu

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B.Tech (ECE)– I Sem   **L   T   P   C**
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(20A56201P) APPLIED PHYSICS LAB
(ECE, EEE, CSE, AI & DS,CSE (AI), CSE(IoT), CSE (Data Science), CSE(AI & ML) & IT)

Course Objectives:

- Understands the concepts of interference, diffraction and their applications.
- Understand the role of optical fiber parameters in communication.
- Recognize the importance of energy gap in the study of conductivity and Hall Effect in a semiconductor.
- Illustrates the magnetic and dielectric materials applications.
- Apply the principles of semiconductors in various electronic devices.

Note: In the following list, out of 15 experiments, any 12 experiments (minimum 10) must be performed in a semester

List of Applied Physics Experiments

1. Determine the thickness of the wire using wedge shape method
2. Determination of the radius of curvature of the lens by Newton's ring method
3. Determination of wavelength by plane diffraction grating method
4. Determination of dispersive power of prism.
5. Determination of wavelength of LASER light using diffraction grating.
6. Determination of particle size using LASER.
7. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
8. Determination of dielectric constant by charging and discharging method.
9. Magnetic field along the axis of a circular coil carrying current –Stewart Gee's method.
10. Measurement of magnetic susceptibility by Gouy's method
11. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)
12. To determine the resistivity of semiconductor by Four probe method
13. To determine the energy gap of a semiconductor
14. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
15. Measurement of resistance with varying temperature.

Course Outcomes:
At the end of the course, the student will be able to
- Operate optical instruments like microscope and spectrometer (L2)
- Determine thickness of a hair/paper with the concept of interference (L2)
- Estimate the wavelength of different colors using diffraction grating and resolving power (L2)
- Plot the intensity of the magnetic field of circular coil carrying current with distance (L3)
- Evaluate the acceptance angle of an optical fiber and numerical aperture (L3)
- Determine the resistivity of the given semiconductor using four probe method (L3)
- Identify the type of semiconductor i.e., n-type or p-type using hall effect (L3)
- Calculate the band gap of a given semiconductor (L3)

References

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.
2. http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University

B.Tech (ECE)– I Sem **L T P C**
0 0 3 1.5

(20A52101P) COMMUNICATIVE ENGLISH LAB
(Common to All Branches of Engineering)

Course Objectives

- students will be exposed to a variety of self instructional, learner friendly modes of language learning
- students will learn better pronunciation through stress, intonation and rhythm
- students will be trained to use language effectively to face interviews, group discussions, public speaking
- students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

List of Topics

1. Phonetics
2. Reading comprehension
3. Describing objects/places/persons
4. Role Play or Conversational Practice
5. JAM
6. Etiquettes of Telephonic Communication
7. Information Transfer
8. Note Making and Note Taking
9. E-mail Writing
10. Group Discussions-1
11. Resume Writing
12. Debates
13. Oral Presentations
14. Poster Presentation
15. Interviews Skills-1

Suggested Software

Orel, Walden Infotech, Young India Films

Reference Books

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. A Textbook of English Phonetics for Indian Students by T.Balasubramanyam

Web Links
www.esl-lab.com
www.englishmedialab.com
www.englishinteractive.net

Course Outcomes

After completing the course, the student will be able to

- Listening and repeating the sounds of English Language
- Understand the different aspects of the English language
- proficiency with emphasis on LSRW skills
- Apply communication skills through various language learning activities
- Analyze the English speech sounds, stress, rhythm, intonation and syllable
- Division for better listening and speaking comprehension.
- Evaluate and exhibit acceptable etiquette essential in social and professional settings
- Create awareness on mother tongue influence and neutralize it in order to
- Improve fluency in spoken English.

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B.Tech (ECE)– I Sem   **L   T   P   C**
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(20A02101P) FUNDAMENTALS OF ELECTRICAL CIRCUITS LAB

Course Objectives:

- Remember, understand and apply various theorems and verify practically.
- Understand and analyze active, reactive power measurements in three phase balanced & un balanced circuits.

List of Experiments:

1. Verification of Thevenin's and Norton's Theorems

2. Verification of Superposition Theorem for average and rms values

3. Maximum Power Transfer Theorem for DC and AC circuits

4. Verification of Compensation Theorem for DC circuits

5. Verification of Reciprocity, Millmann's Theorems for DC circuits

6. Determination of Self, Mutual Inductances and Coefficient of Coupling

7. Measurement of Active Power for Star Connected Balanced Loads

8. Measurement of Reactive Power for Star Connected Balanced Loads

9. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads

10. Measurement of Active Power for Delta Connected Balanced Loads

11. Measurement of Reactive Power for Delta Connected Balanced Loads

Course Outcomes:

At the end of the course, students should be able to

- Remember, understand and apply various theorems and verify practically.
- Understand and analyze active, reactive power measurements in three phase balanced & un balanced circuits.

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B.Tech (ECE)– II Sem   **L   T   P   C**
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(20A54201) DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to Civil, EEE, Mechanical, ECE and Food Technology)

Course Objectives:

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

UNIT -1

Linear differential equations of higher order (Constant Coefficients)
Definitions, homogenous and non-homogenous, complimentaryfunction, generalsolution, particular integral,Wronskean, method of variation of parameters.Simultaneous linear equations, Applications to L-C-R Circuit problems and Mass spring system.

Learning Outcomes:

At the end of this unit, the student will be able to
- Identify the essential characteristics of linear differential equations with constant coefficients (L3)
- Solve the linear differential equations with constant coefficients by appropriate method (L3)
- Classify and interpret the solutions of linear differential equations (L3)
- Formulate and solve the higher order differential equation by analyzing physical situations (L3)

UNIT 2:

Partial Differential Equations
Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order equations using Lagrange's method.

Learning Outcomes:

At the end of this unit, the student will be able to
- Apply a range of techniques to find solutions of standard pdes (L3)
- Outline the basic properties of standard PDEs (L2)

UNIT -3

Applications of Partial Differential Equations

Classification of PDE, method of separation of variables for second order equations. Applications of Partial Differential Equations: One dimensional Wave equation, One dimensional Heat equation.

Learning Outcomes:
At the end of this unit, the student will be able to

- Calcify the PDE (L3)
- Learn the applications of PDEs (L2)

UNIT-4

Vector differentiation
Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

Learning Outcomes:

At the end of this unit, the student will be able to
- Apply del to Scalar and vector point functions (L3)
- Illustrate the physical interpretation of Gradient, Divergence and Curl (L3)

UNIT -5

Vector integration
Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Learning Outcomes:

At the end of this unit, the student will be able to
- Find the work done in moving a particle along the path over a force field (L4)
- Evaluate the rates of fluid flow along and across curves (L4)
- Apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals (L3)

Text Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

Reference Books:
1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
6. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
7. Dean G. Duffy, Advanced engineering mathematics with MATLAB, CRC Press
8. Peter O'neil, Advanced Engineering Mathematics, Cengage Learning.
9. R.L. GargNishu Gupta, Engineering Mathematics Volumes-I &II, Pearson Education
10. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.
11. H. k Das, Er. RajnishVerma, Higher Engineering Mathematics, S. Chand.
12. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Course Outcomes:

At the end of the course, the student will be able to
- Solve the differential equations related to various engineering fields (L6)
- Identify solution methods for partial differential equations that model physical processes (L3)
- Interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- Estimate the work done against a field, circulation and flux using vector calculus (L6)

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B.Tech (ECE)– II Sem	L	T	P	C
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(20A51101T) CHEMISTRY

(CSE, AI & DS,CSE (AI), CSE(IoT), CSE (Data Science), CSE(AI & ML), **ECE, EEE and IT**)

Course Objectives:
- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- To introduce instrumental methods, molecular machines and switches

Unit 1:

Structure and Bonding Models:
Planck's quantum theory, dual nature of matter, Schrodinger equation, significance of Ψ and Ψ^2, applications to hydrogen, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2 and CO, etc. π-molecular orbitals of butadiene and benzene, calculation ofbond order.

Learning Outcomes:

At the end of this unit, the students will be able to
- Apply Schrodinger wave equation to hydrogen atom (L3)
- Illustrate the molecular orbital energy level diagram of different molecular species (L2)
- Explain the calculation of bond order of O_2 and Co molecules (L2)
- Discuss the basic concept of molecular orbital theory (L3)

Unit 2:

Modern Engineering materials:

i). Coordination compounds: Crystal field theory – salient features – splitting in octahedral and tetrahedral geometry. Properties of coordination compounds-Oxidation state, coordination, magnetic and colour.
ii). Semiconductor materials, super conductors- basic concept, band diagrams for conductors, semiconductors and insulators, Effect of doping on band structures.
iii). Supercapacitors: Introduction, Basic concept-Classification – Applications.
iv). Nanochemistry: Introduction, classification of nanometerials, properties and applications of Fullerenes, carbonnano tubes and Graphines nanoparticles.

Learning Outcomes:

At the end of this unit, the students will be able to
- Explain splitting in octahedral and tetrahedral geometryof complexes (L2).
- Discuss the magnetic behaviour and colour of coordination compounds (L3).
- Explain the band theory of solids for conductors, semiconductors and insulators (L2)
- Demonstrate the application of Fullerenes, carbon nano tubes and Graphines nanoparticles (L2).

Unit 3:

Electrochemistry and Applications:

Electrodes – concepts, reference electrodes (Calomel electrode, Ag/AgCl electrode and glass electrode); Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).
Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.
Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries-working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Learning Outcomes:

At the end of this unit, the students will be able to
- Apply Nernst equation for calculating electrode and cell potentials (L3)
- Differentiate between ph metry, potentiometric and conductometric titrations (L2)
- Explain the theory of construction of battery and fuel cells (L2)
- Solve problems based on cell potential (L3)

Unit 4:

Polymer Chemistry:

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation.
Plastics - Thermoplastics and Thermosettings, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.
Elastomers–Buna-S, Buna-N–preparation, properties and applications.
Conducting polymers – polyacetylene, polyaniline, polypyrroles – mechanism of conduction and applications.

Learning Outcomes:

At the end of this unit, the students will be able to
- Explain the different types of polymers and their applications (L2)
- Explain the preparation, properties and applications of Bakelite, Nylon-6,6, and carbon fibres (L2)
- Describe the mechanism of conduction in conducting polymers (L2)
- Discuss Buna-S and Buna-N elastomers and their applications (L2)

Unit 5:

Instrumental Methods and Applications (10 hrs)
Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, UV-Visible,IR Spectroscopies. Solid-Liquid Chromatography–TLC, retention time.

Learning outcomes:

After completion of Unit IV, students will be able to:
- Explain the different types of spectral series in electromagnetic spectrum (L2)
- Understand the principles of different analytical instruments (L2)
- Explain the different applications of analytical instruments (L2)

Text Books:
1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:
1. G.V.Subba Reddy, K.N.Jayaveera and C. Ramachandraiah, Engineering Chemistry, Mc Graw Hill, 2020.
2. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
3. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
4. J.M.Lehn, Supra Molecular Chemistry, VCH Publications

Course Outcomes:

At the end of the course, the students will be able to:
- Compare the materials of construction for battery and electrochemical sensors (l2)
- Explain the preparation, properties, and applications of thermoplastics &thermosetting, elastomers & conducting polymers. (l2)
- Explain the principles of spectrometry, slc in separation of solid and liquid mixtures (l2)
- Apply the principle of Band diagrams in application of conductors and semiconductors (L3)

B.Tech (ECE)– II Sem	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

(20A05201T) C-PROGRAMMING & DATA STRUCTURES
(Common to All Branches of Engineering)

Course Objectives:

- To illustrate the basic concepts of C programming language.
- To discuss the concepts of Functions, Arrays, Pointers and Structures.
- To familiarize with Stack, Queue and Linked lists data structures.
- To explain the concepts of non-linear data structures like graphs and trees.
- To learn different types of searching and sorting techniques.

UNIT-1

Introduction to C Language - C language elements, variable declarations and data types, operators and expressions, decision statements - If and switch statements, loop control statements - while, for, do-while statements, arrays.

Learning outcomes:

At the end of this unit, the students will be able to
- Use C basic concepts to write simple C programs. (L3)
- Use iterative statements for writing the C programs (L3)
- Use arrays to process multiple homogeneous data. (L3)
- Test and execute the programs and correct syntax and logical errors. (L4)
- Translate algorithms into programs. (L4)
- Implement conditional branching, iteration and recursion. (L2)

UNIT – 2

Functions, types of functions, Recursion and argument passing, pointers, storage allocation, pointers to functions, expressions involving pointers, Storage classes – auto, register, static, extern, Structures, Unions, Strings, string handling functions, and Command line arguments.

Learning outcomes:

At the end of this unit, the students will be able to
- Writing structured programs using C Functions. (L5)
- Writing C programs using various storage classes to control variable access. (L5)
- Apply String handling functions and pointers. (L3)
- Use arrays, pointers and structures to formulate algorithms and write programs.(L3)

UNIT-3

Data Structures, Overview of data structures, stacks and queues, representation of a stack, stack related terms, operations on a stack, implementation of a stack, evaluation of arithmetic expressions, infix, prefix, and postfix notations, evaluation of postfix expression, conversion of expression from infix to postfix, recursion, queues - various positions of queue, representation of queue, insertion, deletion, searching operations.

Learning outcomes:

At the end of this unit, the students will be able to
- Describe the operations of Stack. (L2)
- Explain the different notations of arithmetic expression. (L5)
- Develop various operations on Queues. (L6)

UNIT – 4

Linked Lists – Singly linked list, dynamically linked stacks and queues, polynomials using singly linked lists, using circularly linked lists, insertion, deletion and searching operations, doubly linked lists and its operations, circular linked lists and its operations.

Learning outcomes:

At the end of this unit, the students will be able to
- Analyze various operations on singly linked list. (L4)
- Interpret operations of doubly linked lists. (L2)
- Apply various operations on Circular linked lists. (L6)

UNIT-5

Trees - Tree terminology, representation, Binary trees, representation, binary tree traversals. binary tree operations, **Graphs** - graph terminology, graph representation, elementary graph operations, Breadth First Search (BFS) and Depth First Search (DFS), connected components, spanning trees. **Searching and Sorting** – sequential search, binary search, exchange (bubble) sort, selection sort, insertion sort.

Learning outcomes:

At the end of this unit, the students will be able to
- Develop the representation of Tress. (L3)
- Identify the various Binary tree traversals. (L3)
- Illustrate different Graph traversals like BFS and DFS. (L2)
- Design the different sorting techniques (L6)
- Apply programming to solve searching and sorting problems. (L3)

Text Books:

1. The C Programming Language, Brian W Kernighan and Dennis M Ritchie, Second Edition, Prentice Hall Publication.
2. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, Susan Anderson-Freed, Computer Science Press.
3. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. AnandaRao, Pearson Education.
4. B.A. Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
5. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011.

Reference Books:

1. Pradip Dey and Manas Ghosh, Programming in C, Oxford University Press, 2nd Edition 2011.
2. E. Balaguruswamy, "C and Data Structures", 4th Edition, Tata Mc Graw Hill.
3. A.K. Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press.
4. M.T. Somashekara, "Problem Solving Using C", PHI, 2nd Edition 2009.

Course Outcomes:

1. Analyse the basicconcepts of C Programming language. (L4)
2. Design applications in C, using functions, arrays, pointers and structures. (L6)
3. Apply the concepts of Stacks and Queues in solving the problems. (L3)
4. Explore various operations on Linked lists. (L5)
5. Demonstrate various tree traversals and graph traversal techniques. (L2)
6. Design searching and sorting methods (L3)

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(20A04101T) ELECTRONIC DEVICES & CIRCUITS
(Common to EEE and ECE)

Course Objectives:

- To understand the basic principles of all semiconductor devices.
- To be able to solve problems related to diode circuits, and amplifier circuits.
- To analyze diode circuits, various biasing and small signal equivalent circuits of amplifiers.
- To be able to compare the performance of BJTs and MOSFETs
- To design rectifier circuits and various amplifier circuits using BJTs and MOSFETs.

Unit – 1

Review of Semiconductors: Intrinsic semiconductors, Doped Semiconductors, Current Flow in Semiconductors, PN Junction with Open Circuit, PN Junction with Applied Voltage, Capacitive Effects in PN Junction.

Diodes: Introduction, The Ideal Diode – current voltage characteristic, rectifier, diode logic gates, Terminal Characteristics of Junction Diodes– forward bias,reversebias, and breakdown regions, Modeling the Diode Forward Characteristics- exponential model, graphical analysis and Iterative analysis using the exponential model, constant voltage drop model, the small signal model.

Learning outcomes:
- Remember and understand the basic characteristics of semiconductor diode (L1)
- Understand iterative and graphical analysis of simple diode circuits (L1)

Unit – 2

Zener Diodes– Zenerdiode Characteristics, Voltage shunt regulator, Temperature Effects, Rectifier Circuits– half-wave, full-wave and bridge rectifier circuits, rectifier with a filter capacitor, C-L-C filter, Clipping and Clamping Circuits– limiter circuit, the clamped capacitor, voltage doubler, Special Diode Types– UJT, Schottkybarrier diode, Varactor diode, photo diode, light emitting diode(LED), Problem Solving.

Bipolar Junction Transistors(BJTs)**:**Physical Operation - simplified structure and modes of operation, Operation of the npn, and pnp transistors: cutoff, active, andsaturation modes, V-ICharacteristics- of different configurations - graphical representation of transistor characteristics, dependence of collector current on collector voltage, the Early Effect.

Learning outcomes:
- Understand principle of operation of Zener diode and other special semiconductor diodes (L1)
- Understand the V-I characteristics of BJT and its different configurations (L1)
- Analyze various applications of diode and special purpose diodes (L3)
- Design rectifier and voltage regulator circuits (L4)

Unit- 3

BJT circuits at DC,Applying the BJT in Amplifier Design- Voltage Amplifier,Voltage Transfer Characteristic (VTC), Small-Signal Voltage Gain, determining the VTC by Graphical Analysis, Q-point, Small-signal operation and models- the transconductance, input resistance at the base, input resistance at the emitter, Voltage gain, separating the Signal and the DC Quantities, The Hybrid-π Model, the T Model, Basic BJT Amplifier Configurations - Common-Emitter (CE) amplifier without and with emitter resistance, Common-Base (CB) amplifier, Common-Collector (CC) amplifier or Emitter Follower, Biasing in BJT Amplifier Circuits- Fixed bias, Self bias, voltage divider bias circuits, biasing using a Constant-Current Source,CE amplifier – Small signal analysis and design,Transistor breakdown and Temperature Effects, Problem solving.

Learning outcomes:
- Solve problems on various biasing circuits using BJT (L2)
- Analyze BJT based biasing circuits (L3)
- Design an amplifier using BJT based on the given specifications (L4)

Unit – 4

MOS Field-Effect Transistors (MOSFETs)**:**Introduction, Device Structure and Physical Operation – device structure, operation with zero gate voltage, creating a channel for current flow, operation for different drain to source voltages, the P-channel MOSFET,CMOS, V-I characteristics–i_D - v_{DS}characteristics, i_D – v_{GS}characteristics, finite output resistance in saturation, characteristics of the p-Channel MOSFET, MOSFET Circuits at DC, Applying the MOSFET in Amplifier Design – voltage transfer characteristics, biasing the MOSFET to obtain linear amplification, the small signal voltage gain, graphical analysis, the Q-point. Problem solving.

Learning outcomes:
- Understand principle of operation of various types of MOSFET devices (L1)
- Understand the V-I characteristics of MOSFET devices and their configurations (L1)

Unit – 5

MOSFET Small Signal Operation Models– the dc bias, separating the DC analysis and the signal analysis, Small signal equivalent circuit models, the transconductance, the T equivalent circuit model, Basic MOSFET Amplifier Configurations– three basic configurations, characterizing amplifiers, common source(CS) amplifier without and with source resistance, common gate (CG) amplifier, source follower, the amplifier frequency response,Biasing in MOSFET Amplifier Circuits– biasing by fixing V_{GS} with and without source resistance, biasing using drain to gate feedback resistor, biasing using constant current source, Common Source Amplifier using MOSFETs – Small signal analysis and design, Body Effect, Problem Solving.

Learning outcomes:
- Solve problems on small signal equivalent of MOSFET devices (L2)
- Analyze various biasing circuits based on different types of MOSFETs (L3)
- Design an amplifier using BJT based on the given specifications (L4)

Text Books:

1. Adel S. Sedra and KennethC. Smith, "Microelectronic Circuits – Theory and Applications", 6th Edition, Oxford Press, 2013.
2. Donald A Neamen, "Electronic Circuits – analysis and design", 3rd Edition, McGraw Hill (India), 2019.

References:

1. J. Milliman and C Halkias, "Integrated electronics", 2nd Edition, Tata McGraw Hill, 1991.
2. Behzad Razavi, "Microelectronics", Second edition, Wiley, 2013.
3. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits," 9th Edition, Pearson, 2006.
1. Jimmie J Cathey, "Electronic Devices and Circuits," Schaum's outlines series, 3rd edition, McGraw-Hill (India), 2010.

Course Outcomes:

After the completion of the course students will able to

CO1: Understand principle of operation, characteristics and applications of Semiconductor diodes, Bipolar Junction Transistor and MOSFETs.

CO2: Applying the basic principles solving the problems related to Semiconductor diodes, BJTs, and MOSFETs.

CO3: Analyze diode circuits for different applications such as rectifiers, clippers and clampers also analyze biasing circuits of BJTs, and MOSFETs.

CO4: Design of diode circuits and amplifiers using BJTs, and MOSFETs.

CO5: Compare the performance of various semiconductor devices.

B.Tech (ECE)– II Sem   **L   T   P   C**
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(20A03202) ENGINEERING WORKSHOP
(Common to All Branches of Engineering)

Course Objective:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

List of Topics

Wood Working:

Familiarity with different types of woods and tools used in wood working and make following joints
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint

Sheet Metal Working:

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets
   a) Tapered tray   b) Conical funnel   c) Elbow pipe   d) Brazing

Fitting:

Familiarity with different types of tools used in fitting and do the following fitting exercises
  a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two wheeler tyre

Electrical Wiring:

Familiarities with different types of basic electrical circuits and make the following connections
   a) Parallel and series b) Two way switch   c) Godown lighting
   d) Tube light   e) Three phase motor f) Soldering of wires

Course Outcomes:

After completion of this lab the student will be able to
   • Apply wood working skills in real world applications. (l3)
   • Build different objects with metal sheets in real world applications. (l3)
   • Apply fitting operations in various applications. (l3)
   • Apply different types of basic electric circuit connections. (l3)

- Use soldering and brazing techniques. (l2)

Note: In each section a minimum of three exercises are to be carried out.

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B.Tech (ECE)– II Sem   **L T P C**
                                                      0 0 3 1.5

(20A05202) IT WORKSHOP
(Common to All Branches of Engineering)

Course Objectives:

- To make the students know about the internal parts of a computer, assembling and dissembling a computer from the parts, preparing a computer for use by installing the operating system
- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and LAteX
- To learn about Networking of computers and use Internet facility for Browsing and Searching

Preparing your Computer

Task 1:
Learn about Computer: Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

Task 2:
Assembling a Computer: Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods

Task 3:
Install Operating system: Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

Task 4:
Operating system features: Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.
Networking and Internet

Task 5:
Networking: Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using switch/hub and share information. Crimpling activity, logical configuration etc. should be done by the student. The entire process has to be documented.

Task 6:
Browsing Internet: Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email. They should get acquaintance with applications like Facebook, skype etc. If Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating e-mail account.

Task 7:
Antivirus: Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.
Productivity tools

Task 8:
Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered, Image Manipulation tools.

Task 9:
Presentations: creating, opening, saving and running the presentations, selecting the style for slides, formatting the slides with different fonts, colours, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show.

Task 10:
Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet

Task 11:
LateX: Introduction to Latex and its installation and different IDEs. Creating first document using Latex, using content into sections using article and book class of LaTeX. Styling Pages: reviewing and customizing different paper sizes and formats. Formatting text (styles, size, alignment, colors and adding bullets and numbered items, inserting mathematical symbols, and images, etc.). Creating basic

tables, adding simple and dashed borders, merging rows and columns. Referencing and Indexing: cross-referencing (refer to sections, table, images), bibliography (references).

References:

1. Introduction to Computers, Peter Norton, McGraw Hill
2. MOS study guide for word, Excel, Powerpoint& Outlook Exams, Joan Lambert, Joyce Cox, PHI.
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
4. Networking your computers and devices, Rusen, PHI
5. Trouble shooting, Maintaining & Repairing PCs, Bigelows, TMH
6. Lamport L. LATEX: a document preparation system: user's guide and reference manual. Addison-wesley; 1994.

Course Outcomes:

- Disassemble and Assemble a Personal Computer and prepare the computer ready to use.
- Prepare the Documents using Word processors and Prepare spread sheets for calculations .using excel and also the documents using LAteX.
- Prepare Slide presentations using the presentation tool.
- Interconnect two or more computers for information sharing.
- Access the Internet and Browse it to obtain the required information.

Note: Use open source tools for implementation of the above exercises.

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B.Tech (ECE)– II Sem   **L   T   P   C**
                                                                           0   0   3   1.5

(20A05201P) C-PROGRAMMING & DATA STRUCTURES LAB
(Common to All Branches of Engineering)

Course Objectives:

- To get familiar with the basic concepts of C programming.
- To design programs using arrays, strings, pointers and structures.
- To illustrate the use of Stacks and Queues
- To apply different operations on linked lists.
- To demonstrate Binary search tree traversal techniques.
- To design searching and sorting techniques.

Week l

Write C programs that use both recursive and non-recursive functions

 i) To find the factorial of a given integer.
 ii) To find the GCD (greatest common divisor) of two given integers.
 iii) To solve Towers of Hanoi problem.

Week 2

 a) Write a C program to find both the largest and smallest number in a list of integers.
 b) Write a C program that uses functions to perform the following:
   i) Addition of Two Matrices ii) Multiplication of Two Matrices

Week 3
 a) Write a C program that uses functions to perform the following operations:
   i) To insert a sub-string in to a given main string from a given position.
   ii) To delete n characters from a given position in a given string.

Week 4
 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.

Week 5

 a) Write a C Program to perform various arithmetic operations on pointer variables.
 b) Write a C Program to demonstrate the following parameter passing mechanisms:
   i) call-by-value   ii) call-by-reference

Week 6

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.)

Week 7

Write C programs that implement stack (its operations) using

- i) Arrays
- ii) Pointers

Week 8

Write C programs that implement Queue (its operations) using
- i) Arrays
- ii) Pointers

Week 9

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

- i) Converting infix expression into postfix expression
- ii) Evaluating the postfix expression

Week 10

Write a C program that uses functions to perform the following operations on singly linked list.

i) Creation   ii) Insertion   iii) Deletion   iv) Traversal

Week 11

Write a C program that uses functions to perform the following operations on Doubly linkedlist.

i) Creation   ii) Insertion   iii) Deletion   iv) Traversal

Week 12

Write a C program that uses functions to perform the following operations on circular linkedlist.

i) Creation   ii) Insertion   iii) Deletion   iv) Traversal

Week 13

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

    i) Creating a Binary Tree of integers

    ii) Traversing the above binary tree in preorder, inorder and postorder.

Week 14

Write C programs that use both recursive and non-recursive functions to perform the following searching operations for a key value in a given list of integers:

    i)   Linear search
    ii)   Binary search

Week 15

Write a C program that implements the following sorting methods to sort a given list of integers in ascending order

    i)   Bubble sort
    ii)   Selection sort
    iii)   Insertion sort

Text Books:
1. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education.
2. B.A. Forouzon and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
3. Richard F. Gilberg & Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011.

Reference Books:
1. PradipDey and ManasGhosh, Programming in C, Oxford University Press, 2nd Edition 2011.
2. E.Balaguruswamy, "C and Data Structures", 4th Edition, Tata Mc Graw Hill.
3. A.K.Sharma, Computer Fundamentals and Programming in C, 2nd Edition, University Press.
4. M.T.Somashekara, "Problem Solving Using C", PHI, 2nd Edition 2009.

Course Outcomes

- Demonstrate basic concepts of C programming language. (L2)
- Develop C programs using functions, arrays, structures and pointers. (L6)
- Illustrate the concepts Stacks and Queues. (L2)
- Design operations on Linked lists. (L6)
- Apply various Binary tree traversal techniques. (L3)
- Develop searching and sorting methods. (L6)

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B.Tech (ECE) – I Sem   **L   T   P   C**
                                                                    0   0   3   1.5

(20A51101P)   CHEMISTRY LAB
(CSE, AI & DS,CSE (AI), CSE(IoT), CSE (Data Science), CSE(AI & ML), **ECE, EEE and IT)**

Course Objectives:

- Verify the fundamental concepts with experiments

List of Experiments:

1. Measurement of 10Dq by spectrophotometric method
2. Models of potential energy surfaces
3. Conductometrictitration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base
4. Determination of cell constant and conductance of solutions
5. Potentiometry - determination of redox potentials and emfs
6. Determination of Strength of an acid in Pb-Acid battery
7. Preparation of a Bakelite and measurement of its mechanical properties (strength.).
8. Verify Lambert-Beer's law
9. Thin layer chromatography
10. Identification of simple organic compounds by IR.
11. Preparation of nanomaterial's by precipitation
12. Estimation of Ferrous Iron by Dichrometry.

Course Outcomes:

At the end of the course, the students will be able to
- Determine the cell constant and conductance of solutions (L3)
- Prepare advanced polymer Bakelite materials (L2)
- Measure the strength of an acid present in secondary batteries (L3)
- Analysethe IR of some organic compounds (L3)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– II Sem   **L   T   P   C**
                                                                        0   0   3   1.5
(20A04101P) ELECTRONIC DEVICES & CIRCUITS LAB
(Common to EEE and ECE)

Course Objectives:

- To verify the theoretical concepts practically from all the experiments.
- To analyse the characteristics of Diodes, BJT, MOSFET, UJT.
- To design the amplifier circuits from the given specifications.
- To Model the electronic circuits using tools such as PSPICE/Multisim.

 LIST OF EXPERIMENTS: (Execute any 12 experiments).

Note: All the experiments shall be implemented using both Hardware and Software.

1. Verification of Volt- Ampere characteristics of a PN junction diode and find static, dynamic and reverse resistances of the diode from the graphs obtained.
2. Design a full wave rectifier for the given specifications with and without filters, and verify the given specifications experimentally. Vary the load and find ripple factor. Draw suitable graphs.
3. Verify various clipping and clamper circuits using PN junction diode and draw the suitable graphs.
4. Design a Zener diode-based *voltage regulator* against variations of supply and load. Verify the same from the experiment.
5. Study and draw the *output* and *transfer* characteristics of MOSFET (Enhance mode) in Common Source Configuration experimentally. Find *Threshold voltage (V_T), g_m, & K* from the graphs.
6. Study and draw the *output* and *transfer* characteristics of MOSFET (Depletion mode) or JFET in Common Source Configuration experimentally. Find I_{DSS}, g_m, & V_P from the graphs.
7. Verification of the input and output characteristics of BJT in **Common Emitter** configuration experimentally and find required *h – parameters* from the graphs.
8. Study and draw the input and output characteristics of BJT in **Common Base** configuration experimentally, and determine required *h – parameters* from the graphs.
9. Study and draw the Volt Ampere characteristics of UJT and determine *η, I_P, I_v, V_P, &Vv* from the experiment.
10. Design and analysis of voltage- divider bias/self-bias circuit using BJT.
11. Design and analysis of voltage- divider bias/self-bias circuit using JFET.
12. Design and analysis of self-bias circuit using MOSFET.
13. Design a suitable circuit for switch using CMOSFET/JFET/BJT.
14. Design a small signal amplifier using MOSFET (common source) for the given specifications. Draw the frequency response and find the bandwidth.
15. Design a small signal amplifier using BJT(common emitter) for the given specifications. Draw the frequency response and find the bandwidth.

Tools / Equipment Required: Software Toollike Multisim/ Pspice or Equivalent,
DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

Course Outcomes:

- Understand the basic characteristics and applications of basic electronic devices. (L1)Observe the characteristics of electronic devices by plotting graphs. (L2)
- Analyze the Characteristics of UJT, BJT, MOSFET (L3).
  Design MOSFET / BJT based amplifiers for the given specifications. (L4)
  Simulate all circuits in PSPICE /Multisim. (L5).

B.Tech (ECE)– II Sem　　　　　　　　　　　　　　　　**L　T　P　C**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　0

(20A99201)　ENVIRONMENTAL SCIENCE

(Common to All Branches of Engineering)

Course Objectives:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

UNIT – I

Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

Learning outcomes:

At the end of this unit, the students will be able to

- To know the importance of public awareness
- To know about the various resources

UNIT – II

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

    a. Forest ecosystem.
    b. Grassland ecosystem
    c. Desert ecosystem
    d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Learning outcomes:

At the end of this unit, the students will be able to

- To know about various echo systems and their characteristics
- To know about the biodiversity and its conservation

UNIT – III

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.   Thermal pollution
   g.   Nuclear hazards

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Learning outcomes:

At the end of this unit, the students will be able to
- To know about the various sources of pollution.
- To know about the various sources of solid waste and preventive measures.
- To know about the different types of disasters and their managerial measures**.**

UNIT – IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

Learning outcomes:

At the end of this unit, the students will be able to

- To know about the social issues related to environment and their protection acts.
- To know about the various sources of conservation of natural resources.
- To know about the wild life protection and forest conservation acts.

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

Learning outcomes:

At the end of this unit, the students will be able to
- To know about the population explosion and family welfare programmes.
- To identify the natural assets and related case studies.

TEXT BOOKS:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson education
3. S.Azeem Unnisa, "Environmental Studies" Academic Publishing Company
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt. Ltd.

REFERENCES:

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.

Course Outcomes:

At the end of the course, the student will be able to
- Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.
- Understand flow and bio-geo- chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.

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Electronics & Communication Engineering

II B.TECH.

S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	**T**	**P**	
Semester-III							
1.	20A54302	Complex Variables and Transforms	BS	3	0	0	3
2.	20A04301T	Signals and Systems	PC	3	0	0	3
3.	20A02303T	Electrical Engineering	ES	3	0	0	3
4.	20A04302T	Analog Circuits	PC	3	0	0	3
5.	20A52301 20A52302 20A52303	**Humanities Elective– I** Managerial Economics & Financial Analysis Organizational Behaviour Business Environment	HS	3	0	0	3
6.	20A04301P	Simulation Lab	PC	0	0	3	1.5
7.	20A02303P	Electrical Engineering Lab	ES	0	0	3	1.5
8.	20A04302P	Analog Circuits Lab	PC	0	0	3	1.5
9.	20A05305	**Skill oriented course – I** Application Development with Python	SC	1	0	2	2
10.	20A52201	**Mandatory noncredit course – II** Universal Human Values	MC	3	0	0	0
11.	20A99301	**NSS/NCC/NSO Activities**	MC	0	0	2	0
						Total	**21.5**

S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	**T**	**P**	
Semester-IV							
1.	20A54403	Probability Theory & Stochastic Processes	BS	3	0	0	3
2.	20A04303T	Digital Logic Design	PC	3	0	0	3
3.	20A04401	EM Waves and Transmission Lines	PC	3	0	0	3
4.	20A04402T	Communication Systems	PC	3	0	0	3
5.	20A04403T	Linear and Digital IC Applications	PC	3	0	0	3
6.	20A04303P	Digital Logic Design Lab	PC	0	0	3	1.5
7.	20A04402P	Communication Systems Lab	PC	0	0	3	1.5
8.	20A04403P	Linear and Digital IC Applications Lab	PC	0	0	3	1.5
9.	20A52401	**Skill Oriented Course –II** Soft Skills	SC	1	0	2	2
10.	20A99401	**Mandatory noncredit course – III** Design Thinking for Innovation	MC	2	1	0	0
						Total	**21.5**
Community Service Internship (Mandatory) for 6 weeks duration during summer vacation							

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Note:

1. Eligible and interested students can register either for Honors or for a Minor in IV Semester as per the guidelines issued by the University
2. Students shall register for NCC/NSS/NSO activities and will be required to participate in an activity for two hours in a week during third semester.
3. Lateral entry students shall undergo a bridge course in Mathematics during third semester

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Electronics & Communication Engineering

Course Code	Complex variables and Transforms		L	T	P	C
20A54302	**(Common to ECE & EEE)**		**3**	**0**	**0**	**3**
Pre-requisite	**Functions, Differentiations and Integration**	**Semester**		**III**		

Course Objectives:

This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The student develops the idea of using continuous/discrete transforms.

Course Outcomes (CO): Student will be able to

- Understand the analyticity of complex functions and conformal mappings.
- Apply cauchy's integral formula and cauchy's integral theorem to evaluate improper integrals along contours.
- Understand the usage of laplace transforms, fourier transforms and z transforms.
- Evaluate the fourier series expansion of periodic functions.
- Understand the use of fourier transforms and apply z transforms to solve difference equations.

UNIT - I	**Complex Variable – Differentiation**:	8 Hrs

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method-Conformal mappings-standard and special transformations (sin z, e^z, cos z, z^2) Mobius transformations (bilinear) and their properties.

UNIT - II	**Complex Variable – Integration**:	9 Hrs

Line integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof);power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi circle with f(z) not having poles on real axis).

UNIT - III	**Laplace Transforms**	9 Hrs

Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function. Differentiation and integration of transform – solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.

UNIT - IV	**Fourier series**	8 Hrs

Determination of Fourier coefficients (Euler's) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms - Parseval's formula- Complex form of Fourier series.

UNIT - V	**Fourier transforms & Z Transforms:**	9 Hrs

Fourier integral theorem (without proof) – Fourier sine and cosine integrals-complex form of Fourier integral. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – convolution theorem .

Z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by z-transforms.

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Textbooks:
1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.   2. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India
Reference Books:
1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.   2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

Online Learning Resources:

1. nptel.ac.in/courses/111107056
     2. onlinelibrary.wiley.com
     3. https://onlinecourses.nptel.ac.in/noc18ma12.

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Electronics & Communication Engineering

Course Code	SIGNALS AND SYSTEMS		L	T	P	C
20A04301T			3	0	0	3
Pre-requisite	Mathematics - I	Semester	III			

Course Objectives:
- To introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domains.
- To present Fourier tools through the analogy between vectors and signals.
- To teach concept of sampling and reconstruction of signals.
- To analyze characteristics of linear systems in time and frequency domains.
- To understand Laplace and z-transforms as mathematical tool to analyze continuous and discrete-time signals and systems.

Course Outcomes (CO):

CO1: Understand the mathematical description and representation of continuous-time and discrete-time signals and systems. Also understand the concepts of various transform techniques.

CO2: Apply sampling theorem to convert continuous-time signals to discrete-time signals and reconstruct back, different transform techniques to solve signals and system related problems.

CO3: Analyze the frequency spectra of various continuous-time and discrete-time signals using different transform methods.

CO4: Classify the systems based on their properties and determine the response of them.

UNIT - I	**Signals and Systems**

Signals & Systems: Basic definitions and classification of Signals and Systems (Continuous time and discrete time), operations on signals, Concepts of Convolution and Correlation of signals, Analogy between vectors and signals-Orthogonality, mean square error.

UNIT - II	**Fourier Series and Fourier Transform**

Fourier series: Trigonometric & Exponential, Properties of Fourier series, concept of discrete spectrum, Illustrative Problems.
Continuous Time Fourier Transform: Definition, Computation and properties of Fourier transform for different types of signals and systems, Inverse Fourier transform. Statement and proof of sampling theorem of low pass signals, Illustrative Problems.

UNIT - III	**Laplace Transform**

Laplace Transform: Definition, ROC, Properties, Inverse Laplace transforms, the S-plane and BIBO stability, Transfer functions, System Response to standard signals, Solution of differential equations with initial conditions.

UNIT - IV	**Signal Transmission through LTI systems**

Signal Transmission through Linear Systems: Linear system, impulse response, Response of a linear system for different input signals, linear time-invariant (LTI) system, linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time, Energy and Power spectral densities, Illustrative Problems.

UNIT - V	**DTFT & Z-Transform**

Discrete Time Fourier Transform: Definition, Computation and properties of Discrete Time Fourier transform for different types of signals and systems.
Z–Transform: Definition, ROC, Properties, Poles and Zeros in Z-plane, The inverse Z-Transform, System analysis, Transfer function, BIBO stability, System Response to standard signals, Solution of difference equations with initial conditions. Illustrative Problems.

Electronics & Communication Engineering

Textbooks:	
1.	A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2.	Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, Wiley, 2005.
Reference Books:	
1.	BP Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford University Press, 015.
2.	Matthew Sadiku and Warsame H. Ali, "Signals and Systems A primer with MATLAB", CRC Press, 2016.
3.	Hwei Hsu, "Schaum's Outline of Signals and Systems", 4thEdition, TMH, 2019.

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Electronics & Communication Engineering

Course Code	ELECTRICAL ENGINEERING		L	T	P	C
20A02303T			**3**	**0**	**0**	**3**
Pre-requisite	**Fundamentals of Electrical Circuits**	**Semester**		**III**		

Course Objectives:
- Distinguish between classical method and Laplace transform approach in analyzing transient phenomenon in DC excitations
- Understand and design the different types of filters.
- To know about various characteristics of DC Generators and motors.
- To know about principle of operation of a DC machine working as a generator and motor.
- To understand computation and predetermination of regulation of a 1-ϕ transformer.
- To know about principle of operation of three phase induction motor.

Course Outcomes (COs):

CO1: Able to acquire knowledge about how to determine the transient response of R-L, R-C, R-L-C series circuits for D.C and A.C excitations.

CO2: Able to solve the problems on R L C circuits for different excitations using different approaches.

CO3: Analyze the complex circuits of R L C circuits.

CO4: Able to solve the problems the e.m.f. generated on DC Generator

CO5: Able to acquire knowledge about how to determine the efficiency and regulation of single phase transformer and synchronous machine.

UNIT - I	**Transient Analysis**

Introduction, Source free R-L, R-C circuits, R-L, R-C circuits with DC, step, pulse forcing functions, Source free R-L-C circuits – under damped, over damped and critical damped cases, Response of R-L-C circuits with DC and Sinusoidal forcing functions, Relationship between bandwidth and Quality factor in R-L-C circuits – Response of R-L-C circuits using Integral-differential equation and Laplace Transform approaches for dc and sinusoidal excitations – Problem Solving.

UNIT - II	**Frequency Response**

Introduction,Series and Parallel Resonant circuits, Resonant frequency, Relationship between bandwidth and Quality factor, Variation of resonant frequency with circuit elements, Passive Filters – Low pass, High pass, band pass, band elimination filter, Network Synthesis – Foster and Cover forms of LC circuits – Problem Solving.

UNIT - III	**Two-port Networks**

Introduction, Types of two port networks, Various parameters of two port networks, Impedance, Admittance, Transmission, Hybrid parameters and their relations – Finding the two port parameters for various circuits, Concept of transformed network, Two port parameters using transformed variables – Problem solving.

UNIT - IV	**DC Machines**

DC Generators: Principle of operation of DC machines – EMF equation – types of generators – Magnetization and Load characteristics of DC generators
DC Motors: Principle of operation of DC Motor, Types of Motors, Back EMF Equation, Characteristics of DC motor, Torque Equation, Three Point starter, Efficiency Calculation, Swinburne's Test and speed control.

UNIT - V	**AC Machines**

Transformers: Construction and principle of operation of single-phase transformer –EMF equation O.C. & S.C. tests – efficiency and regulation.
Induction Motors: Principle and operation of three phase induction motors – Constructional details – Torque equation- slip torque characteristics.
Alternators: Principle and operation of alternators – O.C. & S.C. tests – regulation by synchronous impedance method.

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Textbooks:
1. William Hayt, Jack E. Kemmerly and Jamie Phillips, "Engineering Circuit Analysis", Mc Graw Hill, 9th edition, 2019.
2. Charles Alexander & Mathew Sadiku, "Fundamentals of Electric Circuits", 6th edition, McGraw Hill Publications, 2016.
3. I. J. Nagrath&D.P.Kothari, "Electric Machines", 7th Edition, Tata Mc Graw Hill, 2005.

Reference Books:
1. M.E. Van Valkenberg, "Network Analysis", 3rd Edition, Prentice Hall (India), 1980.
2. B. R. Gupta, "Fundamentals of Electric Machines", Vandana Singhal, 3rd Edition, New age International Publishers, 2005.
3. T.K. Nagsarkar and M.S. Sukhija, " Basic Electrical Engineering", 3rd Edition, Oxford University Press2017.
4. S. Kamakashiah, "Electromachanics – III", overseas publishers Pvt. Ltd.
5. V.K. Mehta and Rohit Mehta, "Principles of Electrical Engineering", S.Chand Publications, 2005.

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Electronics & Communication Engineering

Course Code	ANALOG CIRCUITS		L	T	P	C
20A04302T			3	0	0	3
Pre-requisite	**Electronic Devices and Circuits, Electrical circuits**	**Semester**		III		

Course Objectives:
- To review analysis & design of single stage amplifiers using BJT & MOSFETs at low and high frequencies.
- To understand the characteristics of Differential amplifiers, feedback and power amplifiers.
- To examine the response of tuned amplifiers and multivibrators
- To categorize different oscillator circuits based on the application
- To design the electronic circuits for the given specifications and for a given application.

Course Outcomes (CO):

CO1: Understand the characteristics of differential amplifiers, feedback and power amplifiers. (L2)

CO2: Examine the frequency response of multistage and differential amplifier circuits using BJT & MOSFETs at low and high frequencies. (L3)

CO3: Investigate different feedback and power amplifier circuits based on the application. (L4)

CO4: Derive the expressions for frequency of oscillation and condition for oscillation of RC and LC oscillator circuits. (L4)

CO5: Evaluate the performance of different tuned amplifiers and multivibrators (L5)

CO6: Design analog circuits for the given specifications and application. (L6)

UNIT - I	Multistage and Differential Amplifiers	10Hrs

Introduction – Recap of Small Signal Amplifiers, Multistage Amplifiers, Cascode amplifier, Darlington pair, the MOS Differential Pair, Small-Signal Operation of the MOS Differential Pair, The BJT Differential Pair, and other Nonideal Characteristics of the Differential Amplifier.

UNIT - II	Frequency Response	15Hrs

Low-Frequency Response of the CS and CE Amplifiers, Internal Capacitive Effects and the High-Frequency Model of the MOSFET and the BJT, High-Frequency Response of the CS and CE Amplifiers, High-Frequency Response of the CG and Cascode Amplifiers, High-Frequency Response of the Source and Emitter Followers, High-Frequency Response of Differential Amplifiers and Multistage amplifiers.

UNIT - III	Feedback Amplifiers & Oscillators	12Hrs

Feedback Amplifiers: Introduction, The General Feedback Structure, Some Properties of Negative Feedback, The Four Basic Feedback Topologies, The Feedback Voltage Amplifier (Series—Shunt), The Feedback Transconductance Amplifier (Series—Series), The Feedback Trans-resistance Amplifier (Shunt—Shunt), The Feedback Current Amplifier (Shunt—Series), Summary.
Oscillators: General Considerations, Phase Shift Oscillator, Wien-Bridge Oscillator, LC Oscillators, Relaxation Oscillator, Crystal Oscillators, Illustrative Problems.

UNIT - IV	Power Amplifiers	10Hrs

Introduction, Classification of Output Stages, Class A Output Stage, Class B Output Stage, Class AB Output Stage, Biasing the Class AB Circuit, CMOS Class AB Output Stages, Power BJTs, Variations on the Class AB Configuration, MOS Power Transistors.

UNIT - V	Tuned Amplifiers and Multivibrators	11Hrs

Tuned Amplifiers: Basic Principle, Use of Transformers, Single Tuned Amplifiers, Amplifiers with multiple Tuned Circuits, Stagger Tuned Amplifiers.
Multivibrators: Analysis and Design of Bistable, Monostable, and Astable Multivibrators.

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Textbooks:
1. Adel. S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits," 6th Edition, Oxford University Press, 2011.
2. J. Millman, C Chalkias, "Integrated Electronics", 4thEdition, McGraw Hill Education (India) Private Ltd., 2015.
3. Millman and Taub, "Pulse,Digital and Switching Waveforms", 3rd Edition, Tata McGraw-Hill Education, 2011.
Reference Books:
1. Behzad Razavi, "Fundamentals of Micro Electronics", Wiley, 2010.
2. Donald A Neamen, "Electronic Circuits – Analysis and Design," 3rdEdition, McGraw Hill (India), 2019.
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 9th Edition, Pearson/Prentice Hall, 2006.
4. K.Lal Kishore, "Electronic Circuit Analysis", 2ndEdition, B S Publications, 2008.

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Electronics & Communication Engineering

Course Code	MANAGERIAL ECONOMICS AND FINANCIAL		L	T	P	C
20A52301	ANALYSIS		3	0	0	3
	(Common to All branches of Engineering)					
Pre-requisite	NIL	Semester		III		

Course Objectives:
- To inculcate the basic knowledge of micro economics and financial accounting
- To make the students learn how demand is estimated for different products, input‑output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements

Course Outcomes (CO):
- Define the concepts related to Managerial Economics, financial accounting and management.
- Understand the   fundamentals of Economics viz., Demand, Production, cost, revenue and markets
- Apply the Concept of Production cost and revenues for effective Business decision
- Analyze how to invest their capital and maximize returns
- Evaluate the capital budgeting techniques
- Develop the accounting statements and evaluate the financial performance of business entity.

UNIT - I	**Managerial Economics**

Introduction – Nature, meaning, significance, functions, and advantages. Demand‑Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

UNIT - II	**Production and Cost Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost & Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.

UNIT - III	**Business Organizations and Markets**

Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly-Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies

UNIT - IV	**Capital Budgeting**

Introduction – Nature, meaning, significance, functions and advantages. Types of Working Capital, Components, Sources of Short-term and Long-term   Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

UNIT - V	**Financial Accounting and Analysis**

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Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions-Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). *Financial Analysis -* Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:
1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

Reference Books:
1. Ahuja Hl Managerial economics Schand,3/e,2013
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage,
   2013.

Online Learning Resources:
https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607
https://www.slideshare.net/balarajbl/market-and-classification-of-market
https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396
https://www.slideshare.net/ashu1983/financial-accounting

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Electronics & Communication Engineering

Course Code	ORGANISATIONAL BEHAVIOUR		L	T	P	C
20A52302	(Common to All branches of Engineering)		3	0	0	3
Pre-requisite	NIL	Semester		III		

Course Objectives:	

- To enable student's comprehension of organizational behavior
- To offer knowledge to students on self-motivation, leadership and management
- To facilitate them to become powerful leaders
- To Impart knowledge about group dynamics
- To make them understand the importance of change and development

Course Outcomes (CO):

- Define the Organizational Behaviour, its nature and scope.
- Understand the nature and concept of Organizational behaviour
- Apply theories of motivation to analyse the performance problems
- Analyse the different theories of leadership
- Evaluate group dynamics
- Develop as powerful leader

UNIT - I	**Introduction to Organizational Behavior**

Meaning, definition, nature, scope and functions - Organizing Process – Making organizing effective -Understanding Individual Behaviour –Attitude -Perception - Learning – Personality.

UNIT - II	**Motivation and Leading**

Theories of Motivation- Maslow's Hierarchy of Needs - Hertzberg's Two Factor Theory - Vroom's theory of expectancy – Mc Cleland's theory of needs–Mc Gregor's theory X and theory Y– Adam's equity theory – Locke's goal setting theory– Alderfer's ERG theory .

UNIT - III	**Organizational Culture**

Introduction – Meaning, scope, definition, Nature - Organizational Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader - Conflict Management -Evaluating Leader- Women and Corporate leadership.

UNIT - IV	**Group Dynamics**

Introduction – Meaning, scope, definition, Nature- Types of groups - Determinants of group behavior - Group process – Group Development - Group norms - Group cohesiveness - Small Groups - Group decision making - Team building - Conflict in the organization– Conflict resolution

UNIT - V	**Organizational Change and Development**

Introduction –Nature, Meaning, scope, definition and functions- Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development

Textbooks:

1. Luthans, Fred, Organisational Behaviour, McGraw-Hill, 12 Th edition 2011
2. P Subba Ran, Organisational Behaviour, Himalya Publishing House 2017

Reference Books:

- McShane, Organizational Behaviour, TMH 2009
- Nelson, Organisational Behaviour, Thomson, 2009.
- Robbins, P. Stephen, Timothy A. Judge, Organisational Behaviour, Pearson 2009.
- Aswathappa, Organisational Behaviour, Himalaya, 2009

Online Learning Resources:

httphttps://www.slideshare.net/Knight1040/organizational-culture-
9608857s://www.slideshare.net/AbhayRajpoot3/motivation-165556714
https://www.slideshare.net/harshrastogi1/group-dynamics-159412405
https://www.slideshare.net/vanyasingla1/organizational-change-development-26565951

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Course Code	Business Environment		L	T	P	C
20A52303	(Common to All branches of Engineering)		3	0	0	3
Pre-requisite	NIL	Semester		III		

Course Objectives:
- To make the student to understand about the business environment
- To enable them in knowing the importance of fiscal and monitory policy
- To facilitate them in understanding the export policy of the country
- To Impart knowledge about the functioning and role of WTO
- To Encourage the student in knowing the structure of stock markets

Course Outcomes (CO):
- Define Business Environment and its Importance.
- Understand various types of business environment.
- Apply the knowledge of Money markets in future investment
- Analyse India's Trade Policy
- Evaluate fiscal and monitory policy
- Develop a personal synthesis and approach for identifying business opportunities

UNIT - I	Overview of Business Environment

Introduction – meaning Nature, Scope, significance, functions and advantages. Types-Internal &External, Micro and Macro. Competitive structure of industries -Environmental analysis- advantages & limitations of environmental analysis& Characteristics of business.

UNIT - II	Fiscal & Monetary Policy

Introduction – Nature, meaning, significance, functions and advantages. Public Revenues - Public Expenditure - Evaluation of recent fiscal policy of GOI. Highlights of Budget- Monetary Policy - Demand and Supply of Money –RBI -Objectives of monetary and credit policy - Recent trends- Role of Finance Commission.

UNIT - III	India's Trade Policy

Introduction – Nature, meaning, significance, functions and advantages. Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank -Balance of Payments– Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.

UNIT - IV	World Trade Organization

Introduction – Nature, significance, functions and advantages. Organization and Structure - Role and functions of WTO in promoting world trade - GATT -Agreements in the Uruguay Round –TRIPS, TRIMS - Disputes Settlement Mechanism - Dumping and Anti-dumping Measures.

UNIT - V	Money Markets and Capital Markets

Introduction – Nature, meaning, significance, functions and advantages. Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI – Stock Exchanges - Investor protection and role of SEBI, Introduction to international finance.

Textbooks:

1. Francis Cherunilam (2009), International Business: Text and Cases, Prentice Hall of India.
 2. K. Aswathappa, Essentials of Business Environment: Texts and Cases & Exercises 13th Revised Edition.HPH2016

Reference Books:

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1.K. V. Sivayya, V. B. M Das (2009), Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black (2009), International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N (2009), International Business, Wiley India.
4.E. Bhattacharya (2009), International Business, Excel Publications, New Delhi.

Online Learning Resources:
https://www.slideshare.net/ShompaDhali/business-environment-53111245
https://www.slideshare.net/rbalsells/fiscal-policy-ppt
https://www.slideshare.net/aguness/monetary-policy-presentationppt
https://www.slideshare.net/DaudRizwan/monetary-policy-of-india-69561982
https://www.slideshare.net/ShikhaGupta31/indias-trade-policyppt
https://www.slideshare.net/viking2690/wto-ppt-60260883
https://www.slideshare.net/prateeknepal3/ppt-mo

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Course Code	SIMULATION LAB		L	T	P	C
20A04301P			**0**	**0**	**3**	**1.5**
Pre-requisite	**Linear Algebra**	**Semester**		**III**		

Course Objectives:
- To realize the concepts studied in theory   - To simulate various Signals and Systems through MATLAB   - To apply the concepts of signals to determine their energy, power, psd etc.   - To analyze the output of a system when it is excited by different types of deterministic and random signals.   - To generate random signals for the given specifications
Course Outcomes (CO):
CO1: Learn how to use the MATLAB software and know syntax of MATLAB programming.   CO2: Understand how to simulate different types of signals and system response.   CO3: Find the Fourier Transform of a given signal and plot amplitude and phase characteristics.   CO4: Analyze the response of different systems when they are excited by different signals and plot power spectral density of signals.   CO5: Generate/Simulate different random signals for the given specifications
List of Experiments:
- Write a program to generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.   - Perform operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.   - Write a program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings- Plot the discrete spectrum of the signal.   - Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.   - Write a program to convolve two discrete time sequences. Plot all the sequences.   - Write a program to find autocorrelation and cross correlation of given sequences.   - Write a program to verify Linearity and Time Invariance properties of a given Continuous/Discrete System.   - Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.   - Write a program to find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.   - Write a program to find response of a low pass filter and high pass filter, when a speech signal is passed through these filters.   - Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).   - Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the same for a time period of 0.2 sec.   - To plot pole-zero diagram in S-plane of given signal/sequence and verify its stability.
Note: All the experiments are to be simulated using MATLAB or equivalent software.
References:
Stephen J. Chapman, "MATLAB Programming for Engineers", Cengage, November 2012.
Online Learning Resources/Virtual Labs:
https://www.vlab.co.in/

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Course Code	ELECTRICAL ENGINEERING LAB		L	T	P	C
20A02303P			**0**	**0**	**3**	**1.5**
Pre-requisite	**Fundamentals of Electrical Circuits**	**Semester**		**III**		

Course Objectives:
• Understand and experimentally verify various resonance circuits
• Apply and experimentally analyze two port network parameters
• To do experiments on DC Machines
• To do experiments on AC Machines
Course Outcomes (CO):
• To determine the various parameters experimentally
• To understand various characteristics of DC generators and DC motors
• To predetermine the efficiency and regulation of a 1-φ transformer

Experiments
1. Response of RL, RC, and R-L-C circuits for step and pulse inputs
2. Series Resonance and its Frequency Response
3. Parallel Resonance and its Frequency Response
4. Determination of Z & Y parameters for the given two port network.
5. Determination of Transmission and Hybrid Parameters of a given two port network
6. OCC of a separately excited DC generator
7. Load characteristics of DC shunt generator
8. Load characteristics of DC shunt motor
9. Swinburne's test
10. Speed control of DC shunt motor
11. OC & SC tests on a 1-φ transformer
12. Load test on Squirrel cage Induction motor
13. Predetermination of regulation of alternator by Synchronous impedance method
Note: Student has to perform at least 10 experiments

Online learning resources/Virtual Labs: https://www.vlab.co.in/

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Course Code	ANALOG CIRCUITS LAB		L	T	P	C
20A04302P			0	0	3	1.5
Pre-requisite	Electronic Devices and Circuits lab	Semester		III		

Course Objectives:	

- To review analysis & design of single stage amplifiers using BJT & MOSFETs at low and high frequencies.
- To understand the characteristics of Differential amplifiers, feedback and power amplifiers.
- To examine the response of tuned amplifiers and multivibrators
- To categorize different oscillator circuits based on the application
- To design the electronic circuits for the given specifications and for a given application.

Course Outcomes (CO):

CO1: Know about the usage of equipment/components/software tools used to conduct the experiments in analog circuits.

CO2: Conduct the experiment based on the knowledge acquired in the theory about various analog circuits using BJT/MOSFETs to find the important parameters of the circuit (viz. Voltage gain, Current gain, bandwidth, input and output impedances etc) experimentally.

CO3: Analyze the given analog circuit to find required important metrics of it theoretically.

CO4:Draw the relevant graphs between important metrics of the system from the observed measurements.

CO5: Compare the experimental results with that of theoretical ones and infer the conclusions.

CO6: Design the circuit for the given specifications.

List of Experiments:

1. Design and Analysis of Darlington pair.
2. Frequency response of CE – CC multistage Amplifier
3. Design and Analysis of Cascode Amplifier.
4. Frequency Response of Differential Amplifier
5. Design and Analysis of Series – Series feedback amplifier and find the frequency response of it.
6. Design and Analysis of Shunt – Shunt feedback amplifier and find the frequency response of it.
7. Design and Analysis of Class A power amplifier
8. Design and Analysis of Class AB amplifier
9. Design and Analysis of RC phase shift oscillator
10. Design and Analysis of LC Oscillator
11. Frequency Response of Single Tuned amplifier
12. Design and Analysis of Bistable Multivibrator
13. Design and Analysis of Monostable Multivibrator
14. Design and Analysis of Astable Multivibrator

Note: At least 12 experiments shall be performed. Both BJT and MOSFET based circuits shall be implemented.

Faculty members who are handling the laboratory shall see that students are given design specifications for a given circuit appropriately and monitor the design and analysis aspects of the circuit.

Online learning resources/Virtual labs:
https://www.vlab.co.in/

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Course Code	Application Development with Python		L	T	P	C
20A05305			**1**	**0**	**2**	**2**
Pre-requisite	**NIL**	**Semester**		**III**		

Course Objectives:
- To learn the basic concepts of software engineering and life cycle models
- To explore the importance of Databases in application Development
- Acquire programming skills in core Python
- To understand the importance of Object-oriented Programming

Course Outcomes (CO):

Students should be able to
- Identify the issues in software requirements specification and enable to write SRS documents for software development problems
- Explore the use of Object oriented concepts to solve Real-life problems
- Design database for any real-world problem
- Solve mathematical problems using Python programming language

Module 1. Basic concepts in software engineering and software project management

Basic concepts: abstraction versus decomposition, the evolution of software engineering techniques, Software development life cycle
Software project management: project planning and project scheduling

Task:
1. Identifying the Requirements from Problem Statements

Module 2. Basic Concepts of Databases
Database systems applications, Purpose of Database Systems, view of Data, Database Languages, Relational Databases, Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table), Data Manipulation Language(DML) Statements
Task:
1. Implement Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table)
2. Implement Data Manipulation Language(DML) Statements

Module 3. Python Programming:
Introduction to Python: Features of Python, Data types, Operators, Input and output, Control Statements, Looping statements
Python Data Structures: Lists, Dictionaries, Tuples.

Strings: Creating strings and basic operations on strings, string testing methods.

Functions: Defining a function- Calling a function- Types of functions-Function Arguments-Anonymous functions- Global and local variables

OOPS Concepts; Classes and objects- Attributes- Inheritance- Overloading- Overriding- Data hiding

Modules and Packages: Standard modules-Importing own module as well as external modules Understanding Packages Powerful Lamda function in python Programming using functions, modules and external packages

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Working with Data in Python: Printing on screen- Reading data from keyboard- Opening and closing file- Reading and writing files- Functions-Loading Data with Pandas-Numpy

Tasks:
1. OPERATORS
a. Read a list of numbers and write a program to check whether a particular element is present or not using membership operators.
b. Read your name and age and write a program to display the year in which you will turn 100 years old.
c. Read radius and height of a cone and write a program to find the volume of a cone.
d. Write a program to compute distance between two points taking input from the user (Hint: use Pythagorean theorem)

2. CONTROL STRUCTURES
a. Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if…elif…else statement.
b. Write a program to create and display a dictionary by storing the antonyms of words. Find the antonym of a particular word given by the user from the dictionary using while loop.
c. Write a Program to find the sum of a Series $1/1! + 2/2! + 3/3! + 4/4! +……+ n/n!$. (Input :n = 5, Output : 2.70833)
d. In number theory, an abundant number or excessive number is a number for which the sum of its proper divisors is greater than the number itself. Write a program to find out, if the given number is abundant. (Input: 12, Sum of divisors of $12 = 1 + 2 + 3 + 4 + 6 = 16$, sum of divisors 16 > original number 12)

3: LIST
a. Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5).
b. Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24)
c. Read a list of numbers and print numbers present in odd index position. (Ex: [10, 25, 30, 47, 56, 84, 96], The numbers in odd index position: 25 47 84).
d. Read a list of numbers and remove the duplicate numbers from it. (Ex: Enter a list with duplicate elements: 10 20 40 10 50 30 20 10 80, The unique list is: [10, 20, 30, 40, 50, 80])

4: TUPLE
a. Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. test_list = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)]
b. Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: test_list = [("GFG", "IS", "BEST"), ("GFg", "AVERAGE"), ("GfG",), ("Gfg", "CS")], Output : [("GFG", "IS", "BEST")]).
c. Given a tuple and a list as input, write a program to count the occurrences of all items of the list in the tuple. (Input : tuple = ('a', 'a', 'c', 'b', 'd'), list = ['a', 'b'], Output : 3)

5: SET
a. Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
b. Write a program to perform union, intersection and difference using Set A and Set B.
c. Write a program to count number of vowels using sets in given string (Input : "Hello World", Output : No. of vowels : 3)
d. Write a program to form concatenated string by taking uncommon characters from two strings using set concept (Input : S1 = "aacdb", S2 = "gafd", Output : "cbgf").

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6: DICTIONARY
a. Write a program to do the following operations:
i. Create a empty dictionary with dict() method
ii. Add elements one at a time
iii. Update existing key"s value
iv. Access an element using a key and also get() method
v. Deleting a key value using del() method
b. Write a program to create a dictionary and apply the following methods:
i. pop() method
ii. popitem() method
iii. clear() method
c. Given a dictionary, write a program to find the sum of all items in the dictionary.
d. Write a program to merge two dictionaries using update() method.

7: STRINGS
a. Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward.
b. Write a program to read a string and count the number of vowel letters and print all letters except 'e' and 's'.
c. Write a program to read a line of text and remove the initial word from given text. (Hint: Use split() method, Input : India is my country. Output : is my country)
d. Write a program to read a string and count how many times each letter appears. (Histogram).

8: USER DEFINED FUNCTIONS
a. A generator is a function that produces a sequence of results instead of a single value. Write a generator function for Fibonacci numbers up to n.
b. Write a function merge_dict(dict1, dict2) to merge two Python dictionaries.
c. Write a fact() function to compute the factorial of a given positive number.
d. Given a list of n elements, write a linear_search() function to search a given element x in a list.

9: BUILT-IN FUNCTIONS
a. Write a program to demonstrate the working of built-in statistical functions mean(), mode(), median() by importing statistics library.
b. Write a program to demonstrate the working of built-in trignometric functions sin(), cos(), tan(), hypot(), degrees(), radians() by importing math module.
c. Write a program to demonstrate the working of built-in Logarithmic and Power functions exp(), log(), log2(), log10(), pow() by importing math module.
d. Write a program to demonstrate the working of built-in numeric functions ceil(), floor(), fabs(), factorial(), gcd() by importing math module.

10. CLASS AND OBJECTS
a. Write a program to create a BankAccount class. Your class should support the following methods for
i) Deposit
  ii) Withdraw
  iii) GetBalanace
  iv) PinChange
b. Create a SavingsAccount class that behaves just like a BankAccount, but also has an interest rate and a method that increases the balance by the appropriate amount of interest (Hint:use Inheritance).

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c. Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employee_info() method and also using dictionary (__dict__).

d. Access modifiers in Python are used to modify the default scope of variables. Write a program to demonstrate the 3 types of access modifiers: public, private and protected.

11. FILE HANDLING

a. . Write a program to read a filename from the user, open the file (say firstFile.txt) and then perform the following operations:
    i. Count the sentences in the file.
    ii. Count the words in the file.
    iii. Count the characters in the file.

b. . Create a new file (Hello.txt) and copy the text to other file called target.txt. The target.txt file should store only lower case alphabets and display the number of lines copied.

c. Write a Python program to store N student"s records containing name, roll number and branch. Print the given branch student"s details only.

References:

1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
2. RamezElmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.
3.Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.
4. Larry Lutz, "Python for Beginners: Step-By-Step Guide to Learning Python Programming", CreateSpace Independent Publishing Platform, First edition, 2018

Online Learning Resources/Virtual Labs:

1. http://vlabs.iitkgp.ernet.in/se/
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php
3. https://python-iitk.vlabs.ac.in

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Course Code	UNIVERSAL HUMAN VALUES		L	T	P	C
20A52201	(Common to all branches of Engineering)		3	0	0	0
Pre-requisite	NIL	Semester		III		

Course Objectives:

The objective of the course is fourfold:
- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Outcomes (CO):

By the end of the course,
- Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability.
- They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

UNIT - I	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education	8 Hrs

Purpose and motivation for the course, recapitulation from Universal Human Values-I

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation-as the process for self-exploration

Continuous Happiness and Prosperity- A look at basic Human Aspirations

Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT - II	Understanding Harmony in the Human Being - Harmony in Myself!	12 Hrs

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'

Understanding the needs of Self ('I') and 'Body' - happiness and physical facility

Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)

Understanding the characteristics and activities of 'I' and harmony in 'I'

Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT - III	Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship	8 Hrs

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Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship Understanding the meaning of Trust; Difference between intention and competence Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives		
UNIT – IV	Understanding Harmony in the Nature and Existence - Whole existence as Coexistence	10 Hrs
Understanding the harmony in the Nature Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature Understanding Existence as Co-existence of mutually interacting units in all- pervasive space Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.		
UNIT – V	Implications of the above Holistic Understanding of Harmony on Professional Ethics	8 Hrs
Natural acceptance of human values Definitiveness of Ethical Human Conduct Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.		
Textbooks:		
R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2		
Reference Books:		
Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004. The Story of Stuff (Book). 4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth" 5. E. FSchumacher. "Small is Beautiful" Slow is Beautiful –Cecile Andrews J C Kumarappa "Economy of Permanence"		

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Pandit Sunderlal "Bharat Mein Angreji Raj" Dharampal, "Rediscovering India" Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule" India Wins Freedom - Maulana Abdul Kalam Azad Vivekananda - Romain Rolland(English) Gandhi - Romain Rolland (English)
MODE OF CONDUCT Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions. While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements. In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting. Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

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Electronics & Communication Engineering

Course Code	PROBABILITY THEORY AND STOCHASTIC PROCESSES		L	T	P	C
20A54403			3	0	0	3
Pre-requisite	Signals Systems & Networks	Semester	IV			

Course Objectives:
- To gain the knowledge of the basic probability concepts and acquire skills in handling situations involving more than one random variable and functions of random variables.
- To understand the principles of random signals and random processes.
- To be acquainted with systems involving random signals.
- To gain knowledge of standard distributions that can describe real life phenomena

Course Outcomes (CO):

CO1: Understanding the concepts of Probability, Random Variables, Random Processes and their characteristics learn how to deal with multiple random variables, conditional probability, joint distribution and statistical independence. (L1)

CO2: Formulate and solve the engineering problems involving random variables and random processes. (L2)

CO3: Analyze various probability density functions of random variables. (L3)

CO4: Derive the response of linear system for Gaussian noise and random signals as inputs. (L3)

UNIT - I	**Probability & Random Variable**

Probability through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events, Problem Solving.

Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties, Problem Solving.

UNIT - II	**Operations on Random variable**

Operations on Single Random Variable: Introduction, Expectation of a random variable, moments-moments about the origin, Central moments, Variance and Skew, Chebyshev's inequality, moment generating function, characteristic function, transformations of random variable.

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected), Unequal Distribution, Equal Distributions.

UNIT - III	**Operations on Multiple Random variables**

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties of Gaussian random variables, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT - IV	**Random Processes**

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, N-Order and Strict-Sense Stationarity. Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-

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Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

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

UNIT - V	**Random Signal Response of Linear Systems**	Lecture Hrs

Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, Band pass, Band Limited and Narrowband Processes, Properties.

Noise Definitions: White Noise, colored noise and their statistical characteristics, Ideal low pass filtered white noise, RC filtered white noise.

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

Reference Books:
1. Simon Haykin, "Communication Systems", 3rd Edition, Wiley, 2010.
2. Henry Stark and John W.Woods, "Probability and Random Processes with Application to Signal Processing," 3rd Edition, Pearson Education, 2002.
3. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis," 3rd Edition, Oxford, 1999.

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Course Code	DIGITAL LOGIC DESIGN		L	T	P	C
20A04303T	**(Common to ECE and EEE)**		**3**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Semester**		**III**		

Course Objectives:
- To familiarize with the concepts of different number systems and Boolean algebra.
- To introduce the design techniques of combinational, sequential logic circuits.
- To model combinational and sequential circuits using HDLs.

Course Outcomes (CO):

CO1: Understand the properties of Boolean algebra, other logic operations, and minimization of Boolean functions using Karnaugh map.

CO2: Make use of the concepts to solve the problems related to the logic circuits.

CO3: Analyze the combinational and sequential logic circuits.

CO4: Develop digital circuits using HDL, and Compare various Programmable logic devices

CO5: Design various logic circuits using Boolean algebra, combinational and sequential logic circuits.

UNIT - I	**Number Systems, Boolean algebra and Logic Gates**

Number systems - binary numbers, octal, hexadecimal, other binary codes; complements, signed binary numbers, digital logic operations and gates, basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, complements of Boolean functions, two-level NAND and NOR Implementation of Boolean functions.

UNIT - II	**Minimization of Boolean functions and Combinational Logic Circuits**

The Karnaugh map method (up to five variables), product of sums simplifications, don't care conditions, Tabular method, Introduction, Combinational circuits, design procedure, adders, subtractors, 4-bit binary adder/ subtractor circuit, BCD adder, carry look- a-head adder, binary multiplier, magnitude comparator, decoders and encoders, multiplexers, demultiplexers,

UNIT - III	**Sequential Logic Circuits**

Basic architectural distinction between combinational and sequential circuits, Design procedure, latches, flip-flops, truth tables and excitation tables, timing and triggering consideration, conversion of flip- flops, design of counters, ripple counters, synchronous counters, ring counter, Johnson counter, registers, shift registers, universal shift register

UNIT - IV	**Finite State Machines and Programmable Logic Devices**

Types of FSM, capabilities and limitations of FSM, state assignment, realization of FSM using flip-flops, Mealy to Moore conversion and vice-versa, reduction of state tables using partition technique, Design of sequence detector.

UNIT - V	**Hardware Description Language**

Types of PLD's: PROM, PAL, PLA, basic structure of CPLD and FPGA, advantages of FPGAs, Design of sequential circuits using ROMs, PLAs, CPLDs and FPGAs, Introduction to Verilog - structural Specification of logic circuits, behavioural specification of logic circuits, hierarchical Verilog Code, Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop; using storage elements with CAD tools-using Verilog constructs for storage elements, flip-flop with clear capability, using Verilog constructs for registers and counters.

Textbooks:
1. M. Morris Mano, "Digital Design", 3rd Edition, PHI. (Unit I to IV)
2. Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGraw-Hill (Unit V)

Reference Books:
1. Charles H. Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers.
2. ZviKohavi and Niraj K.Jha, "Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition, Prentice Hall PTR.
4. D.P. Leach, A.P. Malvino, "Digital Principles and Applications", TMH, 7th Edition.

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Electronics & Communication Engineering

Course Code	ELECTROMAGNETIC WAVES AND		L	T	P	C
20A04401	TRANSMISSION LINES		3	0	0	3
Pre-requisite	Mathematics II and Mathematics III	Semester		IV		

Course Objectives:

- To introduce fundamentals of static and time varying electromagnetic fields.
- To teach problem solving in Electromagnetic fields using vector calculus.
- To demonstrate wave concept with the help of Maxwell's equations.
- To introduce concepts of polarization and fundamental theory of electromagnetic waves in transmission lines and their practical applications.
- To analyze reflection and refraction of electromagnetic waves propagated in normal and oblique incidences.

Course Outcomes (CO):

CO1: Explain basic laws of electromagnetic fields and know the wave concept. (L2)
CO2: Solve problems related to electromagnetic fields. (L3)
CO3: Analyze electric and magnetic fields at the interface of different media. (L3)
CO4: Derive Maxwell's equations for static and time varying fields. (L3)
CO5: Analogy between electric and magnetic fields. (L5)
C06: Describes the transmission lines with equivalent circuit and explain their characteristic with various lengths. (L2)

UNIT - I	**Static Electric Fields**

Recap of Vector Analysis: Coordinate systems and transformation-Cartesian, Cylindrical and Spherical coordinates
Recap of Vector Calculus: Differential length area and volume, line surface and volume integrals, Del operator, gradient, divergent and curl operations.
Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Divergence Theorem, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, 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	**Static Magnetic Fields & Time varying Fields**

Magnetic Fields: 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, Magnetic dipole, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems.
Faraday's Law and Transformer e.m.f, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's equations for time varying fields, Maxwell's Equations in Different Final Forms and Word Statements, Illustrative Problems

UNIT - III	**Boundary Conditions and Uniform Plane Wave**

Boundary Conditions of Electromagnetic fields: Dielectric-Dielectric and Dielectric-Conductor Interfaces, 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, Illustrative Problems.

UNIT - IV	**Reflection and Refraction of Plane Waves**

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Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector, and Poynting Theorem – Applications, Power Loss in a Plane Conductor, Illustrative Problems.

UNIT - V	**Transmission Lines**

Transmission Lines: Introduction, Transmission line parameters, Transmission line equivalent circuit, Transmission line equations and their solutions in their phasor form, input impedance, standing wave ratio, Transmission of finite length- half wave, quarter wave transmission line, Smith chart, graphical analysis of transmission lines using Smith chart, stub matching- single and double stub matching, Illustrative Problems.

Textbooks:
1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 4th edition. Oxford Univ. Press, 2008.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 7th edition.,TMH, 2006.

Reference Books:
1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2000.
2. John D. Krauss, "Electromagnetics", 4th Edition, McGraw- Hill publication, 1999.
3. Electromagnetics, Schaum's outline series, 2nd Edition, Tata McGraw-Hill publications, 2006.

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Course Code	COMMUNICATION SYSTEMS		L	T	P	C
20A04402T			**3**	**0**	**0**	**3**
Pre-requisite	**Signals & Systems**	**Semester**	**IV**			

Course Objectives:
- To introduce various modulation and demodulation techniques of analog and digital communication systems.
- To analyze different parameters of analog and digital communication techniques.
- To Know Noise Figure in AM & FM receiver systems.
- To understand Function of various stages of AM, FM transmitters and Know Characteristics of AM &FMreceivers.
- To analyze the performance of various digital modulation techniques in the presence of AWGN.
- To evaluate the performance of each modulation scheme to know the merits and demerits interms of bandwidth and power efficiency

Course Outcomes (CO):

CO1: Recognize/List the basic terminology used in analog and digital communication techniques for transmission of information/data.

CO2: Explain/Discuss the basic operation of different analog and digital communication systems at baseband and passband level.

CO3: Compute various parameters of baseband and passband transmission schemes by applying basic engineering knowledge.

CO4: Analyze/Investigate the performance of different modulation & demodulation techniques to solve complex problems in the presence of noise.

CO5: Evaluate/Assess the performance of all analog and digital modulation techniques to know the merits and demerits of each one of them in terms of bandwidth and power efficiency.

UNIT - I	Continuous Wave Modulation	15 Hrs

Introduction: The communication Process, Communication Channels, Baseband and Passband Signals, Analog vs Digital Communications, Need for the modulation.
Amplitude Modulation(AM): AM and its modifications – DSB, SSB,VSB. Frequency Translation, Frequency Division Multiplexing (FDM).
Angle Modulation:Frequency Modulation(FM), Phase Modulation, PLL, Nonlinear Effects in FM, Superheterodyne Receivers.

UNIT - II	Noise and Pulse Modulation	12 Hrs

Introduction to Noise: Types of Noise, Receiver Model,Noise in AM, DSB, SSB, and FM Receivers, Pre-Emphasis and De-emphasis in FM.
Introduction to Pulse Modulation: The Sampling Process, PAM, TDM, Bandwidth-Noise Trade off, Quantization process, PCM, Noise considerations in PCM systems, Delta Modulation, DPCM, Coding speech at low bit rates.

UNIT - III	Baseband Pulse Transmission	10 Hrs

Introduction, Matched Filter, Properties of Matched Filter, Error rate due to noise, Inter Symbol Interference (ISI), Nyquist Criterion for distortion less baseband binary transmission, Correlative level coding, Baseband M-ary PAM transmission, QAM, MAP and ML decoding, Equalization, Eye pattern.

UNKT - IV	Digital Passband Transmission	8 Hrs

Introduction, Passband Transmission Model, Gram-Schmidt Orthogonalization Procedure, Geometric Interpretation of Signals, Response of bank of correlators in noise, Correlation receiver, Probability of Error, Detection of Signals with unknown phase.

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UNIT - V	Digital Modulation Schemes & Information Theory	12 Hrs
Coherent Digital Modulation Schemes – ASK, BPSK, BFSK, QPSK, Non-coherent BFSK, DPSK. M-ary Modulation Techniques, Power Spectra, Bandwidth Efficiency, Timing and Frequency synchronization. Information theory: Entropy, Mutual Information and Channel capacity theorem.		
Textbooks:		
1. Simon Haykin, "Communication Systems", JohnWiley& Sons, 4th Edition, 2004. 2. B. P. Lathi, Zhi Ding " Modern Digital and Analog Communication Systems", Oxford press, 2011.		
References:		
1.Sam Shanmugam, "Digital and Analog Communication Systems",JohnWiley& Sons, 1999. 2. Bernard Sklar, F. J. harris"Digial Communications: Fundamentals andApplications", Pearson Publications, 2020. 3. Taub and Schilling, " Principles of Communication Systems", Tata McGraw Hill, 2007.		

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Course Code	LINEAR AND DIGITAL IC APPLICATIONS		L	T	P	C
20A04403T			3	0	0	3
Pre-requisite	Analog circuits, Digital Logic Design	Semester		IV		

Course Objectives:
- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of PLL.
- To introduce the concepts of waveform generation and introduce some special function ICs.
- Exposure to digital IC's

Course Outcomes (CO):
CO1: List out the characteristics of Linear and Digital ICs.
CO2: Discuss the various applications of linear & Digital ICs.
CO3: Solve the application based problems related to linear and digital ICs.
CO4: Analyze various applications based circuits of linear and digital ICs.
CO5: Design the circuits using either linear ICs or Digital ICs from the given specifications.

UNIT – I	ICs and OP- AMPS

INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER: Introduction, Classification of IC's, IC chip size and circuit complexity, basic information of Op-Amp IC741 Op-Amp and its features, the ideal Operational amplifier, Op-Amp internal circuit, Op-Amp characteristics - DC and AC.

UNIT – II	Applications of OP- AMP

LINEAR APPLICATIONS OF OP-AMP: Inverting and non-inverting amplifiers, adder, subtractor, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Integrator and differentiator.

NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators, Oscillators

UNIT - III	Active Filters and other ICs

ACTIVE FILTERS: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters.

TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL.

UNIT – IV	Voltage Regulators and Converters

VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

D to A AND A to D CONVERTERS: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

UNIT - V	Digital ICs

CMOS LOGIC: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic.

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COMBINATIONAL CIRCUITS USING TTL 74XX ICS: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483), Comparator (IC 7485), Decoder (IC74138, IC 74154), BCD-to-7-segment decoder (IC 7447), Encoder (IC 74147), Multiplexer (IC 74151), Demultiplexer (IC74154). **SEQUNTIAL CIRCUITS USING TTL 74XX ICS:** Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter (IC 7493).

Textbooks:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuit", 4th edition (2012), New Age International Pvt.Ltd., New Delhi, India
2. Ramakant A. Gayakwad, "OP-AMP and Linear Integrated Circuits", 4th edition (2012), Prentice Hall / Pearson Education, New Delhi.

Floyd, Jain, "Digital Fundamentals", 8th edition (2009), Pearson Education, New Delhi.

References:

1. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
2. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits,Wiley International, New Delhi.

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Electronics & Communication Engineering

Course Code		DIGITAL LOGIC DESIGN LAB	L	T	P	C
20A04303P		**(Common to ECE and EEE)**	**0**	**0**	**3**	**1.5**
Pre-requisite	**NIL**		**Semester**		**IV**	

Course Objectives:
- To understand various pin configurations of the Digital ICs used in the laboratory
- To conduct the experiments and verify the truth tables of various logic circuits.
- To analyze the logic circuits
- To design sequential and combinational logic circuits and verify their properties.
- To design of any sequential/combinational circuit using Hardware Description Language.

Course Outcomes (CO):
CO1: Understand the pin configuration of various digital ICs used in the lab
CO2: Conduct the experiment and verify the properties of various logic circuits.
CO3: Analyze the sequential and combinational circuits.
CO4: Design of any sequential/combinational circuit using Hardware/ HDL.

List of Experiments:
1. Verification of truth tables of the following Logic gates
   Two input (i) OR (ii) AND (iii) NOR (iv) NAND (v) Exclusive-OR (vi) Exclusive-NOR
2. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit.
3. Verification of functional table of 3 to 8-line Decoder /De-multiplexer
4. 4variable logic function verification using 8 to1 multiplexer.
5. Design full adder circuit and verify its functional table.
6. Verification of functional tables of (i) JK Edge triggered Flip–Flop (ii) JK Master Slav Flip–Flop (iii) D Flip-Flop
7. Design a four-bit ring counter using D Flip–Flops/JK Flip Flop and verify output
8. Design a four bit Johnson's counter using D Flip-Flops/JK Flip Flops and verify output
9. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.
10. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip-Flops and Test It with a low frequency clock and sketch the output waveforms.
11. Design MOD–8 synchronous counter using T Flip-Flop and verify the result and sketch the output waveforms.
12. (a) Draw the circuit diagram of a single bit comparator and test the output
    (b) Construct 7 Segment Display Circuit Using Decoder and7 Segment LED and test it.

ADD on Experiments:
1. Design BCD Adder Circuit and Test the Same using Relevant IC
2. Design Excess-3 to 9- Complement convertor using only four Full Adders and test the Circuit.
3. Design an Experimental model to demonstrate the operation of 74154 De-Multiplexer using LEDs for outputs.
4. Design of any combinational circuit using Hardware Description Language
5. Design of any sequential circuit using Hardware Description Language

References:
M. Morris Mano, "Digital Design", 3rd Edition, PHI

Online learning resources/virtual labs:
https://www.vlab.co.in/

Course Code		COMMUNICATION SYSTEMS LAB	L	T	P	C

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20A04402P		0	0	3	1.5
Pre-requisite	**NIL**	**Semester**		**IV**	

Course Objectives:
- To understandthe basics of analog and digital modulation techniques.
- To Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course.
- To design and implement different modulation and demodulation techniques and their applications.
- To develop cognitive and behavioral skills for performance analysis of various modulation techniques.

Course Outcomes (CO):

CO1: Know about the usage of equipment/components/software tools used to conduct the experiments in analog and digital modulation techniques.

CO2: Conduct the experiment based on the knowledge acquired in the theory about modulation and demodulation schemes to find the important metrics of the communication system experimentally.

CO3: Analyze the performance of a given modulation scheme to find the important metrics of the system theoretically.

CO4: Draw the relevant graphs between important metrics of the system from the observed measurements.

CO5: Compare the experimental results with that of theoretical ones and infer the conclusions.

List of Experiments:

Design the circuits and verify the following experiments taking minimum of six from each section shown below.

<center>Section-A</center>

1. AM Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. Frquency Division Multiplexing
4. FM Modulation and Demodulation
5. Radio receiver measurements
6. PAM Modulation and Demodulation
7. PWM Modulation and Demodulation
8. PPM Modulation and Demodulation

<center>Section-B</center>

1. Sampling Theorem.
2. Time Division Multiplexing
3. Delta Modulation and Demodulation
4. PCM Modulation and Demodulation
5. BASK Modulation and Demodulation
6. BFSK Modulation and Demodulation
7. QPSK Modulation and Demodulation
8. DPSK Modulation and Demodulation

Note: Faculty members (who are handling the laboratory) are requested to instruct the students not to use readymade kits for conducting the experiments. They are advised to make the students work in the laboratory by constructing the circuits and analysing them during the lab sessions.

Online learning resources/virtual labs:
https://www.vlab.co.in/

Course Code		L	T	P	C

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20A04403P	LINEAR AND DIGITAL IC APPLICATIONS LAB		0	0	3	1.5
Pre-requisite	Analog Circuits Lab, Digital Logic Design Lab	**Semester**	**IV**			

Course Objectives:

The objective of the course is to learn design, testing and characterizing of circuit behaviour with digital and analog ICs.

Course Outcomes (CO):

CO1: Understand the pin configuration of each linear/ digital IC and its functional diagram.
CO2: Conduct the experiment and obtain the expected results.
CO3: Analyze the given circuit/designed circuit and verify the practical observations with the analyzed results.
CO4: Design the circuits for the given specifications using linear and digital ICs.
CO5: Acquaintance with lab equipment about the operation and its use.

List of Experiments:

PART – I: Linear IC Experiments

1. OP AMP Applications – Adder, Subtractor, Comparators.
2. Integrator and Differentiator Circuits using IC 741.
3. Active Filter Applications – LPF, HPF (first order)
4. IC 741 Waveform Generators – Sine, Square wave and Triangular waves.
5. IC 555 Timer – Monostable and Astable Multivibrator Circuits.
6. Schmitt Trigger Circuits – using IC 741
7. IC 565 – PLL Applications.
8. Voltage Regulator using IC 723, Three Terminal Voltage Regulators – 7805, 7809, 7912.

PART – II: Digital IC Applications

1. 3-8 decoder using 74138
2. 4-bit comparator using 7485.
3. 8*1 Multiplexer using 74151 and 2*4 Demultiplexer using 74155.
4. D, JK Flip Flops using 7474, 7483.
5. Decade counter using 7490.
6. UP/DOWN counter using 74163
7. Universal shift registers using 74194/195.
8. RAM (16*4) using 74189 (Read and Write operations).

Note: At least 12 experiments shall be performed.

References:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuit", 4th edition (2012), New Age International Pvt.Ltd., New Delhi, India
2. Ramakant A. Gayakwad, "OP-AMP and Linear Integrated Circuits", 4th edition (2012), Prentice Hall / Pearson Education, New Delhi.
3. Floyd, Jain, "Digital Fundamentals", 8th edition (2009), Pearson Education, New Delhi.

Online Learning Resources/Virtual Labs:
https://www.vlab.co.in/

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Course Code	Soft Skills		L	T	P	C
20A52401			1	0	2	2
Pre-requisite	NIL	Semester	IV			

Course Objectives:
• To encourage all round development of the students by focusing on soft skills • To make the students aware of critical thinking and problem-solving skills • To develop leadership skills and organizational skills through group activities • To function effectively with heterogeneous teams

Course Outcomes (CO):
By the end of the program students should be able to • Memorize various elements of effective communicative skills • Interpret people at the emotional level through emotional intelligence • apply critical thinking skills in problem solving • analyse the needs of an organization for team building • Judge the situation and take necessary decisions as a leader • Develop social and work-life skills as well as personal and emotional well-being

UNIT – I	Soft Skills & Communication Skills	10 Hrs

Introduction, meaning, significance of soft skills – definition, significance, types of communication skills - Intrapersonal & Inter-personal skills - Verbal and Non-verbal Communication

Activities:
Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity
(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)
Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.
Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.
Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT – II	Critical Thinking	10 Hrs

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking
Activities:
Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues – placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT – III	Problem Solving & Decision Making	10 Hrs

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution –
Methods of decision making – Effective decision making in teams – Methods & Styles

Activities:
Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.
Case Study & Group Discussion

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UNIT – IV	Emotional Intelligence & Stress Management	10 Hrs

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:
Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.
Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT – V	Leadership Skills	10 Hrs

Team-Building – Decision-Making – Accountability – Planning – Public Speaking – Motivation – Risk-Taking - Team Building - Time Management

Activities:
Forming group with a consensus among the participants- choosing a leader- encouraging the group members to express views on leadership- democratic attitude- sense of sacrifice – sense of adjustment – vision – accommodating nature- eliciting views on successes and failures of leadership using the past knowledge and experience of the participants, Public Speaking, Activities on Time Management, Motivation, Decision Making, Group discussion etc.

NOTE-:
 1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.
2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear or for good Leadership – Mahendar Singh Dhoni etc.

Textbooks:
1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.)Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr Shikha KapoorPublisher : I K International Publishing House; 0 edition (February 28, 2018)

Reference Books:
1. Soft skills: personality development for life success by Prashant Sharma, BPB publications 2018.
2. Soft Skills By Alex K. Published by S.Chand
3. Soft Skills: An Integrated Approach to Maximise Personality Gajendra Singh Chauhan, Sangeetha Sharma Published by Wiley.
4. Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books
5. SOFT SKILLS for a BIG IMPACT (English, Paperback, RenuShorey) Publisher: Notion Press
6. Life Skills Paperback English Dr. Rajiv Kumar Jain, Dr. Usha Jain Publisher: Vayu Education of India

Online Learning Resources:
1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc

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Course Code	Design Thinking for Innovation		L	T	P	C
20A99401	(Common to All branches of Engineering)		2	1	0	0
Pre-requisite	NIL	Semester	IV			

Course Objectives:
The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

Course Outcomes (CO):
• Define the concepts related to design thinking.   • Explain the fundamentals of Design Thinking and innovation   • Apply the design thinking techniques for solving problems in various sectors.   • Analyse to work in a multidisciplinary environment   • Evaluate the value of creativity   • Formulate specific problem statements of real time issues

UNIT - I	Introduction to Design Thinking	10 Hrs
Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.		

UNIT - II	Design Thinking Process	10 Hrs
Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development **Activity:** Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.		

UNIT - III	Innovation	8 Hrs
Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. **Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.		

UNIT - IV	Product Design	8 Hrs
Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. **Activity:** Importance of modelling, how to set specifications, Explaining their own product design.		

UNIT - V	Design Thinking in Business Processes	10 Hrs
Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes. **Activity:** How to market our own product, About maintenance, Reliability and plan for startup.		

Textbooks:
1. Change by design, Tim Brown, Harper Bollins (2009)   2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.

Reference Books:

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1. Design Thinking in the Classroom by David Lee, Ulysses press 2. Design the Future, by Shrrutin N Shetty, Norton Press 3. Universal principles of design- William lidwell, kritinaholden, Jill butter. 4. The era of open innovation – chesbrough.H
Online Learning Resources:
https://nptel.ac.in/courses/110/106/110106124/ https://nptel.ac.in/courses/109/104/109104109/ https://swayam.gov.in/nd1_noc19_mg60/preview

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COMMUNITY SERVICE PROJECT
……Experiential learning through community engagement

Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- 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.

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;

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

Implementation of Community Service Project

- Every student should put in a 6 weeks for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- 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
- A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty incharge.

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- Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- 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.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

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

EXPECTED OUTCOMES
BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

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

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

Social Outcomes
- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

Career Development
- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution
- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS
- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES
- Improved institutional commitment
- Improved student retention
- Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY
- Satisfaction with student participation
- Valuable human resources needed to achieve community goals
- New energy, enthusiasm and perspectives applied to community work
- Enhanced community-university relations.

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SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

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

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

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33. **Food adulteration**
34. **Incidence of Diabetes and other chronic diseases**
35. **Human genetics**
36. **Blood groups and blood levels**
37. **Internet Usage in Villages**
38. **Android Phone usage by different people**
39. **Utilisation of free electricity to farmers and related issues**
40. **Gender ration in schooling lvel- 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;

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

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

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

Programmes for Youth Empowerment
1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco

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4. Awareness on Competitive Examinations
5. Personality Development

Common Programmes

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

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- 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.
- 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.
- An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. Preliminary Survey (One Week)

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

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- 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.
- The Governmental agencies, like revenue administration, corporation and municipal authorities and village secreteriats could be aligned for the survey.

2. **Community Awareness Campaigns (One Week)**
    - Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. **Community Immersion Programme (Three Weeks)**
    Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

4. **Community Exit Report (One Week)**
    - During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks work to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

    Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

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B.TECH. - ELECTRONICS & COMMUNICATION ENGINEERING
Course Structure (R20) – III & IV Year

S.No.	Course Code	Course Name	L	T	P	Credits
		Semester–V				
1.	20A04501	Control Systems Engineering	3	0	0	3
2.	20A04502T	Digital Signal Processing	3	0	0	3
3.	20A04503T	Microprocessors and Microcontrollers	3	0	0	3
4.	20A05602T 20A04504a 20A04504b	**Professional Elective Course – I** Machine Learning Computer Architecture & Organization Information Theory and Coding	3	0	0	3
5.		**Open Elective Course – I**	3	0	0	3
6.	20A04502P	Digital Signal Processing Lab	0	0	3	1.5
7.	20A04503P	Microprocessors and Microcontrollers Lab	0	0	3	1.5
8.	20A04509	**Skill oriented course - III** PCB Design and Prototype development	1	0	2	2
9.	20A04510	Evaluation of Community Service Project				1.5
					Total	**21.5**

Open Elective Course – I

S.No	CourseCode	Course Name	Offered by the Dept.
1	20A01505	Building Technology	CE
2	20A02505	Electric Vehicles	EEE
3	20A03505	3D Printing Technology	ME
4	20A05505a	Java Programming	CSE & Allied/IT
5	20A05602T	Artificial Intelligence	
6	20A12502	Mobile Application Development using Android	
7	20A27505	Computer Applications in Food Processing	FT
8	20A54501	Optimization Techniques	Mathematics
9	20A56501	Materials Characterization Techniques	Physics
10	20A51501	Chemistry of Energy Materials	Chemistry

Note:

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.

2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.

3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline

S.No	Course Code	Course Name	L	T	P	Credits
		Semester–VI				
1.	20A04601T	Antennas & Microwave Engineering	3	0	0	3
2.	20A04602T	VLSI Design	3	0	0	3
3.	20A04603T	Communication Networks	3	0	0	3
4.	20A04604a 20A04604b 20A04604c	**Professional Elective Course– II** Electronic Measurements and Instrumentation Embedded System Design Optical Communications	3	0	0	3
5.		**Open Elective – II**	3	0	0	3
6.	20A04601P	Antennas & Microwave Engineering Lab	0	0	3	1.5
7.	20A04602P	VLSI Design Lab	0	0	3	1.5
8.	20A04603P	Communication Networks Lab	0	0	3	1.5
9.	20A04607	**Skill oriented course - IV** RF System Design	1	0	2	2
10.	20A99601	**Mandatory Non-credit Course** Intellectual Property Rights & Patents	2	0	0	0
		Total				**21.5**
		Industry Internship (Mandatory) for 6 - 8 weeks duration during summer vacation				

Open Elective Course – II

S.No.	CourseCode	Course Name	Offered by the Dept.
1	20A01605	Environmental Economics	CE
2	20A02605	Smart Electric Grid	EEE
3	20A03605	Introduction to Robotics	ME
4	20A05605a	Principles of Operating Systems	CSE & Allied/IT
5	20A05605b	Foundations of Machine Learning	
6	20A05605c	DataAnalytics Using R	
7	20A27605	Food Refrigeration and Cold Chain Management	FT
8	20A54701	Wavelet Transforms & its applications	Mathematics
9	20A56701	Physics Of Electronic Materials and Devices	Physics
10	20A51701	Chemistry of Polymers and its Applications	Chemistry

		Semester-VII				
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.		**Professional Elective Course– III**	3	0	0	3
	20A04701a	DSP Processors & Architectures				
	20A04701b	Introduction to Internet of Things				
	20A04701c	Satellite Communications				
2.		**Professional Elective Course– IV**	3	0	0	3
	20A04702a	Real Time Operating Systems				
	20A04702b	Digital Image Processing				
	20A04702c	Radar Engineering				
3.		**Professional Elective Course– V**	3	0	0	3
	20A04703a	Smart Sensors				
	20A05703b	Nano Electronics				
	20A04703c	Cellular & Mobile Communications				
4.		**Humanities Elective – II**	3	0	0	3
	20A52701a	Entrepreneurship and Incubation				
	20A52701b2	Management Science				
	0A52701c	Enterprise Resource Planning				
5.		**Open Elective Course – III**	3	0	0	3
6.		**Open Elective Course – IV**	3	0	0	3
7.		**Skill oriented course – V**	1	0	2	2
	20A04707	Industrial IoT & Automation				
8.	20A04709	Evaluation of Industry Internship				3
				Total		**23**

Open Elective Course – III

S.No	Course Code	Course Name	Offered by the Dept.
1	20A01704	Cost Effective Housing Techniques	CE
2	20A02704	IOT Applications in Electrical Engineering	EEE
3	20A03704	Product Design & Development	ME
4	20A05704a	Web Technologies	CSE & Allied/IT
5	20A05704b	VR & AR for Engineers	
6	20A05704c	Software Engineering	
7	20A27704	Human Nutrition	FT
8	20A54702	Numerical Methods for Engineers	Mathematics
9	20A56702	Sensors And Actuators for Engineering Applications	Physics
10	20A51702	Chemistry of Nanomaterials and Applications	Chemistry

Open Elective Course – IV

S.No	Course Code	Course Name	Offered by the Dept.
1	20A01705	Health, Safety & Environmental management	CE
2	20A02705	Renewable Energy Systems	EEE
3	20A03705	Introduction to Composite Materials	ME
4	20A05705a	Cyber Security	CSE & Allied/IT
5	20A05705b	Introduction to Full Stack Development	
6	20A27705	Waste and Effluent Management	FT
7	20A54703	Number theory & its applications	Mathematics
8	20A56703	Smart Materials and Devices	Physics
9	20A51703	Green Chemistry and Catalysis for Sustainable Environment	Chemistry

Semester-VIII							
S.No.	Course Code	Course Name	Category	L	T	P	Credits
1.	20A04801	Full Internship & Project work	PR				12
						Total	12

COURSES OFFERED FOR HONOURS DEGREE IN ECE

S.No.	Course Code	Course Title	Contact Hours per Week		Credits
			L	T	
1	20A04H01	Adaptive Signal Processing	3	1	4
2	20A04H02	Software Defined Radio	3	1	4
3	20A04H03	MEMS	3	1	4
4	20A04H04	Low power VLSI Design	3	1	4
5	20A04H05	Wireless Communications	3	1	4
6	20A04H06	Speech Processing	3	1	4
Suggested MOOCs					
8.	20A04107	VLSI Testing			2
9.	20A04108	Embedded Software and Hardware Architecture			2

LIST OF MINORS OFFERED TO ECE

S.No.	Minor Title	Department offering the Minor
1.	Construction Technology	Civil Engineering
2.	Environmental Geotechnology	Civil Engineering
3.	Energy Systems	EEE
4.	3D Printing	ME
5.	Industrial Engineering	ME
6.	Food Science	Food Technology
7.	Artificial Intelligence & Data Science	CSE& Allied/ IT
8.	Virtual & Augmented Reality	
9.	Cyber Security and Blockchain Technologies	

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– III-I Sem	L	T	P	C
	3	0	0	3

(20A04501) CONTROL SYSTEMS ENGINEERING

Course Objectives:
- To introduce concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems and concept of feedback.
- To describe characteristics of the given system in terms of the transfer function.
- To provide knowledge in analyzing the system response in time-domain and frequency domain
- To impart skills for designing different control systems for different applications as per given specifications.
- To introduce concepts of state variable analysis and design.

Course Outcomes:
- Identify open and closed loop control system
- Formulate mathematical model for physical systems
- Use standard test signals to identify performance characteristics of first and second-order systems
- Analyze stability of the closed and open loop systems
- Design closed-loop control system to satisfy dynamic performance specifications using frequency response, root-locus, and state-space techniques

UNIT I Introduction

Introduction: Overview of System, Control System, Open Loop Control System, Closed loop Control System, Different Examples, Mathematical models of Physical Systems, Differential equations of physical systems, Transfer functions, Block diagram Algebra, Signal flow graphs with illustrative examples Effects of Feedback, Feedback Characteristics and its advantages, Line arising effect of feedback.

UNIT II   Time Response Analysis

Controller Components, DC Servomotor (Armature Controlled and Field Controlled) with necessary derivation for transfer function, AC Servomotor and its transfer function, AC Tachometer, Potentiometer, Synchros, AC Position Control Systems.

Time Response Analysis, Standard test Signals, Time response of first and second order systems, steady state errors and error constants, Effect of adding a zero to a system, Design specifications of second order systems, Performance indices

UNIT III   Concepts of Stability

Concepts of Stability and Algebraic Criteria: The concept of Stability, Necessary Conditions for Stability, Routh-Hurwitz Stability Criterion, Relative stability analysis,

The Root Locus Technique: Introduction, The Root Locus concepts, Construction of Root Loci

UNIT IV   Frequency Response Analysis

Frequency response analysis: Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion

UNIT V   State Variable Analysis and Design

State Variable Analysis and Design: Introduction, Concepts of State, State Variables and State models, State models for linear continuous-time systems, State variables and linear discrete-time systems, Solution of state equations and Concepts of Controllability and Observability.

Textbooks:
1. I. J. Nagarath and M. Gopal, "Control System Engineering," New Age International Publishers, Fifth Edition.

References:
1. Katsuhiko Ogata, Modern Control Engineering, Pearson, 5th Edition, 2010.
2. S. Salivahanan, R. Rengaraj, and G. R. Venkata Krishnan, Control Systems Engineering, Pearson, 5th edition, 2015.
3. Benjamin C. Kuo, FraridGolnaraghi, Automatic Control Systems, Wiley Student Edition, Eighth Edition2015.

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B.Tech (ECE)– III-I Sem   **L   T   P   C**
                                                                       3   0   0   3

(20A04502T) DIGITAL SIGNAL PROCESSING

Course Objectives:
- To describe discrete time signals and systems.
- To teach importance of FFT algorithm for computation of Discrete Fourier Transform.
- To expose various implementations of digital filter structures.
- To present FIR and IIR Filter design procedures.
- To outline need of Multi-rate Processing.

Course Outcomes:
- Formulate difference equations for the given discrete time systems
- Apply FFT algorithms for determining the DFT of a given signal
- Compare FIR and IIR filter structures
- Design digital filter (FIR & IIR) from the given specifications
- Outline the concept of multirate DSP and applications of DSP.

UNIT I
Introduction to discrete time signals and systems
Introduction to digital signal processing, review of discrete-time signals and systems, analysis ofdiscrete-time linear time invariant systems, frequency domain representation of discrete timesignals and systems, analysis of linear time-invariant systems in the z-domain, pole-zero stability.

UNIT II
Discrete Fourier Transform - Introduction, Discrete Fourier Series, properties of DFS, Discrete Fourier Transform, Inverse DFT,properties of DFT, Linear and Circular convolution, convolution using DFT.
Fast Fourier Transform = Introduction, Fast Fourier Transform, Radix-2 Decimation in time and Decimation in frequencyFFT, Inverse FFT (Radix-2).

UNIT III
IIR Filters-Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev, Designof IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods,Frequency transformations, Basic structures of IIR Filters - Direct form-I, Direct form-II, Cascadeform and Parallel form realizations.

UNIT IV
FIR Filters-Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phaseFIR filters, Design of FIR filters using Fourier series and windowing methods (Rectangular,Triangular, Raised Cosine, Hanging, Hamming, Blackman), Comparison of IIR & FIR filters,Basic structures of FIR Filters – Direct form, Cascade form, Linear phase realizations.

UNIT V
Quantization Errors in Digital Signal Processing: Representation of numbers, Quantization of filter coefficients, Round-off Effects in digital filters.
Multirate Digital Signal Processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Frequency domain characterization of Interpolator and Decimator; Polyphase decomposition.

Textbooks:
1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education, 2007.
2. A.V.Oppenheim and R.W. Schaffer, Discrete Time Signal Processing ,PHI.

References:
1. S.K.Mitra, Digital Signal Processing – A practical approach , 2nd Edition, Pearson Education, New Delhi, 2004.
2. MH Hayes, Digital Signal Processing, Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using Matlab, Thomson, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– III-I Sem   L T P C

                                                              3 0 0 3

(20A04503T) MICROPROCESSORS AND MICROCONTROLLERS

Course Objectives:
- To introduce fundamental architectural concepts of microprocessors and microcontrollers.
- To impart knowledge on addressing modes and instruction set of 8086 and 8051
- To introduce assembly language programming concepts
- To explain memory and I/O interfacing with 8086 and 8051
- To introduce16 bit and 32 bit microcontrollers.

Course Outcomes:
- Distinguish between microprocessors & microcontrollers
- Develop assembly language programming
- Describe interfacing of 8086 with peripheral devices
- Design applications using microcontrollers

UNIT I

8086 Architecture: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

UNIT II

8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT III

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

UNIT IV

Microcontroller - Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V

Interfacing Microcontroller - Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Textbooks:
1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

References:
1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.

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B.Tech (ECE)– III-I Sem   **L   T   P   C**

                                                           3   0   0   3

(20A05602T) MACHINE LEARNING

Course Objectives:

The course is introduced for students to

- Gain knowledge about basic concepts of Machine Learning
- Study different learning algorithms
- Learn about of evaluation of learning algorithms
- Learn about Dimensionality reduction

Course Outcomes:

After completion of the course, students will be able to

- Identify machine learning techniques suitable for a given problem
- Solve the problems using various machine learning techniques
- Apply Dimensionality reduction techniques
- Design application using machine learning techniques

UNIT I   Lecture 8Hrs

Introduction: Definition of learning systems, Goals and applications of machine learning, Aspects of developing a learning system: training data, concept representation, function approximation.

Inductive Classification: The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Learning conjunctive concepts, The importance of inductive bias.

UNIT II   Lecture 8Hrs

Decision Tree Learning: Representing concepts as decision trees, Recursive induction of decision trees, Picking the best splitting attribute: entropy and information gain, searching for simple trees and computational complexity, Occam's razor, Overfitting, noisy data, and pruning.

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses.

Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

UNIT III   Lecture 9Hrs

Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity for infinite hypothesis spaces, Vapnik- Chervonenkis dimension.

Rule Learning: Propositional and First-Order, Translating decision trees into rules, Heuristic rule induction using separate and conquer and information gain, First-order Horn-clause induction (Inductive Logic Programming) and Foil, Learning recursive rules, Inverse resolution, Golem, and Progol.

UNIT IV   Lecture 9Hrs

Artificial Neural Networks: Neurons and biological motivation, Linear threshold units. Perceptrons: representational limitation and gradient descent training, Multilayer networks and back propagation, Hidden layers and constructing intermediate, distributed representations. Over fitting, learning network structure, recurrent networks.

Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.

UNIT V   Lecture 9Hrs

Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies.

Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning.

Textbooks:

1) T.M. Mitchell, "Machine Learning", McGraw-Hill,1997.
2) Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

Reference Books:

1. EthernAlpaydin, "Introduction to Machine Learning", MIT Press,2004.
2. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
3. Andreas C. Müller and Sarah Guido "Introduction to Machine Learning with Python:A Guide for Data Scientists",Oreilly.

Online Learning Resources:

1. Andrew Ng, "Machine Learning"https://www.deeplearning.ai/machine-learning-yearning/
2. Shai Shalev-Shwartz , Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms" , Cambridge University Press. https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
3. http://nptel.ac.in/courses/106106139/

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B.Tech (ECE)– III-I Sem   **L   T   P   C**
                                                                              3   0   0   3

(20A04504a) COMPUTER ARCHITECTURE & ORGANIZATION

Course Objectives:
The purpose of the course is to introduce principles of computer organization and the basicarchitectural concepts.

Course Outcomes:
- Understand the basics of instructions sets and their impact on processor design.
- Demonstrate an understanding of the design of the functional units of a digital computer system.
- Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory.
- Design a pipeline for consistent execution of instructions with minimum hazards.
- Recognize and manipulate representations of numbers stored in digital computers.

UNIT I
Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.
Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.
Basic Computer Organization and Design: Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt.

UNIT II
Micro programmed Control: Control memory, Address sequencing, micro program example, design of control unit.
Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

UNIT III
Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.
Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

UNIT IV
Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

UNIT V
Reduced Instruction Set Computer: CISC Characteristics, RISC Characteristics. Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence.

Textbook:
1. Computer System Architecture – M. Moris Mano, Third Edition, Pearson/PHI.

References:
1. Computer Organization – Car Hamacher, ZvonksVranesic, SafeaZaky, V th Edition, McGraw Hill.
2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
3. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– III-I Sem	L	T	P	C
	3	0	0	3

(20A04504b) INFORMATION THEORY AND CODING

Course Objectives:
- To teach basic parameters of Information, concepts of source coding techniques and error control coding techniques.
- To transmit knowledge on Information theory and error control coding technique for solving problems.
- To Introduce various source coding and channel coding techniques for error detection and error correction in the information bearing signals.
- To dissimilate block to variable length coding and variable to block length codingtechniques for merits and demerits.
- To describe various systems for linear block codes and convolutional codes.

Course Outcomes:
- Describe basic parameters of Information, the concepts of source coding techniques, and Error Control coding techniques
- Apply knowledge of Information theory and error control coding techniques to solve problems
- Analyze various source coding and channel coding techniques for error detection and error correction in the information bearing signals
- Compare various block to variable length coding and variable to block length coding techniques for merits and demerits
- Design various systems for linear block codes and convolutional codes

UNIT I
Information Theory: Introduction, Definition of Entropy, Conditional Entropy, Relative Entropy, Basic Properties of Entropy, Mutual Information, Information Inequalities, Problem solving.
Block to Variable length Coding: Prefix-free Code, Coding a single Random Variable, Prefix, Free Code, Kraft Inequality, Bounds on optimal Code length, Coding a Single Random Variable, Rooted Tree with Probabilities, Shanon-Fano Coding, Free fix code, Coding an information Source, Huffman Coding, Example.
Variable to Block Length Coding: Proper message set, Assigning probabilities to K-ary rooted tree corresponding to a proper message set, Prefix free Coding of a proper message set, Tunstall message set, Tunstall coding.

UNIT II
Asymptotic Equi-partition Property, Chebyshev inequality, Weak law of large numbers, Typical Sequences, Block to Block Coding of DMS: Consequences of Asymptotic Equipartition Property, Problem solving.
Universal Source Coding: Lempel-Ziv Algorithm, LZ -77 Encoding and Decoding, Lempel- Ziv Welch (LZW) Algorithm, LZW Encoding, and Decoding.
Coding of Sources with memory, Channel Capacity, Noisy Channel Coding Theorem, Differential Entropy, Gaussian Channel, Rate Distortion Theory, Blahut-Arimoto Algorithm, problem solving.

UNIT III
Error Control Coding: Introduction to Error Control Codes, Error Probability with Repetition in the Binary Symmetric Channel, Parity Check Bit Coding for Error Detection, Block Coding for Error Detection and Correction, The Hamming Distance, The upper bound of the Probability of Error with Coding, Soft Decision Decoding, Hard Decision Decoding.

UNIT IV
Linear Block Codes, Introduction to Linear Block Codes, Syndrome and Error Detection, Encoding Block Codes, Decoding of Block Codes, Single Parity Check bit Code, Repeated Codes, Hadamard Code, Hamming Code, Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes, Encoding and Decoding of Cyclic Codes, BCH codes, Reed-Solomon Code.

UNIT V
Convolutional Coding, Code Generation, Decoding Convolutional Code, the Code Tree, Decoding in the presence of Noise, State and Trellis Diagrams, The Viterbi Algorithm, Comparison of Error Rates in Coded and Uncoded Transmission, Turbo Codes, LDPC codes, Hard and Soft Decision Decoding.

Textbooks:
1. Thomas M.Cover, Joy A. Thomas, Elements of Information Theory, John Wiley & Sons, 2nd Edition, 2006.
2. Herbert Taub, Donald L Shilling, Goutam Saha, Principles of Communication Systems, 4th Edition, McGraw Hill, 2017.

References:
1. Shu Lin, Daniel J. Costello Jr., Error Control Coding, Pearson, Second Edition, 2013.
2. Simon Haykin, Communication Systems, John Wiley, 4th Edition, 2010.

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B.Tech (ECE)– III-I Sem   **L   T   P   C**
                                                                               0   0   3   1.5

(20A04502P) DIGITAL SIGNAL PROCESSING LAB

Course Outcomes:
- Implement various DSP Algorithms using software packages.
- Implement DSP algorithms with Digital Signal Processor.
- Analyze and observe magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters.
- Analyze and observe magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters using window techniques.
- Analyze digital filters using Software Tools.

The Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/ Equivalent) and Hardware (Using TI / Analog Devices / Motorola / Equivalent DSP processors).

List of Experiments:
1. Generate the following standard discrete time signals.
   i) Unit Impulse ii) Unit step iii) Ramp iv) Exponential v) Sawtooth
2. Generate sum of two sinusoidal signals and find the frequency response (magnitude and phase).
3. Implement and verify linear and circular convolution between two given signals.
4. Implement and verify autocorrelation for the given sequence and cross correlation between two given signals.
5. Compute and implement the N-point DFT of a given sequence and compute the power density spectrum of the sequence.
6. Implement and verify N-point DIT-FFT of a given sequence and find the frequency response (magnitude and phase).
7. Implement and verify N-point IFFT of a given sequence.
8. Design IIR Butterworth filter and compare their performances with different orders (Low Pass Filter /High Pass Filter)
9. Design IIR Chebyshev filter and compare their performances with different orders (Low Pass Filter /High Pass Filter).
10. Design FIR filter (Low Pass Filter /High Pass Filter) using windowing technique.
    i.   Using rectangular window
    ii. Using hamming window
    iii. Using Kaiser window
11. Design and verify Filter (IIR and FIR) frequency response by using Filter design and Analysis Tool.
12. Compute the Decimation and Interpolation for the given signal.
13. Real time implementation of an audio signal using a digital signal processor.
14. Compute the correlation coefficient for the two given audio signals of same length using a digital signal processor.

Note: Any TWELVE of the experiments are to be conducted.
References:
1. Digital Signal Processing: Alon V. Oppenhelm, PHI
2. Digital Signal processing(II-Edition): S.K. Mitra, TMH
Online Learning Resources/Virtual Labs:
1. http://vlabs.iitkgp.ac.in/dsp/#

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B.Tech (ECE)– III-I Sem	L	T	P	C
	0	0	3	1.5

(20A04503P) MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Objectives:
To acquire the knowledge on microprocessors and microcontrollers, interfacing various peripherals, configure and develop programs to interface peripherals/sensors.

Course Outcomes:
- Formulate problems and implement algorithms using Assembly language.
- Develop programs for different applications.
- Interface peripheral devices with 8086 and 8051.
- Use Assembly/Embedded C programming approach for solving real world problems

List of Experiments:
1. PROGRAMS FOR 16 BIT ARITHMETIC OPERATIONS (Using various addressing modes)
   a) Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
   b) Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
   c) Write an ALP to find square, cube and factorial of a given number.
2. PROGRAMS INVOLVING BIT MANIPULATION INSTRUCTIONS
   a) Write an ALP to find the given data is positive or negative.
   b) Write an ALP to find the given data is odd or even.
   c) Write an ALP to find Logical ones and zeros in a given data.
3. PROGRAMS ON ARRAYS FOR 8086
   a) Write an ALP to find Addition/subtraction of N no's.
   b) Write an ALP for finding largest/smallest no.
   c) Write an ALP to sort given array in Ascending/descending order.
4. PROGRAM FOR STRING MANIPULATIONS FOR 8086
   a) Write an ALP to find String length.
   b) Write an ALP for Displaying the given String.
   c) Write an ALP for Comparing two Strings.
   d) Write an ALP to reverse String and Checking for palindrome.
5. PROGRAM FOR DIGITAL CLOCK DESIGN USING 8086
   a) Write an ALP for Designing clock using INT 21H Interrupt.
   b) Write an ALP for Designing clock using DOS Interrupt Functions.
   c) Write an ALP for Designing clock by reading system time.
6. INTERFACING STEPPER MOTOR WITH 8086
   a) Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosingvariable step-size.
   b) Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise bychoosing variable step-size.
7. INTERFACING ADC/DAC WITH 8086
   a) Write an ALP to 8086 processor to Interface ADC.
   b) Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Stepsignal.
8. COMMUNICATION BETWEEN TWO MICROPROCESSORS
   a) Write an ALP to have Parallel communication between two microprocessors using 8255
   b) Write an ALP to have Serial communication between two microprocessor kits using 8251.
9. PROGRAMS USING ARITHMETIC AND LOGICAL INSTRUCTIONS FOR 8051
   a) Write an ALP to 8051 Microcontroller to perform Arithmetic operations like addition, subtraction,
   b) Multiplication and Division.
   c) Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR.

d) Programs related to Register Banks.

10. PROGRAM TO VERIFY TIMERS/COUNTERS OF 8051
    a) Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.
    b) Write a program to create a delay of 50 µsec using Timer1 in mode 0 and blink all the Pins of P2.
    c) Write a program to create a delay of 75msec using counter0 in mode 2 and blink all the Pins of P1.
    d) Write a program to create a delay of 80 µsec using counter1 in mode 1 and blink all the Pins of P3.

11. UART OPERATION IN 8051
    a) Write a program to transfer a character serially with a baud rate of 9600 using UART.
    b) Write a program to transfer a character serially with a baud rate of 4800 using UART.
    c) Write a program to transfer a character serially with a baud rate of 2400 using UART.

12. INTERFACING LCD WITH 8051
    a) Develop and execute the program to interface16*2 LCD to 8051.
    b) Develop and execute the program to interface LCD to 8051 in 4-bit or 8-bit mode.

Reference Books:
1. Kenneth.J.Ayala. The 8051 microcontroller, 3rd edition, Cengage learning,2010.
2. Advanced microprocessors and peripherals-A.K ray and K.M.Bhurchandani, TMH, 2nd edition2006.
3. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad AliMazidi, Janice GillispieMazidi, Second Edition.

Note: Any TEN of the experiments are to be conducted.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– III-I Sem   **L T P C**

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(20A04509) PCB DESIGN AND PROTOTYPE DEVELOPMENT
(Skill Oriented Course – III)

Course Objectives:
This course will teach teams of students how to design and fabricate PCB for prototyping as well as in Industrial Production environment. This will help students to innovate faster with electronics technology.

Course Outcomes:
- Understand a single layer and multilayer PCB
- Create and fabricate a PCB
- Evaluate and test a PCB

UNIT I
Fundamental of basic electronics: Component identification, Component symbols & their footprints, understand schematic, Creating new PCB, Browsing footprints libraries, Setting up the PCB layers, Design rule checking, Track width selection, Component selection, Routing and completion of the design

UNIT II
Introduction to PCB: Definition and Need/Relevance of PCB, Background and History of PCB, Types of PCB, Classes of PCB Design, Terminology in PCB Design, Different Electronic design automation (EDA)tools and comparison.

UNIT III
PCB Design Process: PCB Design Flow, Placement and routing, Steps involved in layout design, Artwork generation Methods - manual and CAD, General design factors for digital and analogue circuits, Layout and Artwork making for Single-side, double-side and Multilayer Boards, Design for manufacturability, Design-specification standards

Practice Exercises: Any twelve experiments are to be done
1. Practice following PCB Design steps
    - SchematicDesign:FamiliarizationoftheSchematicEditor,Schematiccreation,Annotation,   Netlist generation.
    - LayoutDesign:FamiliarizationofFootprintEditor,Mappingofcomponents,Creationof   PCB   layout Schematic.
    - Create new schematic components.
    - Create new component footprints.
2. Regulator circuit using 7805
3. InvertingAmplifier or SummingAmplifier using op-amp
4. Full-wave Rectifier
5. Astable multivibrator using IC555
6. Monostable multivibrator using IC555
7. RCPhase-shiftorWein-bridgeOscillatorusingtransistor.
8. Full-Adder using half-adders.
9. 4-bit binary /MOD N counter using D-Flip flops.
10. One open-ended (analog/ digital/mixed circuit) experiments of similar nature andmagnitude to the above are to be assigned by the teacher
    (Student is expected to solve and execute/simulate independently).
11. Design   an   8051   Development   board havingPowersectionconsistingofIC7805,capacitor,resistor,headers,LED.
12. Design an 8051 Development board having Serial communication section consisting of MAX 232, Capacitors, DB9connector,Jumper, LEDs
13. Design   an   8051   Development   board   having Reset&Input/outputsectionsconsistingof89C51Microcontroller,ElectrolyticCapacitor,Resistor,Jumper,CrystalOscillator,Capacitors
14. Fabricate a single-sided PCB, mount the components and assemble them in acabinet for any one of the

circuits mentioned in the above exercises.

References:
1. Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002
2. R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill 2001
3. C. Robertson. PCB Designer´s Reference. Prentice Hall, 2003
4. Open-source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/ 13. PCB Fabrication user guide page:
   http://www.wikihow.com/Create-Printed-Circuit-Boards
   http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication/
   http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself
   PCB Fabrication at home(video): https://www.youtube.com/watch?v=mv7Y0A9YeUc, https://www.youtube.com/watch?v=imQTCW1yWkg

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B.Tech (ECE)– III-II Sem	L	T	P	C
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(20A04601T)ANTENNAS&MICROWAVE ENGINEERING

Course Objectives:

- To enable the student to understand the basic principles in antenna and microwave system design
- To make the student to acquire knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications.

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

- Learn about the antenna's basics and wire antennas.
- Gain knowledge on few types of antennas, their operation and applications.
- Understand the uses of antenna arrays and analyze waveguides and resonators
- Analyze various microwave components and understand the principles of different microwave sources.
- Gain knowledge on microwave semiconductor devices and microwave measurements.

UNIT I

Antenna Basics &Wire Antennas: Definition of antenna, Radiation Mechanism – single wire, two wire, dipoles, Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Loop Antennas - Introduction, Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative Treatment), Arrays with Parasitic Elements - Yagi - Uda Arrays, Folded Dipoles & their characteristics

UNIT II

VHF, UHF and Microwave Antennas: Helical Antennas-Helical Geometry, Helix modes, Horn Antennas- Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns, Micro strip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas-Geometry and parameters, characteristics of Micro strip antennas, reflector antennas - Introduction, corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Reflector Types - Related Features, Lens Antennas - Geometry of Non-metallic Dielectric Lenses, Zoning , Tolerances, Applications

UNIT III

Antenna Arrays and propagation: Arrays of 2 Isotropic sources- Different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, Bionomial Arrays, Different modes of wave propagation, Ground wave propagation Space wave propagation - Sky wave propagation **(Qualitative treatment).**

Waveguides: Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation, Circular waveguide – TE and TM modes, Wave propagation, waveguide resonators.

UNIT IV

Passive Microwave Devices: Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Hybrid ring, Directional Couplers – Bethe hole and Two hole Couplers, Microwave propagation in Ferrites, Microwave devices employing Faraday rotation – Isolator, Circulator, Deriving Scattering matrix for Microwave passive devices.

Microwave Amplifiers and Oscillators: Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification

process (**Qualitative treatment only**). Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition.

UNIT V
Microwave Semiconductor Devices: Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.
Antennas and Microwave Measurements: Sources of errors, Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods). Description of Microwave bench-different blocks and their features, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of 'Q' of a cavity, Impedance measurements.

Textbooks:
1. John D. Kraus, Ronald J. Marhefka and Ahmad S.Khan, "Antennas and Wave propagation", TMH, New Delhi, 4th Ed., 2010.
2. Samuel Y. Liao, "Microwave devices and circuits", 3rd Edition, Pearson Publishing, 2003.

References:
1. R. E. Collin, "Foundations for microwave engineering", 2nd Edition, John Wiley, 2002.
2. C.A. Balanis, "Antenna Theory- Analysis and Design", John Wiley & Sons, 2nd Edn., 2001.
3. M. Kulkarni, "Microwave and Radar Engineering", Umesh Publications, 4th edition 2009.
4. G.S.N Raju, "Antenna and Wave Propagation", Pearson Education India, 3rd Edition 2009.

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B.Tech (ECE)– III-II Sem	L	T	P	C
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(20A04602T)VLSI DESIGN

Course Objectives:
- To give exposure to different steps involved in fabrication of ICs using MOS transistor, CMOS/BICOM transistors and passive components.
- To provide knowledge on electrical properties of MOS &BICMOS devices to analyze the behavior of inverters designed with various loads.
- To provide concepts to design building blocks of data path of any system using gates.
- To teach about basic programmable logic devices and testing of CMOS circuits.

Course Outcomes:
- Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors,
- Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit
- Design building blocks of data path using gates.
- Design simple memories using MOS transistors and can understand design of large memories
- Understand the concept of testing and adding extra hardware to improve testability of system

UNIT I

Introduction: Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS &BiCMOS Technologies Basic Electrical Properties of MOS and BiCMOS Circuits: I_{DS} - V_{DS} relationships, MOS transistor Threshold Voltage-V_T, figure of merit-ω_0, Transconductance - g_m, g_{ds} ; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT II

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III

Gate level Design: Logic gates and other complex gates, Switch logic, Alternate gate circuits. Basic Circuit Concepts: Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out

UNIT IV

Subsystem Design: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

UNIT V

CMOS Testing: Need for testing, Design for testability - built in self-test (BIST) – testing combinational logic –testing sequential logic – practical design for test guide lines – scan design techniques.

Textbooks:
1. Essentials of VLSI Circuits and Systems, Kamran Eshraghian, EshraghianDougles, A. Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3 Ed., 1997, Pearson Education.

References:
1. CMOS VLSI Design-A Circuits and Systems Perspective, Neil H.E Weste, David Harris, Ayan Banerjee, 3rd Edn, Pearson, 2009.
2. BehzadRazavi , "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2003.
3. Jan M. Rabaey, "Digital Integrated Circuits", AnanthaChandrakasan and Borivoje Nikolic, Prentice-Hall of India Pvt.Ltd, 2nd edition, 2009.

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B.Tech (ECE)– III-II Sem   **L T P C**
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(20A04603T) DATA COMMUNICATION &NETWORKS

Course Objectives:
To provide a solid conceptual understanding of the fundamentals of data communications and computer networks.

Course Outcomes:
- Understand the basics of data communication, networking, internet and their importance.
- Analyze the services and features of various protocol layers in data networks.
- Differentiate wired and wireless computer networks
- Analyse TCP/IP and their protocols.
- Recognize the different internet devices and their functions.

UNIT I
Data Communications: Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview, topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity. Review of Error Detection and Correction codes. Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

UNITII
Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-waitARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to – Point Access: PPPPoint –to- Point Protocol, PPP Stack

UNIT III
Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

UNITIV
Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

UNIT V
Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service.
Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail(SMTP), file transfer (FTP), HTTP and WWW.

Textbooks:
1. S. Tannenbum, D. Wetherall, —Computer Networks‖, Prentice Hall, Pearson, 5th Ed
2. Behrouz A. Forouzan, —Data Communications and Networking‖, Tata McGraw-Hill, 4th Ed

References:
1. Fred Halsall, —Computer Networks‖, Addison – Wesley Pub. Co. 1996.
2. Larry L, Peterson and Bruce S. Davie, —Computer Networks: A system Approach‖, Elsevier, 4th Ed
3. Tomasi, —Introduction To Data Communications & Networking‖, Pearson 7th impression 2011
4. William Stallings, —Data and Computer Communications‖, Prentice Hall, Imprint of Pearson, 9th Ed.

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B.Tech (ECE)– III-II Sem   **L T P C**
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(20A04604a) ELECTRONIC MEASUREMENTS AND INSTRUMENTATION
(Professional Elective Course- II)

Course Objectives:
The objective of the course is to introduce the fundamentals of Electronics Instruments and Measurement providing an in-depth understanding of Measurement errors, Bridge measurements, Digital Storage Oscilloscope, Function Generator and Analyzer, Display devices, Data acquisition systems and transducers.

Course Outcomes:
- Explain operation of various instruments required in measurements
- Apply measurement techniques for different types of tests
- Select specific instruments for specific measurement function
- Use oscilloscope to determine frequency and phase of a sinusoidal signal
- Compare different types of bridge circuits
- Analyze various measuring techniques for both electrical and nonelectrical quantities

UNIT 1
Performance characteristics of Instruments: Static characteristics, Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, and their statistical analysis, dynamic characteristics-speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters, AC voltmeters Thermocouple type RF ammeter, ohm meters, series type, shunt type, multi meter for voltage, current and resistance measurements.

UNIT II
Oscilloscopes: Standard specifications of CRO,CRT features, vertical and horizontal amplifiers, horizontal and vertical deflection systems, sweep trigger pulse, delay line, sync selector circuits, probes for CRO – active, passive, and attenuator type, dual trace/beam CRO, Principles of sampling oscilloscope, storage oscilloscope, and digital storage oscilloscope, Digital frequency counters, time & Period measurements.

UNIT III
Signal Generators and Analyzers: Fixed and variable frequency AF oscillators, function generators, pulse, random noise, sweep, and arbitrary waveform generators, their standards, specifications and principles of working (Block diagram approach); Wave analyzers, Harmonic distortion analyzers, Spectrum analyzers, and Logic analyzers.

UNIT IV
Bridges: Wheatstone bridge, We in Bridge, errors and precautions in using bridges, AC bridges: Measurement of inductance-Maxwell's bridge, Anderson Bridge. Measurement of capacitance-Schearing Bridge, Kelvin Bridge, Q-meter, EMI and EMC, Interference and noise reduction techniques.

UNIT V
Sensors and Transducers: Active and passive transducers: Measurement of displacement (Resistance, capacitance, inductance; LVDT) Force (strain gauges) Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples, and thermistors), Velocity, Acceleration, Vibration, pH measurement.

Textbooks:
1. H.S.Kalsi, Electronic Instrumentation, 3rd edition, McGraw Hill Education, 2017.

References:
1. D. Helfrick, W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, ,1st edition, Pearson Education India, 2015
2. David A. Bell, Electronic Instrumentation and Measurements, Oxford Univ. Press, 2007
3. B.M. Oliver, J.M. Cage, Electronic Measurements and Instrumentation, TMH Reprint 2009.
4. Ernest O. Doebelin and Dhanesh N Manik, Measurement Systems, 6th Ed., TMH,2010.

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B.Tech (ECE)– III-II Sem	L	T	P	C
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(20A04604b) EMBEDDED SYSTEM DESIGN
(Professional Elective Course- II)

Course Objectives:
- To teach the basics of an embedded system and RTOS.
- To introduce the typical components of an embedded system & different communication interfaces.
- To provide knowledge on the design process of embedded system applications

Course Outcomes:
- Identify hardware and software components of an embedded system
- Learn the basics of OS and RTOS
- Illustrate different Inter Process Communication (IPC) mechanisms used by tasks/process/tasks to communicate in multitasking environment
- Design simple embedded system-based applications

UNITI INTRODUCTION TO EMBEDDED SYSTEMS
History of embedded systems, Classification of embedded systems based on generation and complexity, Purpose of embedded systems, The embedded system design process-requirements, specification, architecture design, designing hardware and software, components, system integration, Applications of embedded systems, and characteristics of embedded systems.

UNITII TYPICAL EMBEDDED SYSTEM
Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, Sensors, actuators, I/O components: seven segment LED, relay, piezo buzzer, push button switch, other sub-systems: reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

UNITIII COMMUNICATION INTERFACE
Onboard communication interfaces-I2C, SPI, CAN, parallel interface; External communication interfaces-RS232 and RS485, USB, infrared, Bluetooth, Wi-Fi, ZigBee, GPRS, GSM.

UNITIV EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT
Embedded firmware design approaches-super loop based approach, operating system based approach; embedded firmware development languages-assembly language based development, high level language based development.

UNITV RTOS BASED EMBEDDED SYSTEM DESIGN
Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-pre-emptive and pre-emptive scheduling; task communication-shared memory, message passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/ Synchronization Issues, Task Synchronization Techniques

Textbooks:
1. Introduction to Embedded Systems - Shibu KV, Mc Graw Hill Education.
2. Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

References:
1. Embedded System Design -frank vahid, tony grivargis, john Wiley.
2. Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.
3. Embedded Systems – Raj Kamal, TMH

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B.Tech (ECE)– III-II Sem   **L T P C**
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(20A04604c) OPTICAL COMMUNICATIONS
(Professional Elective Course- II)

Course Objectives:
- To understand the construction and characteristics of optical fibre cable.
- To develop the knowledge of optical signal sources and power launching.
- To identify and understand the operation of various optical detectors.
- To understand the design of optical systems and WDM.

Course Outcomes:

At the end of the course, the student will be able to:
- Understand and analyze the constructional parameters of optical fibres.
- Estimate the losses due to attenuation, absorption, scattering and bending.
- Compare various optical detectors and choose suitable one for different applications.

UNIT I

Overview of Optical Fiber Communication: - Historical development, The general system, Advantages of Optical Fiber Communications, Optical Fiber Wave Guides- Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Cylindrical Fibers- Modes, V number, Mode Coupling, Step Index Fibers, Graded Index Fibers. Single Mode Fibers- Cut Off Wavelength, Mode Field Diameter, Effective Refractive Index, Fiber Materials Glass, Halide, Active Glass, Chalgenide Glass, Plastic Optical Fibers.

UNIT II

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.

UNIT III

Fiber Splicing: Splicing Techniques, Splicing Single Mode Fibers, Fiber Alignment and Joint Loss-Multimode Fiber Joints, Single Mode Fiber Joints. Optical Sources- LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Injection Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies, Reliability of LED & ILD.

UNIT IV

Optical Detectors: Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, 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

Optical System Design: Considerations, Component Choice, Multiplexing, Point-to- Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion in Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples. Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye Pattern.

Textbooks:

1. Optical Fiber Communications – Gerd Keiser, MC GRAW HILL EDUCATION, 4th Edition, 2008.
2. Optical Fiber Communications – John M. Senior, Pearson Education, 3rd Edition, 2009.

References:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.
4. Introduction to Fiber Optics by Donald J.Sterling Jr. – Cengage learning, 2004.

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B.Tech (ECE)– III-II Sem
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(20A04601P) ANTENNAS &MICROWAVE ENGINEERING LAB

Course Objectives:
* To understand the working, different microwave components and verify characteristics using microwave bench setup.
* To study various antennas

Course Outcomes:
At the end of this course, the students will be able to
* Understand the working, different microwave components and sources in a microwave bench
* Verify the characteristics of various microwave components using microwave bench setup
* Design and study of various antennas
* Analyze performance characteristics of Antennas

Part-A Antennas Lab
1. To analyze the characteristics of Simple Dipole λ/2 and λ/4 Antenna
2. To analyze the variation in the Radiation Strength at given distance from Antenna
3. To analyze the Reciprocity Theorem for Antennas
4. To study Folded Dipole λ /2 Antenna
5. Study of Yagi Uda 3 element Folded Dipole, 5 element folded dipole.
6. To analyze the characteristics of micro strip antennas
7. To analyze the characteristics and radiation pattern of broad side and end fire arrays.

Part-B Microwave Engineering lab
1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Directional Coupler Characteristics.
4. VSWR Measurement.
5. Measurement of Wave Guide Parameters.
6. Measurement of Impedance of a given load.
7. Measurement of Scattering Parameters of a Magic Tee.
8. Measurement of Scattering Parameters of a Circulator.
9. Attenuation Measurement.
10. Microwave Frequency Measurement

NOTE: At least 5 Experiments from each section must be done in the semester.

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B.Tech (ECE)– III-II Sem   **L   T   P   C**
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(20A04602P) VLSI DESIGN LAB

Course Outcomes:
- Design any logic circuit using CMOS transistor.
- Use different software tools for analysis of circuits.
- Design layouts to the CMOS circuits.
- Use different software tools for analog layout

List of Experiments:
1. Design and analysis of CMOS Inverter
   a) Implement CMOS inverter schematic using 180 nm technology and design its symbol.
   b) Implement test bench for CMOS Inverter and check its output response.
   c) Perform DC and AC analysis for CMOS inverter.
   d) Check the performance of CMOS inverter using parametric sweep.
2. Design and analysis of NAND and NOR Logic gates
   a) Implement NAND/NOR schematic using 180 nm technology and design its symbol.
   b) Implement test bench for NAND/NOR and check its output response.
   c) Perform DC and AC analysis for NAND/NOR.
   d) Check the performance of NAND/NOR using parametric sweep.
3. Design and analysis of XOR and XNOR Logic gates
   a) Implement XOR/XNOR schematic using 180 nm technology and design its symbol.
   b) Implement test bench for XOR/XNOR and check its output response.
   c) Perform DC and AC analysis for XOR/XNOR.
   d) Check the performance of XOR/XNOR using parametric sweep.
4. Design of AOI logic
   a) Design Schematic for AB+C'D and check its output response.
   b) Design Schematic for AB'+C'D and check its output response.
   c) Design Schematic for (A+B')(C+D) and check its output response.
   d) Design Schematic for (A+B')(C'+D) and check its output response.
5. Design and analysis of Full adder
   a) Design full adder using Full custom IC design.
   b) Design full adder using Semi custom IC design.
6. Analysis of NMOS and PMOS characteristics
   a) Implement test bench for NMOS/PMOS transistor.
   b) Perform DC and AC analysis for NMOS/PMOS transistor
   c) Check the performance of NMOS/PMOS transistor using parametric sweep.
7. Design and analysis of Common source amplifier
   a) Implement CS amplifier schematic using 180 nm technology and design its symbol.
   b) Implement test bench for CS amplifier and check its output response.
   c) Perform DC and AC analysis for CS amplifier.
   d) Check the performance of CS amplifier using parametric sweep.
8. Design and analysis of Common drain amplifier
   a) Implement CD amplifier schematic using 180 nm technology and design its symbol.
   b) Implement test bench for CD amplifier and check its output response.
   c) Perform DC and AC analysis for CD amplifier.
   d) Check the performance of CD amplifier using parametric sweep.
9. Design of MOS differential amplifier
   a) Design differential amplifier schematic using 180 nm technology and its symbol.
   b) Implement test bench for differential amplifier and check its output response.
   c) Perform DC and AC analysis for differential amplifier.
   d) Check the performance of differential amplifier using parametric sweep.

10. Design of two stage differential amplifier

a) Design two stage differential amplifier schematic using 180 nm technology and its symbol.

b) Implement test bench for two stage differential amplifier and check its output response.

c) Perform DC and AC analysis for two stage differential amplifier.

d) Check the performance of two stage differential amplifier using parametric sweep.

11. Design of Inverter Layout

a) Design and implement inverter schematic.

b) Design the layout for inverter using 180 nm tech file.

c) Perform LVS for schematic and layout

d) Check and remove all DRC violations.

e) Extract parasitic R and C in layout.

12. Design of NAND/NOR Layout

a) Design and implement NAND/NOR schematic.

b) Design the layout for inverter using 180 nm tech file.

c) Perform LVS for schematic and layout

d) Check and remove all DRC violations.

e) Extract parasitic R and C in layout

Note: Any TEN of the experiments are to be conducted

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

Software Required: i. Mentor Graphics Software / Equivalent Industry Standard Software. ii. Personal computer system with necessary software to run the programs and to implement.

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B.Tech (ECE)– III-II Sem   **L   T   P   C**
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(20A04603P) DATA COMMUNICATION &NETWORKS LAB

Course Objectives:
To introduce Computer Network laboratory and familiarize with the tools by simulating various aspects of networking.

Course Outcomes:
- Familiarize with the network simulation tools
- Usage of the network simulators to study the various aspects that effect network performance

List of Experiments:
Introduction to Computer Network laboratory
Introduction to Discrete Event Simulation
Discrete Event Simulation Tools - ns2/ns3, Omnet++

Usage of the tool ns2/ns3 to:
1. Simulate telnet and ftp between N sources - N sinks (N = 1, 2, 3).
   Evaluate the effect of increasing data rate on congestion.
2. Simulating the effect of queueing disciplines on network performance - Random Early Detection/Weighted RED / Adaptive RED (This can be used as a lead up to DiffServ / IntServ later).
3. Simulate http, ftp and DBMS access in networks
4. Effect of VLAN on network performance –i) multiple VLANs and single router ii) multiple VLANs with separate multiple routers
5. Implementation of IP address configuration.
6. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
7. Implementation of a routing algorithm
8. Simulation of Congestion Control Algorithms
9. Simulating the effect of DiffServ / IntServ in routers on throughput enhancement.
10. Simulating the performance of wireless networks
11. Case Study I: Evaluating the effect of Network Components on Network Performance To Design and Implement LAN With Various Topologies and To Evaluate Network Performance Parameters for DBMS etc)
12. Case Study II: Evaluating the effect of Network Components on Network Performance To Design and Implement LAN Using Switch/Hub/Router As Interconnecting Devices For Two Different LANs and To Evaluate Network Performance Parameters.

NOTE: At least 10 Experiments out of the list must be done in the semester.

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(20A04607) RF SYSTEM DESIGN
Skill Oriented Course – IV

Course Objectives:
To be well-versed in functionalities of basic RF electronics utilized in the industry
Course Outcomes: After the completion of this course, students will be able to
- Verify the basic principles and design aspects involved in high frequency communication systems components
- Conduct the experiments on different high frequency components to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts.
- Design and develop RF components using microstrip technology
- Apply knowledge of basic RF Electronics for realizing any RF system.

UNIT I
Basic Concepts in RF Design: Introduce any RF design software and orient students with the tools of the laboratory. Practice the tool to use it for significant design.Introduction to RF Design, Time Variance and Nonlinearity, Effects of nonlinearity, Passive impedance transformation, Scattering parameters, impedance matching, L match, Pi match, T match, Passive IC Components- Resistors, capacitors Inductors, Schottky Diode, RF Switch.

UNIT II
RF Power Amplifiers and Filters: RF Power amplifier design examples, Gain equalizers, Voltage controlled oscillators, Phase locked loops, Linearized PLL models, PLL design examples, High frequency oscillators, Loop filters, lumped filter. LPF, HPF and BPF.

UNIT III
LNA, VCO and Mixers: General considerations, Problem of input matching, Low Noise Amplifiers design in various topologies, Gain Switching, Band Switching, Voltage Controlled Oscillators, Mixers-General considerations, Passive down conversion mixers, Active down conversion mixers, Up conversion mixers.

UNIT IV
Microstrip transmission lines and discontinuities: S parameters of a Microstrip Transmission Line, Smith Chart, Analysis of Microstrip Transmission Line standing wave patterns at various frequencies, Different types of   Transmission lines like CPW, Microstrip and Co-axial cable. Different types of Microstrip discontinuities like Bend, T, Via, Gap etc., Microstrip Ring Resonator.

List of Experiments
(ADS/IE3D/HFSS or any similar/ equivalent tool may be used for the design)

1. Design of λ/2, λ/4 micro strip transmission line.
2. Design of microstrip inductor and capacitor
3. Design of impedance matching network
4. Design and Simulate a Schottky Diode and RF Switch.
5. Design and characterization of RF BJT Amplifier and LNA
6. Analyse and measure the gain of a Power Amplifier and equalise its gain using an Equalizer.
7. Design of low pass, high pass, band pass and band stop filter at RF
8. Design and characterization of RF Mixer
9. Design and characterization of VCO
10. Measure the S parameters of a Micro strip Transmission Line and plot the normalised impedance on a smith chart
11. Analysis of Microstrip Transmission Line standing wave pattern at various frequencies.
12. Study of different types of Transmission lines like CPW, Microstrip and Co-axial and find/measure its Insertion Loss (S21 and S12)
13. Study of different types of Microstrip discontinuities like Bend, T, Via , Gap etc and find/measure its Insertion loss.

14. Design and characterization of micro strip patch antennas
15. Determine the Bandwidth and Quality Factor of a Microstrip Ring Resonator.

NOTE: Any TWELVE experiments are to be conducted

References:
1. T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004
2. Reinhold Ludwig and PavelBretchko, "RF circuit design," Pearson Education, 2007.
3. B.Razavi, "RF Microelectronics", Pearson Education, 2012

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B.Tech (ECE)– III-II Sem   **L   T   P   C**
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(20A99601) INTELLECTUAL PROPERTY RIGHTS AND PATENTS
(Mandatory Non-Credit Course)

Course Objectives:
This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Cyber Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations

Course Outcomes:
- Understand IPR law& Cyber law
- Discuss registration process, maintenance and litigations associated with trademarks
- Illustrate the copy right law
- Enumerate the trade secret law.

UNIT I
Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory – Overuse or Misuse of Intellectual Property Rights –Compliance and Liability Issues.

UNIT II
Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law-Semiconductor Chip Protection Act.

UNIT III
Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.

UNIT IV
Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.

UNIT V
Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law.Introduction to Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.

Textbooks:
1. Deborah E.Bouchoux: "Intellectual Property". Cengage learning, New Delhi
2. Kompal Bansal &Parishit Bansal "Fundamentals of IPR for Engineers", BS Publications (Press)
3. Cyber Law. Texts & Cases, South-Western's Special Topics Collections

References:
1. Prabhuddha Ganguli: ' Intellectual Property Rights" Tata Mc-Graw – Hill, New Delhi
2. Richard Stim: "Intellectual Property", Cengage Learning, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali: "Intellectual Property Right" Serials Pub.

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(20A04701a) DSP PROCESSORS & ARCHITECTURES
(Professional Elective Course –III)

Course Objectives:
- To describe unique features of Digital signal processing.
- To demonstrate various computational parameters of DSP devices.
- To introduce architectural improvements in programmable DSP devices.
- To expose to basic DSP algorithms.
- To outline DSP processors for developing various applications.

Course Outcomes:
- Summarize features of Digital Signal Processing
- Evaluate dynamic ranges and precision for the given DSP system
- Explain architectural features of DSP processors
- Analyze performance of DSP algorithms on programmable DSP platform for given application
- Select DSP processors for building real time applications

UNIT I

Introduction to Digital Signal Processing: A Digital signal processing system, the sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time invariant systems, Digital filters, Decimation and interpolation.

UNIT II

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of Error in DSP Implementation, A/D Conversion Errors, D/A Conversion Errors

UNIT III

Architecture for Programmable DSP Devices: DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Programmability and Program Execution, Speed Issues, Commercial Digital Signal Processing Devices, Data Addressing Modes of TMS320C54xx Processors, Memory space of TMS320C54xx Processors, TMS320C54xx Instructions and Programs

UNIT IV

Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, PID Controller, Adaptive Filters,2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Bit Reversed Index Generation, 4-point FFT Implementation on the TMS320C54xx, Computation of the Signal Spectrum .

UNIT V

Applications of Programmable DSP Devices: A DSP System, DSP Based Biotelemetry Receiver, A Speech Processing System, An Image Processing System.

Textbooks:
1. B. Venkataramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TMH, 2002.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing, Thomson Publications, 2004.

References:
1. J.G.Proakis, Algorithms for Statistical Signal Processing, Pearson,2002.
2. Jonatham Stein, Digital Signal Processing, John Wiley, 2005.
3. K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, A Practical Approach to Digital Signal Processing. New Age International, 2006/2009
4. Lapsley et al., DSP Processor Fundamentals - Architectures & Features, S. Chand & Co.,2000

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(20A04701b) INTRODUCTION TO INTERNET OF THINGS
(Professional Elective Course –III)

Course Objectives:
Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes:
- Understand the concepts of Internet of Things
- Identify hardware and software components of Internet of Things
- Analyze basic communication protocols
- Design IoT applications in different domain and be able to analyze their performance

UNIT 1
Introduction to IoT: Architectural overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals-Devices and gateways, Data management, Business processes in IoT, Role of cloud in IoT

UNIT II
Elements of IoT:Hardware components – computing (Arduino, Raspberry Pi), communication, Sensing, Actuation, I/O interfaces Software Components- Programming APIs (Using python/Arduino) for communication protocols-MQTT, Zigbee, Bluetooth, CoAP, UDP, TCP

UNIT III
Sensing and Actuation: Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT

UNIT IV
IoT Application Development: Solution frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices

UNIT V
IoT Case Studies: IoT Case studies and mini projects based on industrial Automation, Transportation, Agriculture, Healthcare, Home Automation.

Textbooks:
 1. Vijay Madisetti, ArshdeepBahga, "Internet of Things a Hands-On- Approach",2014.

References:
1. Dr SRN Reddy, RachitThukral and Manasi Mishra ," Introduction to Internet of Things": A practical Approach" ETI Labs
2. Raj Kamal , " Internet of Things: Architecture and Design", McGraw Hill
3. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013

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(20A04701c) SATELLITE COMMUNICATIONS
(Professional Elective Course –III)

Course Objectives:

To introduce various aspects in the design of systems for satellite communication.

Course Outcomes:

- Learn the dynamics of the satellite.
- Understand the communication satellite design.
- Understand how analog and digital technologies are used for satellite communication networks.
- Learn the design of satellite links.
- Study the design of Earth station and tracking of the satellites.

UNIT I

Elements of orbital mechanics. Equations of motion. Tracking and orbit determination. Orbital correction/control. Satellite launch systems. Multistage rocket launchers and their performance

UNIT II

Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

UNIT III

Multiple access techniques. FDMA,TDMA,CDMA. Random access techniques. Satellite onboard processing.

UNIT IV

Satellite link design: Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite - based personal communication. links.

UNIT V

Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting.

Textbooks:

D. Roddy, Satellite Communication (4/e), McGraw- Hill, 2009.

T. Pratt & C.W. Bostain, Satellite Communication, Wiley 2000.

References:

B.N. Agrawal, Design of Geosynchrons Spacecraft, Prentice- Hall,1986

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(20A04702a) REAL TIME OPERATING SYSTEMS
(Professional Elective Course –IV)

Course Objectives:
- To introduce general idea, structure and functions of general purpose operating systems.
- To describe process & memory management techniques
- To teach concepts of how process is created and controlled with RTOs.
- To provide knowledge about the common problems in developing an RTOS.
- To discuss application development using RTOS

Course Outcomes:
- Describe real-time operating system requirements and design issues
- Illustrate role of operating systems in memory and I/O devices management
- Apply concepts of inter-task communication and synchronization via shared memory, message queues, signals, semaphores
- Examine challenges arising in design problems when developing embedded applications in multitasking systems
- Develop programs using system proved timers, signals, mutual exclusion, semaphores, message queues and exception handlers

UNIT I

Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems, Operating System services, user OS Interface, System Calls, Types of System Calls, System Programs, Opening System Design and Implementation, OS Structure, Virtual machines

UNIT II

Process Concept, Process Scheduling, Operations on Processes, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors, Memory Management and Virtual Memory and File System Interface.

UNIT III

RTOs: Differences between General Purpose OS & RTOS, Real-time concepts, Hard Real time and Soft Real-time systems, Basic architecture of an RTOS, components in RTOS, kernel, objects, scheduler, Multitasking, context switch, Scheduling types, Task states, Task management. Kernel Objects, Semaphores, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared- resource- access synchronization, message queue, Common pipe, pipe operation, Select operation on multiple pipes, Pipes for inter-task Synchronization, Event register, control block, Signals, Catch operation, Execution sequence of wait and signal operations.

UNIT IV

RTOS Services Overview- TCP/IP protocol- Stack- File system- Remote procedure calls- RTOS command shell Exceptions and Interrupts- Programmable interrupt controller-Priority scheme- Task and stack Interrupt nesting- Interrupt processing in two contexts. Timer and Timer Services - Real-time clock Soft-timer- Servicing the timer interrupt in the task context- Timeout event handlers. I/O Subsystem and Memory Management Port-mapped I/O- Memory-mapped I/O- Write operation for a block-mode device- I/O function mapping- Associating devices with drivers-Memory allocation map, fragmentation, free operation, Management unit.

UNIT V

Typical RTOS Introduction to RT Linux, Real-Time Linux Applications in Embedded system, Common Design Problems - Deadlock, priority inversion problem, Embedded RTOS for fault-Tolerant applications

Textbooks:

1. Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne 8th Edition, Wiley Student Edition.
2. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011

References:
1. Operating systems - Internals and Design Principles, W. Stallings, 6th Edition, Pearson.
2. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.

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(20A04702b) DIGITAL IMAGE PROCESSING
(Professional Elective Course –IV)

Course Objectives:

This course is designed to enable the students to familiarize themselves with basic concepts of digital image processing and different image transforms and learn various image processing techniques like image enhancement, restoration, segmentation and compression

Course Outcomes:

After completion of the course, students will be able to

- Perform image manipulations and different digital image processing techniques
- Illustrate basic operations like – Enhancement, segmentation, compression, Image transforms and restoration techniques on image.
- Analyze pseudo and full color image processing techniques.
- Apply various morphological operators on images

UNIT I   Lecture 8Hrs

Introduction: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing. Image Transforms: Need for image transforms, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform, Importance of Phase, Walsh Transform. Hadamard transform, Haar Transform, Slant transform, Discrete Cosine transform, KL Transform, SVD and Radon Transform, Comparison of different image transforms.

UNIT II   Lecture 9Hrs

Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters , sharpening spatial filters, Combining spatial enhancement methods Filtering in the Frequency Domain: Preliminary concepts, The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.

UNIT III   Lecture 9Hrs

Image Restoration and Reconstruction: A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering, constrained least squares filtering, geometric mean filter ,image reconstruction from projections.

UNIT IV   Lecture 8Hrs

Image compression: Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-Length coding, Symbol-Based coding, Bit-Plane coding, Block Transform coding, Predictive coding Wavelets and Multiresolution Processing: Image pyramids, subband coding, Multiresolution expansions, wavelet transforms in one dimensions & two dimensions, Wavelet coding.

Lecture 9Hrs

UNIT V

Image segmentation: Fundamentals, point, line, edge detection, thresholding, region –based segmentation. Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds.

Color image processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image

segmentation based on color, noise in color images, color image compression.

Textbooks:
1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2011.

Reference Books:
1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009

Online Learning Resources:
https://nptel.ac.in/courses/117105079
https://nptel.ac.in/courses/117105135

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(20A04702c) RADAR ENGINEERING
(Professional Elective Course –IV)

Course Objectives:
- To make student to acquire the knowledge on types of Radars, working principles, tracking a target, applications and understand on phased array antennas, navigational aids

Course Outcomes:
- Learn the basic working principle of Radar and target detection procedure
- Know the working and applications of CW and Frequency modulated Radar
- Gain the knowledge of about MTI and Pulse Doppler Radar
- Understand different methods of tracking a target and analyze the effect of noise at the receiver
- Learn about the phased array antennas and navigational aids

UNIT I

Basics of Radar: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Displays – types, Illustrative Problems.

UNIT II

CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems.FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

UNIT III

MTI and Pulse Doppler Radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, And Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

UNIT IV

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.

Detection of Radar Signals in Noise: Introduction, Noise Figure and Noise Temperature, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver.

UNIT V

Phased Array Antennas and Navigational Aids: Introduction to Phased Array Antennas- Basic Concepts, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency – scan Arrays, Radiation for Phased Array, Architecture for Phased Arrays. Radiation Pattern. Beam Steering and Beam Width changes. Navigational Aids: Direction Finder, VOR, ILS and Loran

Textbooks:
1. Merrill I. Skolnik, "Introduction to Radar Systems", 2nd Edition, TMH Special Indian Edition, 2007.
2. Byron Edde, "Radar Principals, Technology, Applications", Pearson Education, 1992.

References:
1. F.E. Terman, Radio Engineering, Mc Graw Hill Book Co. (for Chapter 7 only), Fourth Edition 1955
2. Simon Kingsley & Shaun Quegan, Understanding RADAR Systems, McGraw Hill Book Co., 1993.

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(20A04703a) SMART SENSORS
(Professional Elective Course –V)

Course Objective:
To make student to acquire the knowledge on types of sensors/transducers, working principles, selection procedure, applications of sensing systems

Course Outcomes:
- Understand measuring parameters, measuring systems, effects of environment, characteristics and parameters to be considered for designing an instrument
- Understand different types of sensors/transducers, working principles, selection procedure, applications of sensing systems
- Select a sensor/sensing system for a requirement
- Derive sensor-based solution for different applications.

UNIT I
Introduction to Measurement: Measurement units, applications, elements, choosing appropriate measuring instruments. Instrument Types and Performance Characteristics: Review of instrument types, Static characteristics, dynamic characteristics Error during measurement process: Sources of systematic error, reduction and quantification of systematic errors, random errors, aggregation of measurement system errors. Calibration: Calibration of measuring instruments, Primary calibration, secondary calibration and field calibration. Calibration methods for different parameters (temperature, pressure, humidity, flow...etc.). Automatic Calibration mechanisms.

UNIT II
Temperature Sensors: Thermo-resistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric
Humidity and Moisture Sensors: Capacitive, Electrical Conductivity, Thermal Conductivity, Optical Hygrometer, Time Domain Reflect meter.
Pressure and Force Sensors: Mercury Pressure, Bellows, Membranes, and Thin Plates, Piezoresistive, Capacitive, Optoelectronic, Vacuum, Strain Gauges, Tactile, Piezoelectric Force

UNIT III
Occupancy and Motion Detectors: Ultrasonic, Microwave Motion, Capacitive Occupancy, Visible and Near-Infrared Light, Far-Infrared Motion, PIR Motion, Position, Displacement, and Level Sensors: Potentiometric, Gravitational, Capacitive, Inductive and Magnetic, Optical, Ultrasonic, Radar Velocity and Acceleration Sensors: Capacitive Accelerometers, Piezoresistive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers, Heated-Plate Accelerometer, Heated Gas Accelerometer, Gyroscopes, Piezoelectric Cables

UNIT IV
Flow Sensors: Pressure Gradient Technique, Thermal Transport, Ultrasonic, Electromagnetic, and Micro flow, Coriolis Mass Flow, Acoustic Sensors: Resistive Microphones, Fiber-Optic, Piezoelectric, Solid-State microphone, Light & Radiation Sensors: Photodiodes, Phototransistor, Photo resistors, Thermal detectors
Chemical Sensors: Metal-Oxide Chemical, ChemFET, Electro-chemical, Potentiometric, Conduct metric, Amperometric, Optical Chemical, Mass Detector

UNIT V
Introduction to wireless sensor networks, Challenges for wireless sensor networks, Applications for wireless sensor networks, enabling technologies for wireless sensor networks.
Single node architecture – Hardware components, Energy consumption of Sensor nodes (only Operation states with different power consumption, Relationship between computation and communication, Power consumption of sensor and actuators is included), Deployment environments
Sensor Network Architecture - Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, Gateway-concepts.

Textbooks
1. Measurement and Instrumentation Principles - Morris, AlanS
2. An Introduction to Error Analysis by John R.Taylor
3. Sensor Technology Handbook, John S.Wilson
4. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor
5. Networks" John-Wiley,First-Edition-2014.

References:
1. Mechanical Measurements – Beckwith, Marangoni,Lienhard
2. Measurement of Systems - Application and design - Earnest O.Doeblin
3. Electronic Instrumentation and Measurement Technique - Albert DHelfrick
4. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology,
5. Protocols, AndApplications", John Wiley,2007.

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(20A04703b) NANO ELECTRONICS
(Professional Elective Course -V)

Course Objectives
- To teach nano electronic systems and its building blocks
- To provide knowledge on spin electronic devices.
- To familiarize students with the present research trend in Nano electronics

Course Outcomes:
- Describe the fabrication process and limitations in the CMOS design
- Choose different models of MOS devices according to the requirement.
- Integrate and model the device with basic quantum structures.
- Compare MOSFET, CNFET and Spin FET devices

UNIT I

Challenges going to sub-100 nm MOSFETs Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation.

UNITII

Novel MOS-based devices Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, Fin FETs, vertical MOSFETs, strained Si devices.

UNITIII

Quantum structures quantum wells, quantum wires and quantum dots, Single electron devices charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations.

UNIT IV

Hetero structure based devices Type I, II and III hetero junctions, Si-Ge hetero structure, hetero structures of III-V and II-VI compounds - resonant tunneling devices.

UNIT V

Carbon nanotubesbased devices CNFET, characteristics; Spin-based devices spin FET, characteristics, Applications of MOSFET, CNFET and Spin FET devcies.

Textbooks:
1. Mircea Dragoman and Daniela Dragoman, " Nano electronics Principles & devices", Artech House Publishers, 2005.
2. Karl Goser, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices", Springer 2005.

References:
1. Mark Lundstrom and Jing Guo, "Nanoscale Transistors: Device Physics Modelling and Simulation", Springer, 2005.
2. Vladimir VMitin, Viatcheslav A Kochelap and Michael A Stroscio, "Quantum hetero structures", Cambridge University Press, 1999.
3. S M Sze (Ed), "High speed semiconductor devices", Wiley, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– IV-I Sem   **L T P C**

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(20A04703c) CELLUAR & MOBILE COMMUNICATIONS
(Professional Elective Course –V)

Course Objectives:
- To explain cell coverage for signal and traffic, diversity techniques and mobile antennas by the use of Engineering Mathematics.
- To present impairments due to multipath fading channel, fundamental techniques to overcome different fading effects, frequency management, Channel assignment and types of handoffs.
- To teach concepts and solve problems on mobile antennas and cellular systems.

Course Outcomes:
- Know about cell coverage for signal and traffic, diversity techniques and mobile antennas by the use of Engineering Mathematics
- Explain impairments due to multipath fading channel, fundamental techniques to overcome different fading effects, frequency management, Channel assignment and types of handoff
- Apply concepts to solve problems on mobile antennas and cellular systems
- Analyze Co-channel and Non Co-channel interferences, different Hand-offs and dropped call rates
- Evaluate performance of dropped call rate and false alarm rate
- Compare different handoffs

UNIT I

Introduction to Cellular Mobile Radio Systems: Limitations of Conventional Mobile Telephone Systems, Basic Cellular Mobile System, Uniqueness of Mobile Radio Environment, Mobile Fading Characteristics, Operations of Cellular Systems, Evolution of Cellular Systems.

Fundamentals of Cellular Radio System Design: Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I from a Normal Case in an Omni Directional Antenna System, System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems- CellSplitting, Sectoring, Microcell Zone Concept.

UNIT II

Cell Coverage for Signal and Traffic: Signal Reflections in Flat and Hilly Terrain, Effect of Human Made Structures, Phase Difference between Direct and Reflected Paths, Constant Standard Deviation, Straight Line Path Loss Slope, General Formula for Mobile Propagation Over Water and Flat Open Area, Near and Long Distance Propagation, Path Loss from a Point to Point Prediction Model in Different Conditions, Merits of Lee Model.

Cell Site and Mobile Antennas: Space Diversity Antennas, Umbrella Pattern Antennas, Minimum Separation of Cell Site Antennas, Mobile Antennas.

UNIT III

Co-Channel Interference Reduction: Measurement of Real Time Co-Channel Interference, Design of Omnidirectional and directional Antenna System, Antenna Parameters and Their Effects, Diversity Techniques-Space Diversity, Polarization Diversity, Frequency Diversity, Time Diversity.

Non-Co-Channel Interference: Adjacent Channel Interference, Near End Far End Interference, Cross Talk, Effects on Coverage and Interference by Power Decrease, Antenna Height Decrease, Effects of Cell Site Components.

UNIT IV

Frequency Management and Channel Assignment: Numbering and Grouping, Setup Access and Paging Channels, Channel Assignments to Cell Site and Mobile Units, Channel Sharing and Borrowing, Sectorization, Overlaid Cells, Non Fixed Channel Assignment.

UNIT V

Handoffs and Dropped Calls: Handoff Initiation, Types of Handoff, Delaying Handoff, Advantages of Handoff, Power difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoffs, Intersystem Handoff, Introduction to Dropped Call Rates and their Evaluation.

System Evaluation: Performance Evaluation, Blockage, Dropped-call rate, Signaling Evaluation-False Alarm Rate, Word error rate consideration and calculations, Measurement of averaged received signal level and level crossings.

Textbooks:
1. W.C.Y. Lee, Mobile Cellular Telecommunications, McGraw Hill, 2nd Edn., 1989.
2. Theodore. S. Rapport, Wireless Communications, Pearson Education, 2nd Edn., 2002.

References:
1. W.C.Y Lee, Mobile Communications Engineering-Theory and Applications, McGraw Hill, Second Edition, ,2014.
2. Gordon L. Stuber, Principles of Mobile Communications, Springer International, 2nd Edn., 2001.
3. Simon Haykin, Michael Moher, Modern Wireless Communications, Pearson Education, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– III-II Sem
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(20A52701a) ENTREPRENEURSHIP & INCUBATION
(HUMANITIES ELECTIVE II)

Course Objectives:

- To make the student understand about Entrepreneurship
- To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
- To facilitate the student in knowing various sources of finance in starting up of a business
- To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
- To encourage the student in creating and designing business plans

Course Outcomes:

- Understand the concept of Entrepreneurship and challenges in the world of competition.
- Apply the Knowledge in generating ideas for New Ventures.
- Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
- Evaluate the role of central government and state government in promoting Entrepreneurship.
- Create and design business plan structure through incubations.

UNIT I

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

UNIT II

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

UNIT III

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

UNIT IV

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

UNIT V

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence the Type/benefits of incubators - Corporate/educational / institutional incubators - Broader business incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure - Value proposition

Textbooks:

1. D F Kuratko and T V Rao, "Entrepreneurship" - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit : login.cengage.com)
2. Nandan H, " Fundamentals of Entrepreneurship", PHI, 2013

References:

1. Vasant Desai, "Small Scale Industries and Entrepreneurship", Himalaya Publishing 2012.
2. Rajeev Roy "Entrepreneurship", 2nd Edition, Oxford, 2012.

3. B.JanakiramandM.Rizwana‖ "Entrepreneurship Development: Text & Cases", Excel Books, 2011.
4. Stuart Read, Effectual "Entrepreneurship", Routledge, 2013.

E-Resources

1. Entrepreneurship-Through-the-Lens-of-enture Capital
2. http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship
3. http://nptel.ac.in/courses/122106032/Pdf/7_4.pd
4. http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurhip/50

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B.Tech (ECE)– III-II Sem   **L   T   P   C**
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(20A52701b) MANAGEMENT SCIENCE
(HUMANITIES ELECTIVE-II)

Course Objectives:

- To provide fundamental knowledge on Management, Administration, Organization & its concepts.
- To make the students understand the role of management in Production
- To impart the concept of HRM in order to have an idea on Recruitment, Selection,Training& Development, job evaluation and Merit rating concepts
- To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
- To make the students aware of the contemporary issues in management

Course Outcomes:

- Understand the concepts & principles of management and designs of organization in a practical world
- Apply the knowledge of Work-study principles & Quality Control techniques in industry
- Analyze the concepts of HRM in Recruitment, Selection and Training & Development.
- Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
- Create Modern technology in management science.

UNITI INTRODUCTION TO MANAGEMENT

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

UNIT II OPERATIONS MANAGEMENT

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Deming's contribution to Quality. **Material Management -** Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management -** Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

UNIT IIIHUMAN RESOURCES MANAGEMENT (HRM)

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

UNIT IV STRATEGIC & PROJECT MANAGEMENT

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management -** Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

UNIT V CONTEMPORARY ISSUES IN MANAGEMENT

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

Textbooks:

1. A.R Aryasri, "Management Science", TMH, 2013
2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

References:

1. Koontz &Weihrich, "Essentials of Management", 6th edition, TMH, 2005.
2. Thomas N.Duening& John M.Ivancevich, "Management Principles and Guidelines", Biztantra.
3. Kanishka Bedi, "Production and Operations Management", Oxford University Press, 2004.
4. Samuel C.Certo, "Modern Management", 9th edition, PHI, 2005

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– III-II Sem   **L   T   P   C**
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(20A52701c) ENTERPRISE RESOURCE PLANNING
(HUMANITIES ELECTIVE-II)

Course Objectives:
- To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning
- To enable the students in knowing the Advantages of ERP
- To train the students to develop the basic understanding of how ERP enriches the
- Business organizations in achieving a multidimensional growth.
- Impart knowledge about the historical background of BPR
- To aim at preparing the students, technologically competitive and make them ready to self-upgrade with the higher technical skills.

Course Outcomes:
- Understand the basic use of ERP Package and its role in integrating business functions.
- Explain the challenges of ERP system in the organization
- Apply the knowledge in implementing ERP system for business
- Evaluate the role of IT in taking decisions with MIS
- Create reengineered business processes with process redesign

UNITI

Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM),

UNITII

Benefits of ERP: Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

UNITIII

ERP Implementation Lifecycle: Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

UNITIV

BPR: Historical background: Nature, significance and rationale of business process reengineering (BPR), Fundamentals of BPR. Major issues in process redesign: Business vision and process objectives, Processes to be redesigned, Measuring existing processes,

UNITV

IT in ERP: Role of information technology (IT) and identifying IT levers. Designing and building a prototype of the new process: BPR phases, Relationship between BPR phases. MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

Textbooks:
1. Pankaj Sharma. "Enterprise Resource Planning". Aph Publishing Corporation, New Delhi, 2004.
2. Alexis Leon, "Enterprise Resource Planning", IV Edition, Mc.Graw Hill, 2019

References:
1. Marianne Bradford "Modern ERP", 3rd edition.
2. ERP making it happen Thomas f. Wallace and Michael
3. Directing the ERP Implementation Michael w pelphrey

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (ECE)– IV-I Sem   **L T P C**

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(20A04707) INDUSTRIAL IOT AND AUTOMATION
(Skill Oriented Course- V)

Course Objectives:

To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.

Learning Outcomes:

- Discover key IIoT concepts including identification, sensors, localization, wireless protocols, data storage and security
- Explore IoT technologies, architectures, standards, and regulation
- Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices
- Examine technological developments that will likely shape the industrial landscape in the future
- Understand how to develop and implement own IoT technologies, solutions, and applications

Course Syllabus

MODULE 1: Introduction & Architecture

What is IIoT and connected world? the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

 Practice

 1. Introduction to Arduino, Introduction to raspberry Pi.

https://www.youtube.com/watch?v=AQdLQV6vhbk

MODULE 2: IIOT Components

Fundamentals of Control System, introductions, components, closed loop & open loop system. Introduction to Sensors (Description and Working principle): What is sensor? Types of sensors, working principle of basicSensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11).Digital switch, Electro Mechanical switches.

 Practice

1. Measurement of temperature & pressure values of the process using raspberry pi/node mcu.

2. Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.

3. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

MODULE 3: Communication Technologies of IIoT

Communication Protocols: IEEE 802.15.4, ZigBee, Bluetooth, BLE, NFC, RFIDIndustry standards communication technology (MQTT), wireless network communication.

 Practice

 1. Demonstration of MQTT communication.

MODULE 4: Visualization and Data Types of IIoT

Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

 Practice

1. Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')

2. Sending alert message to the user. ways to control and interact with your environment)

MODULE 5: Retrieving Data

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

 Practice

1. Device control using mobile Apps or through Web pages.

2. Machine to Machine communication.

MODULE 6: Control & Supervisory Level of Automation
Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA).
Practice
1. Digital logic gates programming using ladder diagram.
2. Implementation of Boolean expression using ladder diagram.
3. Simulation of PLC to understand the process control concept.

Projects:
IIoT based smart energy meter
Smart Agriculture system
Automation using controller via Bluetooth
Temperature controlled Fan/cooler using controller
Automatic streetlight
Smart Baggage Tracker

Textbooks
1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2. Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)

OPEN ELECTIVES

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-I Sem	L	T	P	C
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(20A01505) BUILDING TECHNOLOGY
(Open Elective-I)

Course Objectives:
- To know different types of buildings, principles and planning of the buildings.
- To identify the termite control measure in buildings, and importance of grouping circulation, lighting and ventilation aspects in buildings.
- To know the different modes of vertical transportation in buildings.
- To know the utilization of prefabricated structural elements in buildings.
- To know the importance of acoustics in planning and designing of buildings.

Course Outcomes (CO):
- Understand the principles in planning and design the buildings
- To get different types of buildings, principles and planning of the buildings
- To know the different methods of termite proofing in buildings.
- Know the different methods of vertical transportation in buildings.
- Know the implementation of prefabricated units in buildings and effect of earthquake on buildings.
- Know the importance of acoustics in planning and designing of buildings.

UNIT I

Overview of the course, basic definitions, buildings-types-components-economy and design-principles of planning of buildings and their importance. Definitions and importance of grouping and circulation-lighting and ventilation-consideration of the above aspects during planning of building.

UNIT II

Termite proofing: Inspection-control measures and precautions-lighting protectionof buildings-general principles of design of openings-various types of fire protection measures to be considered while panning a building.

UNIT III

Vertical transportation in a building: Types of vertical transportation-stairs-different forms of stairs-planning of stairs-other modes of vertical transportation –lifts-ramps-escalators.

UNIT IV

Prefabrication systems in residential buildings-walls-openings-cupboards-shelves etc., planning and modules and sizes of components in prefabrication. Planning and designing of residential buildings against the earthquake forces, principles, seismic forces and their effect on buildings.

UNIT V

Acoustics –effect of noise –properties of noise and its measurements, principles of acoustics of building. Sound insulation-importance and measures.

Textbooks:
1. Building construction by Varghese, PHI Learning Private Limited 2nd Edition 2015
2. Building construction by Punmia.B.C, Jain.A.K and Jain.A.K Laxmi Publications 11th edition 2016

Reference Books:
1. National Building Code of India, Bureau of Indian Standards
2. Building construction-Technical teachers training institute, Madras, Tata McGraw Hill.
3. Building construction by S.P.Arora and S.P.BrndraDhanpat Rai and Sons Publications, New Delh 2014 edition
   https://nptel.ac.in/courses/105102206
   https://nptel.ac.in/courses/105103206

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-I Sem

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(20A02505) ELECTRIC VEHICLES
(Open Elective-I)

Course Objectives:
- To get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles
- To get exposed to EV system configuration and parameters
- To know about electro mobility and environmental issues of EVs
- To understand about basic EV propulsion and dynamics
- To understand about fuel cell technologies for EV and HVEs
- To know about basic battery charging and control strategies used in electric vehicles

Course Outcomes:
- Understand and differentiate between conventional and latest trends in Electric Vehicles
- Analyze various EV resources, EV dynamics and Battery charging
- Apply basic concepts of EV to design complete EV system
- Design EV system with various fundamental concepts

UNIT I   INTRODUCTION TO EV SYSTEMS AND PARAMETERS
Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters.

UNIT II   EV AND ENERGY SOURCES
Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems

UNIT III   EV PROPULSION AND DYNAMICS
Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration.

UNIT IV   FUEL CELLS
Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.
Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples

UNIT V   BATTERY CHARGING AND CONTROL

Battery charging: Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.
Control: Introduction, modelling of electromechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle

Textbooks:
1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Reference Books:
1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2005.
2. li Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015.

Online Learning Resources: .https://onlinecourses.nptel.ac.in/noc22_ee53/preview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-I Sem   **L   T   P   C**
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(20A03505) 3D PRINTING TECHNOLOGY
(Open Elective-I)

Course Objectives:
- Familiarize techniques for processing of CAD models for rapid prototyping.
- Explain fundamentals of rapid prototyping techniques.
- Demonstrate appropriate tooling for rapid prototyping process.
- Focus Rapid prototyping techniques for reverse engineering.
- Train Various Pre – Processing, Processing and Post Processing errors in RP Processes.

Course Outcomes:
- Use techniques for processing of CAD models for rapid prototyping.
- Understand and apply fundamentals of rapid prototyping techniques.
- Use appropriate tooling for rapid prototyping process.
- Use rapid prototyping techniques for reverse engineering.
- Identify Various Pre – Processing, Processing and Post Processing errors in RP processes.

UNIT I   Introduction to 3D Printing

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

UNIT II   Solid and Liquid Based RP Systems

Working Principle, Materials, Advantages, Limitations and Applicationsof Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereo lithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

UNIT III   Powder Based & Other RP Systems

Powder Based RP Systems: Working Principle,Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM).

Other RP Systems: Working Principle,Materials, Advantages, Limitations and Applications of Three Dimensional Printing (3DP), Ballastic Particle Manufacturing (BPM) and Shape Deposition Manufacturing (SDM).

UNIT IV   Rapid Tooling & Reverse Engineering

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

UNIT V   Errors in 3D Printing and Applications:

Pre-processing, processing and post-processing errors, Part building errors in SLA, SLS, etc.

Software: Need for software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Textbooks:
1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" 5/e, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer, 2/e, 2010.

Reference Books:

1. Frank W.Liou, "Rapid Prototyping & Engineering Applications", CRC Press, Taylor & Francis Group, 2011.
2. Rafiq Noorani, **"**Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley&Sons, 2006.

Online Learning Resources:

- NPTEL Course on Rapid Manufacturing.
- https://nptel.ac.in/courses/112/104/112104265/
- https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
- https://slideplayer.com/slide/6927137/
- https://www.mdpi.com/2073-4360/12/6/1334
- https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf
- https://lecturenotes.in/subject/197
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- https://www.youtube.com/watch?v=NkC8TNts4B4

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B.Tech III-I Sem   **L   T   P   C**

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(20A05505a) JAVA PROGRAMMING
(Open Elective Course – I)

Course Objectives:
- To understand object-oriented concepts and problem-solving techniques
- To obtain knowledge about the principles of inheritance and polymorphism
- To implement the concept of packages, interfaces, exception handling and concurrency mechanism.
- To design the GUIs using applets and swing controls.
- To understand the Java Database Connectivity Architecture

Course Outcomes:
- Solve real-world problems using OOP techniques.
- Apply code reusability through inheritance, packages and interfaces
- Solve problems using java collection framework and I/O classes.
- Develop applications by using parallel streams for better performance and develop applets for web applications.
- Build GUIs and handle events generated by user interactions and Use the JDBC API to access the database.

UNIT I   Introduction

Introduction to Object Oriented Programming, The History and Evolution of Java, Introduction to Classes, Objects, Methods, Constructors, this keyword, Garbage Collection, Data Types, Variables, Type Conversion and Casting, Arrays, Operators, Control Statements, Method Overloading, Constructor Overloading, Parameter Passing, Recursion, String Class and String handling methods

UNIT II   Inheritance, Packages, Interfaces

Inheritance: Basics, Using Super, Creating Multilevel hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract classes, Using final with inheritance, Object class,
Packages: Basics, Finding packages and CLASSPATH, Access Protection, Importing packages.
Interfaces: Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

UNIT III   Exception handling, Stream based I/O

Exception handling - Fundamentals, Exception types, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built-in exceptions, creating own exception subclasses.
Stream based I/O (java.io) – The Stream Classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and Writing Files, Random access file operations, The Console class, Serialization, Enumerations, Autoboxing, Generics.

UNIT IV   Multithreading, The Collections Framework

Multithreading: The Java thread model, creating threads, Thread priorities, Synchronizing threads, Interthread communication.
The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collectionclasses- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Hashtable, Properties, Stack, Vector, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner.

UNIT V   Applet, GUI Programming with Swings, Accessing Databases with JDBC

Applet: Basics, Architecture, Applet Skeleton, requesting repainting, using the status window, passing parameters to applets
GUI Programming with Swings – The origin and design philosophy of swing, components and containers, layout managers, event handling, using a push button, jtextfield, jlabel and image icon, the swing buttons, jtext field, jscrollpane, jlist, jcombobox, trees, jtable, An overview of jmenubar, jmenu and jmenuitem,

creating a main menu, show message dialog, show confirmdialog, show input dialog, show option dialog, jdialog, create a modeless dialog.

Accessing Databases with JDBC:

Types of Drivers, JDBC Architecture, JDBC classes and Interfaces, Basic steps in developing JDBC applications, Creating a new database and table with JDBC.

Textbooks:
1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Java How to Program, 10th Edition, Paul Dietel, Harvey Dietel, Pearson Education.

Reference Books:
1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
2. Core Java Volume – 1 Fundamentals, Cay S. Horstmann, Pearson Education.
3. Java Programming for core and advanced learners, Sagayaraj, Dennis, Karthik andGajalakshmi, University Press
4. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
5. Object Oriented Programming through Java, P. Radha Krishna, University Press.
6. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
7. Java Programming and Object-oriented Application Development, R.A. Johnson, Cengage Learning.

Online Learning Resources:
https://www.w3schools.com/java/java_oop.asp
http://peterindia.net/JavaFiles.html

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-I Sem   L   T   P   C
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(20A05602T) ARTIFICIAL INTELLIGENCE
Open Elective Course - I

Course Objectives:
This course is designed to:
- Introduce Artificial Intelligence
- Teach about the machine learning environment
- Present the searching Technique for Problem Solving
- Introduce Natural Language Processing and Robotics

Course Outcomes:
After completion of the course, students will be able to
- Apply searching techniques for solving a problem
- Design Intelligent Agents
- Develop Natural Language Interface for Machines
- Design mini robots
- Summarize past, present and future of Artificial Intelligence

UNIT I   **Introduction**   Lecture 9Hr

Introduction: What is AI, Foundations of AI, History of AI, The State of Art.
Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Na
Environments, The Structure of Agents.

UNIT II   **Solving Problems by searching**   Lecture 9 Hr

Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Stra
Informed search strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithm
Optimization Problems, Local Search in Continues Spaces, Searching with Nondeterministic A
Searching with partial observations, online search agents and unknown environments.

UNIT III   **Reinforcement Learning & Natural Language Processing**   Lecture 8Hr

Reinforcement Learning: Introduction, Passive Reinforcement Learning, Active Reinforcement Le
Generalization in Reinforcement Learning, Policy Search, applications of RL
Natural Language Processing: Language Models, Text Classification, Information Retrieval, Infor
Extraction.

UNIT IV   **Natural Language for Communication**   Lecture 8 Hr

Natural Language for Communication: Phrase structure grammars, Syntactic Analysis, Aug
Grammars and semantic Interpretation, Machine Translation, Speech Recognition
Perception: Image Formation, Early Image Processing Operations, Object Recognition by appe
Reconstructing the 3D World, Object Recognition from Structural information, Using Vision.

UNIT V   **Robotics**   Lecture 10H

Robotics: Introduction, Robot Hardware, Robotic Perception, planning to move, planning un
movements, Moving, Robotic software architectures, application domains
Philosophical foundations: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components,
Architectures, Are we going in the right direction, What if AI does succeed.

Textbooks:
1. Stuart J.Russell, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd Edition, I
   Education, 2019.

Reference Books:

1. Nilsson, Nils J., and Nils Johan Nilsson. Artificial intelligence: a new synthesis. Morgan Kaufmann, 1998.
2. Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 30-39.

Online Learning Resources:

http://peterindia.net/AILinks.html

http://nptel.ac.in/courses/106106139/

https://nptel.ac.in/courses/106/105/106105152/

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B.Tech III-I Sem   **L   T   P   C**
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(20A12502) MOBILE APPLICATION DEVELOPMENT USINGANDROID
(Open Elective-I)

Course Objectives:
- Facilitate students to understand android SDK.
- Help students to gain a basic understanding of Android application development.
- Inculcate working knowledge of Android Studio development tool.

Course Outcomes:
- Identify various concepts of mobile programming that make it unique from programming for other platforms.
- Evaluate mobile applications on their design pros and cons.
- Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
- Develop mobile applications for the Android operating system that use basic and advanced phone features.
- Demonstrate the deployment of applications to the Android marketplace for distribution.

UNIT I   Introduction and Mobile User Interface Design
Introduction to Android: The Android Platform, Android SDK, Android Studio Installation, Android Installation, building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT II   Activities, Intents and Android User Interface
Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions

UNIT III   Advanced User Interface and Data Persistence
Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

UNIT IV   Android Services, Publishing Android Applications
Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

UNIT V   Android Databases
Using Common Android APIs: Using Android Data and Storage APIs, managing data using SQLite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Textbooks:
1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011).
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development," Wiley India, FirstEdition,2012.

Reference Books:
1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

Online Learning Resources:
1. https://developer.android.com/

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B.Tech III-I Sem   **L   T   P   C**
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(20A27505) COMPUTER APPLICATIONS IN FOOD TECHNOLOGY
(Open Elective-1)

Course Objectives:
- To know different software and applications in food technology.
- To understand the Chemical kinetics in food processing, Microbial distraction in thermal processing of food.
- To acquire knowledge on computer aided manufacturing and control of food machinery, inventory control, process control.

Course Outcomes:
- Students will gain knowledge on software in food technology, data analysis, Chemical kinetics, microbial distortion in thermal process
- Use of linear regression in analyzing sensory data, application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants.

UNIT I
Introduction to various software and their applications in food technology. Application of MS Excel to solve the problems of Food Technology, SPSS and JMP for data analysis, Pro-Engineering for design, Lab VIEW and SCADA for process control .

UNIT II
Chemical kinetics in food processing: Determining rate constant of zero order reaction First order rate constant and half-life of reactions. Determining energy of activation of vitamin degradation during food storage Rates of Enzymes catalyzed reaction. Microbial distraction in thermal processing of food. Determining decimal reduction time from microbial survival data, Thermal resistance factor, Z-values in thermal processing of food. Sampling to ensure that a lot is not contaminated with more than a given percentage Statistical quality control. Probability of occurrence in normal distribution. Using binomial distribution to determine probability of occurrence. Probability of defective items in a sample obtained from large lot

UNIT III
Sensory evaluation of food Statistical descriptors of a population estimated from sensory data obtained from a sample Analysis of variance**.** One factor, completely randomized design For two factor design without replication**.** Use of linear regression in analyzing sensory data. Mechanical transport of liquid food**.** Measuring viscosity of liquid food using a capillary tube viscometer . Solving simultaneous equations in designing multiple effect evaporator while using matrix algebra available in excel.

UNIT IV
Familiarization with the application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants, stating from the receiving of raw material up to the storage & dispatch of finished product.

UNIT V
Basic Introduction to computer aided manufacturing. Application of computers, instrumentation and control of food machinery, inventory control, process control etc.

Recommended books:
1. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis by R. Paul Singh, AP.
2. Manuals of MS Office.

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B.Tech III-I Sem   **L   T   P   C**
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(20A54501) OPTIMIZATION TECHNIQUES
(Open Elective- I)

Course Objectives:
This course enables the students to classify and formulate real-life problem for modeling as optimization problem, solving and applying for decision making.

Course Outcomes: Student will be able to
- formulate a linear programming problem and solve it by various methods.
- give an optimal solution in assignment jobs, give transportation of items from sources to destinations.
- identify strategies in a game for optimal profit.
- implement project planning.

UNIT I
Introduction to operational research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method.

UNIT II
Transportation problems- assignment problems-Game theory.

UNIT III
CPM and PERT –Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations.

UNIT IV
Sequencing Problems-Replacement problems-Capital equipment- Discounting costs- Group replacement.

UNIT V
Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models- Single period inventory models with shortage cost.

Textbooks:
1. Operations Research , S.D. Sharma.
2. Operations Research, An Introduction, Hamdy A. Taha, Pearson publishers.
3. Operations Research, Nita H Shah, Ravi M Gor, Hardik Soni, PHI publishers

Reference Books:
1. Problems on Operations Research, Er. Prem kumargupta, Dr.D.S. Hira, Chand publishers
2. Operations Research, CB Gupta, PK Dwivedi, Sunil kumaryadav

Online Learning Resources:
https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L2slides.pdf
https://slideplayer.com/slide/7790901/
https://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf

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B.Tech III-I Sem	L	T	P	C
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(20A56501) MATERIALS CHARACTERIZATION TECHNIQUES
(Open Elective- I)

Course Objectives:
- To provide an exposure to different characterization techniques.
- To enlighten the basic principles and analysis of different spectroscopic techniques.
- To explain the basic principle of Scanning electron microscope along with its limitations and applications.
- To identify the Resolving power and Magnification of Transmission electron microscope and its applications.
- To educate the uses of advanced electric and magnetic instruments for characterization.

Course Outcomes: At the end of the course the student will be able
- To explain the structural analysis by X-ray diffraction.
- To understand the morphology of different materials using SEM and TEM.
- To recognize basic principles of various spectroscopic techniques.
- To study the electric and magnetic properties of the materials.
- To make out which technique can be used to analyse a material

UNIT I

Structure analysis by Powder X-Ray Diffraction: Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherrer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

UNIT II

Microscopy technique -1 –Scanning Electron Microscopy (SEM)
Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

UNIT III

Microscopy Technique -2 - Transmission Electron Microscopy (TEM): Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.

UNIT IV

Spectroscopy techniques – Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

UNIT V

Electrical & Magnetic Characterization techniques: Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

Textbooks:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods –Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Handbook of Materials Characterization -by Sharma S. K. - Springer

References:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity& Stuart R Stocks, Prentice Hall, 2001
3. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods-Yang Leng-John Wiley & Sons
4. Characterization of Materials 2nd Edition, 3 Volumes-Kaufmann E N -John Wiley (Bp)

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B.Tech III-I Sem   **L   T   P   C**
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(20A51501) CHEMISTRY OF ENERGY MATERIALS
(Open Elective- I)

Course Objectives:
- To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
- To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
- To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
- Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
- To understand and apply the basics of calculations related to material and energy flow in the processes.

Course Outcomes:
- Ability to perform simultaneous material and energy balances.
- Student learn about various electrochemical and energy systems
- Knowledge of solid, liquid and gaseous fuels
- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively

UNIT I: Electrochemical Systems: Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batterie**s.**
UNIT II: Fuel Cells: Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,.
UNIT III: Hydrogen Storage: Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogel storage by high pressure methods. Liquifaction method.
UNIT IV:Solar Energy: Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells.
UNIT V: Photo and Photo electrochemical Conversions: Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.
References:
1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff

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B.Tech IV-I Sem

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(20A01605) ENVIRONMENTAL ECONOMICS
(Open Elective Course - II)

Course Objectives:
- To impart knowledge on sustainable development and economics of energy
- To teach regarding environmental degradation and economic analysis of degradation
- To inculcate the knowledge of economics of pollution and their management
- To demonstrate the understanding of cost benefit analysis of environmental resources
- To make the students to understand principles of economics of biodiversity

Course Outcomes :
After the completion of the course, the students will be able to know
- The information on sustainable development and economics of energy
- The information regarding environmental degradation and economic analysis of degradation
- The identification of economics of pollution and their management
- The cost benefit analysis of environmental resources
- The principles of economics of biodiversity

UNIT I

Sustainable Development: Introduction to sustainable development - Economy-Environment inter-linkages - Meaning of sustainable development - Limits to growth and the environmental Kuznets curve – The sustainability debate - Issues of energy and the economics of energy – Nonrenewable energy, scarcity, optimal resources, backstop technology, property research, externalities, and the conversion of uncertainty.

UNIT II

Environmental Degradation: Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation – Equi –marginal principle.

UNIT - III

Economics of Pollution: Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions – Managing pollution through market intervention: Taxes, subsidies and permits.

UNIT IV

Cost – Benefit Analysis: Economic value of environmental resources and environmental damage - Concept of Total Economic Value - Alternative approaches to valuation – Cost-benefit analysis and discounting.

UNIT V

Economics of biodiversity: Economics of biodiversity conservation - Valuing individual species and diversity of species -Policy responses at national and international levels. Economics of Climate Change – stern Report

Textbooks:
1. An Introduction to Environmental Economics by N. Hanley, J. Shogren and B. White Oxford University Press.(2001)
2. Blueprint for a Green Economy by D.W. Pearce, A. Markandya and E.B. Barbier Earthscan, London.(1989)

Reference Books:
1. Environmental Economics: An Elementary Introduction by R.K. Turner, D.W. Pearce and I. Bateman Harvester Wheatsheaf, London. (1994),
2. Economics of Natural Resources and the Environment by D.W. Pearce and R.K. Turner Harvester Wheat sheaf, London. (1990),
3. Environmental and Resource Economics: An Introduction by JNtichael S. Common and Michael Stuart 2ndEdition, Harlow: Longman.(1996),
4. Natural Resource and Environmental Economics by Roger Perman, Michael Common, Yue Ma and James Mc Gilvray 3rdEdition, Pearson Education.(2003),

Online Learning Resources:
https://nptel.ac.in/courses/109107171

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B.Tech III-II Sem	L	T	P	C
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(20A02605) SMART ELECTRIC GRID
(Open Elective Course-II)

Course Objectives:
- Understand recent trends in grids, smart grid architecture and technologies
- Analyze smart substations
- Apply the concepts to design smart transmission systems
- Apply the concepts to design smart distribution systems

Course Outcomes:
- Understand trends in Smart grids, needs and roles of Smart substations
- Design and Analyze Smart Transmission systems
- Design and Analyze Smart Distribution systems
- Analyze SCADA and DSCADA systems in practical working environment

UNIT I   INTRODUCTION TO SMART GRID
Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid

UNIT II   SMART GRID TECHNOLOGIES
Characteristics of Smart grid, Micro grids, Definitions, Drives, benefits, types of Micro grid, building blocks, Renewable energy resources, needs in smart grid, integration impact, integration standards, Load frequency control, reactive power control, case studies and test beds

UNIT III   SMART SUBSTATIONS
Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation

UNIT IV   SMART TRANSMISSION SYSTEMS
Energy Management systems, History, current technology, EMS for the smart grid, Synchro Phasor Measurement Units (PMUs), Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid

UNIT V   SMART DISTRIBUTION SYSTEMS
DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization, FDIR - Fault Detection Isolation and Service restoration (FDIR),faults, objectives and benefits, equipment, implementation

Textbooks:
1. Stuart Borlase, Smart Grids - Infrastructure, Technology and Solutions, CRC Press, 1e, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2e, 2013.

Reference Books:
1. A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and their Applications, Springer Edition, 2e, 2017.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2e, 2012.

Online Learning Resources:
1. https://onlinecourses.nptel.ac.in/noc22_ee82/preview

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B.Tech IV-I Sem　　　　　　　　　　　　　　　　　　　　　　　**L　T　P　C**
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(20A03605c) INTRODCUTION TO ROBOTICS
(Open Elective-II)

Course Objectives:
- Learn the fundamental concepts of industrial robotic technology.
- Apply the basic mathematics to calculate kinematic and dynamic forces in robot manipulator.
- Understand the robot controlling and programming methods.
- Describe concept of robot vision system

Course Outcomes:
After completing the course, the student will be able to,
- Explain fundamentals of Robots
- Apply kinematics and differential motions and velocities
- Demonstrate control of manipulators
- Understand robot vision
- Develop robot cell design and programming

UNIT I　　　Fundamentals of Robots

Introduction, definition, classification and history of robotics, robot characteristics and precision of motion, advantages, disadvantages and applications of robots. Introduction to matrix representation of a point in a space a vector in space, a frame in space, Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis.

UNIT II　　　Kinematics, Differential motions and velocities of robot

Kinematics of robot: Forward and inverse kinematics of robots- forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg(D-H) representation of forward kinematic equations of robots, the inverse kinematic of robots, degeneracy and dexterity, simple problems with D-H representation.

Differential motions and Velocities: Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

UNIT III　　　Control of Manipulators

Open- and close-loop control, the manipulator control problem, linear control schemes, characteristics of second-order linear systems, linear second-order SISO model of a manipulator joint, joint actuators, partitioned PD control scheme, PID control Scheme, computer Torque control, force control of robotic manipulators, description of force-control tasks, force control strategies, hybrid position/force control, impedance force/torque control.

UNIT IV　　　Robot Vision

Introduction, architecture of robotic vision system, image processing, image acquisition camera, image enhancement, image segmentation, imaging transformation, Camera transformation and calibrations, industrial applications of robot vision.

UNIT V　　　Robot Cell Design and Programming

Robot cell layouts-Robot centred cell, In-line robot cell, considerations in work cell design, work cell control, interlocks, error detection, work cell controller. methods of robot programming, WAIT, SIGNAL, and DELAY commands, Robotic languages, VAL system.

Textbooks:
1. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel,Nicholas G.Odrey , Industrial Robotics — Mc Graw Hill, 1986.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.

References:

1. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
2. H. Asada and J.J.E. Slotine, Robot Analysis and Control, 1st Edition Wiley- Interscience, 1986.
3. Robert J. Schillin, Fundamentals of Robotics: Analysis and control, Prentice-Hall Of India Pvt. Limited, 1996.

Online Learning Resources:

https://nptel.ac.in/courses/108105088
https://nptel.ac.in/courses/108105063
https://nptel.ac.in/courses/108105062
https://nptel.ac.in/courses/112104288

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-II Sem   **L   T   P   C**
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(20A05605a) PRINCIPLES OF OPERATING SYSTEMS
(Open Elective Course – II)

Course Objectives:
- Understand basic concepts and functions of operating systems
- Understand the processes, threads and scheduling algorithms.
- Expose the students with different techniques of handling deadlocks
- Provide good insight on various memory management techniques
- Explore the concept of file-system and its implementation issues

Course Outcomes:
- Demonstrate and understand of computer systems and operating systems functions
- Distinguish between process and thread and classify scheduling algorithms
- Solve synchronization and deadlock problems
- Compare various memory management schemes
- Explain file systems concepts and i/o management

UNIT I   Introduction to Computer and Operating system

Computer Types, Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Character Representation, Performance, Historical Perspective, Memory Locations and Addresses, Memory operations, Instructions and Instruction Sequencing, Addressing modes
Architecture Operating System Structure, Operations Process, Memory, Storage Management, Protection and Security Computing Environments Operating System Services User Operating System Interface System Calls Types System Programs OS Structure OS Generation System Boot.

UNIT II   Process, Threads and Scheduling

Process Concept Scheduling Operations on Processes Cooperating Processes Inter-Process Communication Threads - Multithreading Models -Thread Libraries- Threading Issues – Scheduling Criteria Scheduling Algorithms Algorithm Evaluation.

UNIT III   Process Synchronization and Deadlocks

The Critical-Section Problem Synchronization Hardware Mutex Locks -Semaphores Classic Problems of Synchronization Critical Regions Monitors Deadlocks System Model Deadlock Characterization Methods for Handling Deadlocks Deadlock Prevention Deadlock Avoidance Deadlock Detection Recovery from Deadlock.

UNIT IV   Memory Management

Introduction - Swapping Contiguous Memory Allocation Paging Segmentation- Structure of the Page Table - Virtual Memory- Background Demand Paging Copy on Write Page Replacement Allocation of Frames Thrashing.

UNIT V   Input/ Output and Files

Overview of Mass Storage Structure - Disk Structure - Disk Scheduling and Management-File System Interface File Concept - Access Methods -Directory and Disk Structure- Directory Implementation - Allocation Methods- I/O Systems I/O Hardware- Application I/O Interface - Kernel I/O Subsystem.

Textbooks:
1. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.
2. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating Systems Concepts, Ninth Edition, Wiley,2012.

Reference Books:
1. William Stallings, Operating Systems: Internals and Design Principles, Ninth Edition, Prentice-Hall, 2018.
2. Andrew Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2009.

Online Learning Resources:
https://nptel.ac.in/courses/106/106/106106144/
http://peterindia.net/OperatingSystems.html

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B.Tech III-II Sem   **L   T   P   C**

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(20A05605b) FOUNDATIONS OF MACHINE LEARNING
Open Elective Course– II

Course Objectives:
- Acquire theoretical knowledge on setting hypothesis for pattern recognition.
- Apply suitable machine learning techniques for data handling and to gain knowledge from it.
- Evaluate the performance of algorithms and to provide solution for various real-world applications.

Course Outcomes (CO):
After completion of the course, students will be able to
1. Understand the characteristics of machine learning strategies.
2. Apply various supervised learning methods to appropriate problems.
3. Identify and integrate more than one technique to enhance the performance of learning.
4. Create probabilistic and unsupervised learning models for handling unknown pattern.
5. Analyse the co-occurrence of data to find interesting frequent patterns.
6. Pre-process the data before applying to any real-world problem and can evaluate its performance

UNIT - I   **Introduction to Machine Learning**   Lecture 8Hrs
What is machine learning, learning associations, classification, regression, unsupervised learning, reinforcement learning
Supervised Learning: learning a class from examples, learning multiple classes, model selection and generalization

UNIT - II   **Parametric, Non-Parametric methods**   Lecture 9Hrs
Parametric Methods: Introduction, maximum likelihood estimation, evaluating an estimator, parametric classification, regression, model selection procedures
Nonparametric Methods: Introduction, nonparametric density estimation: histogram estimator, kernel estimator, k-nearest neighbour estimator

UNIT - III   **Multivariate Methods**   Lecture 9Hrs
Multivariate Methods: Multivariate data, parameter estimation, estimation of missing values, multivariate normal distribution, multi variate classification

UNIT - IV   **Dimensionality Reduction, Clustering**   Lecture 8Hrs
Dimensionality Reduction: Introduction, subset selection, principal component analysis, singular value decomposition and matrix factorization
Clustering: Mixture densities, k-means clustering, expectation-maximization algorithm, mixtures of latent variables

UNIT - V   **Deep Learning**   Lecture 8Hrs
Deep Learning: Introduction, train multiple hidden layers, improving training convergence, regularization, convolution layers, tuning the network structure, learning sequences.

Textbooks:
1. EthemAlpaydin, Introduction to Machine Learning, Fourth Edition, MIT Press, Fourth Edition, 2020
2. MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012

Reference Books:
1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, CRC Press, 2015.
3. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.

Online Learning Resources:
1. https://bloomberg.github.io/foml/
2. https://d1rkab7tlqy5f1.cloudfront.net/EWI/Over%20de%20faculteit/Afdelingen/Intellig ent%20Systems/Pattern%20Recognition%20Laboratory/PR/Reading%20Group/Founda tions_of_Machine_Learning.pdf

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (IT)– III-II Sem	L	T	P	C
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(20A05605c) DATA ANALYTICS USING R
(Open Elective-II)

Course Objectives:
- Facilitate students to understand R programming
- Help students to gain a basic understanding of Data Analytics
- Inculcate working knowledge of plotting

Course Outcomes:
- Identify and execute basic syntax and programs in R
- Perform the Matrix operations using R built in functions
- Apply nonnumeric values in vectors
- Create the list and data frames
- Exploit the graph using ggplot2.

UNIT I   **Introduction to R Programming**

History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes- Comments- Installing and Loading R Packages- Help Files and Function Documentation-Saving Work and Exiting R- Conventions- R for Basic Math- Arithmetic- Logarithms and Exponentials - E-Notation - Assigning Objects – Vectors - Creating a Vector-Sequences, Repetition, Sorting and Lengths – Subsetting and Element Extraction -Vector – Oriented Behavior.

UNIT II   **Matrices and Arrays**

Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions-Subsetting- Row, Column, and Diagonal Extractions- Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication-Matrix Inversion-Multidimensional Arrays-Subsets, Extractions and Replacements.

UNIT III   **Non-Numeric values**

Logical Values- Relational Operators- Characters- Creating a String- Concatenation- Escape Sequences-Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels-Combining and Cutting.

UNIT IV   **Lists and Data frames**

List of Objects - Component Access – Naming – Nesting - Data Frames - Adding Data Columns and Combining Data Frames – Logical Record Subsets – Some Special Values – Infinity – NaN – NA - NULL – Attributes – Object - Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions

UNIT V   **Basic Plotting**

Using plot with Coordinate Vectors-Graphical Parameters-Automatic Plot Types-Title and Axis Labels-Color-Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an ExistingPlot-ggplot2 Package-Quick Plot with qplot-Setting Appearance Constants with Geoms— Reading and Writing Files- R-Ready Data Sets- Contributed Data Sets- Reading in External Data Files- Writing Out Data Files and Plots-AdHoc Object Read/Write Operations

Textbooks:
1. Tilman M. Davies, "The Book of R-A First Programming, Statistics" Library of Congress Cataloging-in-Publication Data, 2016.

Reference Books:
1. Hadley Wickham, Garrett Grolemund,"R for Data Science",Oreilly Publication,2017.
2. Roger D. Peng, "R Programming for Data Science" Lean Publishing, 2016.
3. Steven Keller, "R ProgrammingforBeginners",CreateSpaceIndependentPublishingPlatform2016.

Online Learning Resources:
1. https://www.coursera.org/learn/data-analysis-r
2. https://www.careers360.com/courses-certifications/data-analysis-with-r-courses-brpg

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-II Sem

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(20A27605) FOOD REFRIGERATION AND COLD CHAIN MANAGEMENT
OPEN ELECTIVE II

Course Objectives:
- To know the equipment available to store perishable items for a long time
- To understand to increase the storage life of food items

Course Outcomes

By the end of the course, the students will
- Understand various principles and theories involved in refrigeration systems
- Understand the different equipment useful to store the food items for a long period.
- Understand how to increase the storage life of food items

UNIT I

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization; Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures;

UNIT II

Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry vs wet compression, throttling vs isentropic expansion), representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling;

UNIT III

Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle; Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve;

UNIT IV

Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice; Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations; Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display;

UNIT V

Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling load calculations: Load sources, product cooling, conducted heat, convicted heat, internal heat sources, heat of respiration, peak load; etc.

Textbooks:
1. Arora, C. P. "Refrigeration and Air Conditioning". Tata MC Graw Hill Publishing Co.Ltd., New Delhi. 1993.

References:
1. Adithan, M. and Laroiya, S. C. "Practical Refrigeration and Air Conditioning". Wiley Estern Ltd., New Delhi 1991

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(20A54701) WAVELET TRANSFORMS AND ITS APPLICATIONS
(Open Elective-II)

Course Objectives:
This course provides the students to understand Wavelet transforms and its applications.

Course Outcomes:
- Understand wavelets and wavelet expansion systems.
- Illustrate the multi resolution analysis ad scaling functions.
- Form fine scale to coarse scale analysis.
- Find the lattices and lifting.
- Perform numerical complexity of discrete wavelet transforms.
- Find the frames and tight frames using fourier series.

UNIT I   Wavelets
Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets - effectiveness of Wavelet Analysis -The Discrete Wavelet Transform the Discrete-Time and Continuous Wavelet Transforms.

UNIT II   A Multiresolution Formulation of Wavelet Systems
Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

UNIT III   Filter Banks and the Discrete Wavelet Transform
Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - -Different Points of View.

UNIT IV   Time-Frequency and Complexity
Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

UNIT V   Bases and Matrix Examples
Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

Textbooks:
1. C. Sidney Burrus, Ramesh A. Gopinath, "Introduction to Wavelets and Wavelets Transforms",Prentice Hall, (1997).
2. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999).

Reference Books:
1. Raghuveer Rao, "Wavelet Transforms", Pearson Education, Asia.

Online Learning Resources:
https://www.slideshare.net/RajEndiran1/introduction-to-wavelet-transform-51504915

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(20A56701) PHYSICS OF ELECTRONIC MATERIALS AND DEVICES
(Open Elective-II)

Course Objectives:
- To impart the fundamental knowledge on various materials, their properties and applications.
- To provide insight into various semiconducting materials, and their properties.
- To enlighten the characteristic behavior of various semiconductor devices.
- To provide the basics of dielectric and piezoelectric materials and their properties.
- To explain different categories of magnetic materials, mechanism and their advanced applications.

Course Outcome: At the end of the course the student will be able
- To understand the fundamentals of various materials.
- To exploit the physics of semiconducting materials
- To familiarize with the working principles of semiconductor-based devices.
- To understand the behaviour of dielectric and piezoelectric materials.
- To identify the magnetic materials and their advanced applications.

UNIT I   Fundamentals of Materials Science
Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Basic idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RT and glow discharge).

UNIT II   Semiconductors
Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

UNIT III Physics of Semiconductor devices
Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Construction and working principles of: Light emitting diodes, Heterojunctions, Transistors, FET and MOSFETs.

UNIT IV Dielectric Materials and their applications:
Introduction, Dielectric properties, Electronic polarizability and susceptibility, Dielectric constant and frequency dependence of polarization, Dielectric strength and dielectric loss, Piezoelectric properties.

UNIT V Magnetic Materials and their applications
Introduction, Magnetism & various contributions to para and dia magnetism, Ferro and Ferri magnetism and ferrites, Concepts of Spin waves and Magnons, Anti-ferromagnetism, Domains and domain walls, Coercive force, Hysteresis, Nano-magnetism, Super-paramagnetism – Properties and applications.

Textbooks
1. Principles of Electronic Materials and Devices- S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2007.
2. Electronic Components and Materials- Grover and Jamwal, Dhanpat Rai and Co.

Reference Books:
1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning, 6th edition
2. Electronic Materials Science- Eugene A. Irene, , Wiley, 2005
3. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd., , 2nd Edition,2011
4. A First Course In Material Science- by Raghvan, McGraw Hill Pub.
5. The Science and Engineering of materials- Donald R.Askeland, Chapman& Hall Pub.

NPTEL courses linkshttps://nptel.ac.in/courses/113/106/113106062/
https://onlinecourses.nptel.ac.in/noc20_mm02/preview,
https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-mm07

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech III-II Sem   L   T   P   C

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(20A51701) CHEMISTRY OF POLYMERS AND ITS APPLICATIONS

Course Objectives:
- To understand the basic principles of polymers
- To synthesize the different polymeric materials and their characterization by various instrumental methods.
- To impart knowledge to the students about fundamental concepts of Hydro gels of polymer networks, surface phenomenon by micelles
- To enumerate the applications of polymers in engineering

Course Outcome
- At the end of the course, the student will be able to:
- Understand the state of art synthesis of Polymeric materials
- Understand the hydro gels preparation, properties and applications in drug delivery system.
- Characterize polymers materials using IR, NMR, XRD.
- Analyze surface phenomenon fo micelles and characterise using photoelectron spectroscopy, ESCA and Auger spectroscopy

UNIT I : Polymers-Basics and Characterization

Basic concepts: monomers, repeat units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: condensation, addition, radical chain, ionic and coordination and copolymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution Measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

Unit II : Synthetic Polymers

Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization.

Preparation and significance, classification of polymers based on physical properties, Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications.

Preparation of Polymers based on different types of monomers, Olefin polymers, Diene polymers, nylons, Urea - formaldehyde, phenol - formaldehyde and melamine Epoxy and Ion exchange resins. Characterization of polymers by IR, NMR, XRD.

UNIT III : Natural Polymers & Modified cellulosics

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEAK.

Learning Outcomes:

UNIT IV: Hydrogels of Polymer networks and Drug delivery

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

Introduction to drug systems including, drug development, regulation, absorption and disposition, routes of administration and dosage forms. Advanced drug delivery systems and controlled release.

UNIT V : Surface phenomena

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

References :

1. A Text book of Polymer science, Billmayer
2. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B.Miller, Prentice Hall
4. Polymer Chemistry – G.S.Mishra
5. Polymer Chemistry – Gowarikar
6. Physical Chemistry –Galston
7. Drug Delivery- Ashim K. Misra

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(20A01704) COST EFFECTIVE HOUSING TECHNIQUES
(Open Elective Course - III)

Course Objectives:
- To understand the requirements of structural safety for future construction.
- To know about the housing scenario, housing financial systems land use and physical
- planning for housing and housing the urban poor
- To know the traditional practices of rural housing
- To know the different innovative cost effective construction techniques
- To know the alternative building materials for low cost housing.

Course Outcomes :
- To know the repair and restore action of earthquake damaged non engineered buildings and ability to understand the requirements of structural safety for future construction
- To know about the housing scenario, housing financial systems land use and physical planning for housing and housing the urban poor
- Apply the traditional practices of rural housing
- Understand the different innovative cost effective construction techniques
- Suggest the alternative building materials for low cost housing

UNIT I
a) **Housing Scenario :**Introducing - Status of urban housing - Status of Rural Housing
b) **Housing Finance**: Introducing - Existing finance system in India - Government role as facilitator - Status at Rural Housing Finance - Impedimently in housing finance and related issues
c) **Land use and physical planning for housing :**Introduction - Planning of urban land - Urban land ceiling and regulation act - Efficiency of building bye lass - Residential Densities
d) **Housing the urban poor :**Introduction - Living conditions in slums - Approaches and strategies for housing urban poor

UNIT II
Development and adoption of low cost housing technology
Introduction - Adoption of innovative cost effective construction techniques - Adoption of precast elements in partial prefatroices - Adopting of total prefactcation of mass housing in India- General remarks on pre cast rooting/flooring systems -Economical wall system - Single Brick thick loading bearing wall - 19cm thick load bearing masonry walls - Half brick thick load bearing wall – Fly-ash gypsum thick for masonry - Stone Block masonry - Adoption of precast R.C. plank and join system for roof/floor in the building

UNIT III
Alternative building materials for low cost housing
Introduction - Substitute for scarce materials – Ferro-cement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - alternative building maintenance
Low cost Infrastructure services:
Introduce - Present status - Technological options - Low cost sanitation - Domestic wall - Water supply, energy

UNIT IV
Rural Housing: Introduction traditional practice of rural housing continuous - Mud Housing technology Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs

UNIT V

Housing in Disaster prone areas:

Introduction – Earthquake - Damages to houses - Traditional prone areas - Type of Damages and Railways of non-engineered buildings - Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions. Requirement's of structural safety of thin precast roofing units against Earthquake forces Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety

Textbooks:

1. Building materials for low – income houses – International council for building research studies and documentation.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Low cost Housing – G.C. Mathur by South Asia Books

Reference Books:

1. Properties of concrete – Neville A.m. Pitman Publishing Limited, London.
2. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences 1963.
3. Modern trends in housing in developing countries – A.G. Madhava Rao, D.S. Rama chandra Murthy &G.Annamalai. E. & F. N. Spon Publishers

Online Learning Resources:

https://nptel.ac.in/courses/124107001

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem   **L T P C**
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(20A02704) IoT APPLICATIONS IN ELECTRICAL ENGINEERING
(Open Elective Course – III)

Course Objectives:
- Understand basics of Internet of Things and Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process
- Analyze motion less and motion detectors in IoT applications
- Understand about Analyze applications of IoT in smart grid
- Apply the concept of Internet of Energy for various applications

Course Outcomes:
- Understand the concept of IoT in Electrical Engineering
- Analyze various types of motionless sensors and various types of motion detectors
- Apply various applications of IoT in smart grid
- Design future working environment with Energy internet

UNIT I   SENSORS
Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

UNIT II   OCCUPANCY AND MOTION DETECTORS
Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors

UNIT III   MEMS
Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

UNIT IV   IoT FOR SMART GRID
Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

UNIT V   INTERNET of ENERGY (IoE)
Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid

Textbooks:
1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004
2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1st Edition, Mc Grawhill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, From Smart grid to Internet of Energy, 1st Edition, Academic Press, 2019

Reference Books:
1. Raj Kumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management, 1st Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things, Wiley, 2019

Online Learning Resources:
1. https://onlinecourses.nptel.ac.in/noc22_cs96/preview
2. https://nptel.ac.in/courses/108108123
3. https://nptel.ac.in/courses/108108179

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem
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(20A03704) PRODUCT DESIGN AND DEVELOPMENT
(Open Elective-III)

Course Objectives:
- To Design products creatively while applying engineering design principles.
- To Apply principles of human factors, ethics and environmental factorsin product design.
- To Work in groups or individually in their pursuit of innovative product design.
- To implement value design for optimum product cost.

Course Outcomes: After successful completion of the course, the student will be able to
- Apply knowledge of basic science and engineering fundamentals
- Undertake problem identification, formulation and solution
- Understanding of the principles of sustainable design and development
- Understanding of professional and ethical responsibilities and commitment to them

UNIT I   Product Development Process
General problem-solving process - Flow of Work during the process of designing - Activity Planning Timing and scheduling, Planning Project and Product Costs - Effective Organization Structures - Interdisciplinary Cooperation, Leadership and Team behaviour.

UNIT II   Task Clarification
Importance of Task Clarification - Setting up a requirements list - Contents, Format, Identifying the requirements, refining and extending the requirements, Compiling the requirements list, Examples. Using requirements lists - Updating, Partial requirements lists, Further uses - Practical applications of requirements lists.

UNIT III   Conceptual Design
Steps in Conceptual Design. Abstracting to identify the essential problems - Aim of Abstraction, Broadening the problem. Formulation, Identifying the essential problems from the requirements list, establishing functions structures, Overall function, Breaking a function down into sub-functions. Developing working structures - Searching for working principles, Combining Working Principles, Selecting Working Structures, Practical Application of working structures. Developing Concepts - Firming up into principle solution variants, Evaluating principle solution variants, Practical Applications of working structures. Examples of Conceptual Design - One Handed Household Water Mixing Tap, Impulse - Loading Test Rig.

UNIT IV   Embodiment Design
Steps of Embodiment Design, Checklist for Embodiment Design Basic rules of Embodiment Design Principles of Embodiment Design - Principles of Force Transformations, Principles of Division of Tasks, Principles of Self-Help, Principles of Stability and Bi-Stability, Principles of Fault-Free Design Guide for Embodiment Design - General Considerations, Design to allow for expansion, Design to allow for creep and relaxation, Design against Corrosion, Design to minimize wear, Design to Ergonomics, Design for Aesthetics, Design for Production, Design for Assembly, Design for Maintenance, Design for Recycling, Design for Minimum risk, Design to standards. Evaluation of Embodiment Designs.

UNIT V   Mechanical Connections, Mechatronics And Adaptronics:
Mechanical Connections - General functions and General Behaviour, Material connections, From Connections, Force connections, Applications. Mechatronics - General Architecture and Terminology, Goals and Limitations, Development of Mechatronic Solution, Examples. Adaptronics - Fundamentals and Terminology, Goals and Limitations, Development of Adaptronics Solutions, Examples.

Textbooks:
1. G.Paul; W. Beitzetal, Engineering Design, Springer International Education, 2010.
2. Kevin Otto: K. Wood, Product Design And Development, Pearson Education, 2013.

References:
1. Kenith B. Kahu, Product Planning Essentials, Yes dee Publishing, 2011.
2. K.T. Ulrich, Product Design and Development, TMH Publishers, 2011.

Online Learning Resources:
- https://nptel.ac.in/courses/112107217
- https://nptel.ac.in/courses/112104230
- https://www.youtube.com/watch?v=mvaqZAFdL6U
- https://nptel.ac.in/courses/107103082
- https://quizxp.com/nptel-product-design-and-manufacturing-assignment-5/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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(20A05704) WEB TECHNOLOGIES
(Open Elective-III)

Course Objectives:
The course is designed to Introduce the key technologies that have been developed as part of the birth and maturation of the World Wide Web.

Course Outcomes:
- Understand the Web essentials.
- Develop web pages using XHTML
- Apply style to web pages using CSS
- Write scripts for client side
- Develop and transform XML documents.

UNIT I   Web Essentials: Clients, Servers, and Communication
The Internet, Basic Internet protocols, WWW, HTTP request message, HTTP response message, Web clients, Web Servers, Case study.

UNIT II   Markup Languages: XHTML 1.0
An introduction to HTML, Basic XHTML syntax and semantics, fundamental HTML elements, Relative URLs, Lists, Tables, Frames, Forms, Defining XHTML's abstract syntax, Creating HTML documents.

UNIT III   Cascading Style Sheets
Introduction, features, core syntax, style sheets and HTML, style rule cascading and inheritance, text properties, Box model, normal flow box layout, beyond the normal flow, lists, tables, cursor styles.

UNIT IV   Client-side programming: JavaScript
Basic syntax, variables and data types, statements, operators, literals, functions, objects, Arrays, built-in objects, JavaScript debuggers.

UNIT V   Representing Web Data: XML
Documents and vocabularies, Versions and declaration, Namespaces, Ajax, DOM and SAX parsers, transforming XML documents, XPath, XSLT, Displaying XML documents in Web browsers.

Textbooks:
1. J.C. Jackson, Web technologies: A computer science perspective, Pearson.

Reference Books:
1. Sebesta, Programming world wide web, Pearson.
2. Dietel and Nieto , Internet and World Wide Web – How to program, Pearson Education
3. Chris Bates , Web Programming, building internet applications, 2nd edition, WILEY, Dreamtech

Online Learning Resources:
http://getbootstrap.com/
https://www.w3schools.com/whatis/
https://nptel.ac.in/courses/106105084

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(20A05704b) VR & AR FOR ENGINEERS
(Open Elective Course – III)

Course Objectives:
- Introduce to the design of visualization tools
- Demonstrate Virtual reality
- Learn Virtual reality animation and 3D Art optimization
- Understand the foundational principles describing how hardware, computer vision algorithms function
- Explore the history of spatial computing and design interactions

Course Outcomes:
- Apply VR/MR/AR in various fields in industry
- Design Data visualization tools
- Design audio and video interaction paradigms
- Apply technical and creative approaches to make successful applications and experiences.
- Explain how the humans interact with computers

UNIT I
Computer generated worlds: what is augmented reality? what is virtual reality?
Understanding virtual space: defining visual space and content, defining position and orientation in three dimensions, navigation
The Mechanics of Sight: the visual path way, spatial vision, and Depth Cues.
Component Technologies of Head mounted Displays: Display fundamentals, related terminology and concepts, optical Architectures.

UNIT II
Augmented Displays: Binocular augmenting displays, Monocular augmenting displays.
Fully immersive Displays: PC-Console driven displays, smartphone based displays, CAVES and Walls, Hemispheres and Domes.
The Mechanics of hearing: Defining sound, the auditory pathway, sound cues and localization, the vestibular system.
Audio displays: Conventional audio

UNIT III
The Mechanics of Feeling: The Science of feeling, Anatomy and Composition of the skin.
Tactile and force feedback Devices: Haptic illusions, tactile feedback devices, Force feedback devices.
Sensors for tracking Position, and orientation and motion: introduction to sensor technologies, optical trackers, beacon trackers, electromagnetic trackers, inertial sensors, acoustic sensors.
Devices to enable navigation and interaction: 2D vs 3D interaction and navigation, the importance of a manual interface, hand and gesture tracking, whole body tracking, gaming and entertainment interfaces, navigating with your mind.

UNIT IV
Gaming and Entertainment: Virtual reality and the arts, gaming, immersive video/ cinematic virtual reality.
Architecture and Construction: Artificial spaces, architectural design: Manage group architectures, Construction management, real estate sales applications, architectural acoustics.
Science and engineering: Simulate and innovate, naval architecture and marine engineering, automotive engineering, aerospace engineering, nuclear engineering and manufacturing.

Health and medicine: advancing the field of medicine, training applications, treatment applications.

UNIT V

Aerospace and Defence: Flight simulation and training, mission planning and rehearsal, dismounted soldier situational awareness, advanced cockpit avionics, space operations.

Education: Tangible skills education, theory, knowledge acquisition and concept formation.

Information control and big data visualization: What is big data?, big data analytics and human vision.

Telerobotics and Telepresence: Defining Telerobotics and Telepresence, space applications and robonaut, undersea applications, Terrestrial and airborne applications.

Textbooks:

1. Steve Aukstakalnis, "Practical Augmented Reality", Pearson Education, 2017.

Reference Books:

1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, "Creating Augmented& Virtual Realities", O'REILLY

Online Learning Resources:

1. https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues
2. https://www.coursera.org/learn/ar

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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(20A05704c) SOFTWARE ENGINEERING
(Open Elective Course – III)

Course Objectives:
- To learn the basic concepts of software engineering and life cycle models
- To explore the issues in software requirements specification and enable to write SRS documents for software development problems
- To elucidate the basic concepts of software design and enable to carry out procedural and object oriented design of software development problems
- To understand the basic concepts of black box and white box software testing and enable to design test cases for unit, integration, and system testing
- To reveal the basic concepts in software project management

Course Outcomes (CO):
After completion of the course, students will be able to
- Obtain basic software life cycle activity skills.
- Design software requirements specifications for given problems.
- Implement structure, object oriented analysis and design for given problems.
- Design test cases for given problems.
- Apply quality management concepts at the application level.

UNIT - I	**Basic concepts in software engineering and software project management**	Lecture 8Hrs

Basic concepts: abstraction versus decomposition, evolution of software engineering techniques, Software development life cycle (SDLC) models: Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, RAD model, Agile models, software project management: project planning, project estimation, COCOMO, Halstead's Software Science, project scheduling, staffing, Organization and team structure, risk management, configuration management.

UNIT - II	**Requirements analysis and specification**	Lecture 8Hrs

The nature of software, The Unique nature of Webapps, Software Myths, Requirements gathering and analysis, software requirements specification, Traceability, Characteristics of a Good SRS Document, IEEE 830 guidelines, representing complex requirements using decision tables and decision trees, overview of formal system development techniques, axiomatic specification, algebraic specification.

UNIT - III	**Software Design**	Lecture 9Hrs

Good Software Design, Cohesion and coupling, Control Hierarchy: Layering, Control Abstraction, Depth and width, Fan-out, Fan-in, Software design approaches, object oriented vs. function oriented design. Overview of SA/SD methodology, structured analysis, Data flow diagram, Extending DFD technique to real life systems, Basic Object oriented concepts, UML Diagrams, Structured design, Detailed design, Design review, Characteristics of a good user interface, User Guidance and Online Help, Mode-based vs Mode-less Interface, Types of user interfaces, Component-based GUI development, User interface design methodology: GUI design methodology.

UNIT - IV	**Coding and Testing**	Lecture 9Hrs

Coding standards and guidelines, code review, software documentation, Testing, Black Box Testing, White Box Testing, debugging, integration testing, Program Analysis Tools, system testing, performance testing, regression testing, Testing Object Oriented Programs.

UNIT - V	**Software quality, reliability, and other issues**	Lecture 9Hrs

Software reliability, Statistical testing, Software quality and management, ISO 9000, SEI capability maturity model (CMM), Personal software process (PSP), Six sigma, Software quality metrics, CASE and its scope, CASE environment, CASE support in software life cycle, Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basic issues in any reuse program, Reuse approach, Reuse at organization level.

Textbooks:
1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
2. Pressman R, "Software Engineering- Practioner Approach", McGraw Hill.

Reference Books:

4. Somerville, "Software Engineering", Pearson 2.
5. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill.
6. JalotePankaj, "An integrated approach to Software Engineering", Narosa

Online Learning Resources:

https://nptel.ac.in/courses/106/105/106105182/

http://peterindia.net/SoftwareDevelopment.html

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B.Tech IV-I Sem

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(20A27704) HUMAN NUTRITION
(OPEN ELECTIVE-III)

Course Objectives:
- To get knowledge on Concepts and content of nutrition source and metabolic functions.
- To know about Balanced diets for various groups; Diets and disorders, recommended dietary allowances
- To learn about Epidemiology of under nutrition and over nutrition.
- To understand Nutrition and immunity.

Course Outcomes:
- To study the Salient features of Concepts and content of nutrition, Malnutrition, Nutrition education
- Assessment of nutritional status, disorders Food fad and faddism.

UNIT I

Concepts and content of nutrition: Nutrition agencies; Nutrition of community; Nutritional policies and their implementation; Metabolic function of nutrients. Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings;

UNIT II

Water and energy balance: Water intake and losses; Basal metabolism- BMR; Body surface area and factors affecting BMR Formulation of diets: Classification of balanced diet; Balanced diets for various groups; Diets and disorders. Recommended dietary allowances (RDA); For various age group; According physiological status; Athletic and sports man; Geriatric persons

UNIT III

Malnutrition: Type of Malnutrition; Multi-factorial causes; Epidemiology of under nutrition and over nutrition; Nutrition and immunity.

UNIT IV

Nutrition education Assessment of nutritional status: Diet surveys; Anthropometry; Clinical examination; Biochemical assessment; Additional medical information

UNIT V

Blood constituents; Hormone types; Miscellaneous disorders Food fad and faddism. Potentially toxic substances in human food.

Textbooks:
1. Swaminathan M, Advanced Text Book on Food & Nutrition (Volume I and II) , The Bangalore Printing and Publishing Co.Ltd, Bangalore. 2006
2. Stewart Truswell, ABC of Nutrition (4th edition) , BMJ Publishing Group 2003, ISBN 0727916645.
3. Martin Eastwood, Principles of Human Nutrition , Blackwell Publishing, Boca Rotan

Reference:
1. Mike Lean and E. Combet ,Barasi's Human Nutrition – A Health Perspective , Second Edition CRC Press, London
2. Introduction to Human Nutrition, Micheal J. G., Susan A.L. Aedin C. and Hester H.V, Wiley-Blackwell Publication, UK 2009 , ISBN 9781405168076
3. Bogert L.J., Goerge M.B, Doris H.C., Nutrition and Physical Fitness, W.B. Saunders Company, Toronto, Canada

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B.Tech IV-I Sem   **L   T   P   C**
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(20A54702) NUMERICAL METHODS FOR ENGINEERS
(OPEN ELECTIVE-III)

Course Objectives:
This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.

Course Outcomes:
- Apply numerical methods to solve algebraic and transcendental equations.
- Understand fitting of several kinds of curves.
- Derive interpolating polynomials using interpolation formulae.
- Solve differential and integral equations numerically.

UNIT I   Solution of Algebraic & Transcendental Equations
Introduction-Bisection Method-Iterative method-Regula falsi method-Newton Raphson method.
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

UNIT II   Curve Fitting
Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves.

UNIT III   Interpolation
Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae
Gauss forward and backward formula, Stirling's formula, Bessel's formula

UNIT IV   Numerical Integration
Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule

UNIT V   Solution of Initial value problems to Ordinary differential equations

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

Textbooks:
1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE.
3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India

Reference Books:
1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

Online Learning Resources:
https://slideplayer.com/slide/8588078/

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(20A56702) SENSORS AND ACTUATORS FOR ENGINEERING APPLICATIONS
(OPEN ELECTIVE-III)

Course Objectives:
- To provide exposure to various kinds of sensors and actuators and their engineering applications.
- To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
- To enlighten the operating principles of various sensors and actuators
- To educate the fabrication of sensors
- To identify the required sensor and actuator for interdisciplinary application

Course Outcomes:
- To recognize the need of sensors and actuators
- To understand working principles of various sensors and actuators
- To identify different type of sensors and actuators used in real life applications
- To exploit basics in common methods for converting a physical parameter into an electrical quantity
- To make use of sensors and actuators for different applications

UNIT I Introduction to Sensors and Actuators
Sensors: Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Materials used and their fabrication process: Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching.
Actuators: Functional diagram of actuators, Types of actuators and their basic principle of working: Hydraulic, Pneumatic, Mechanical, Electrical, Magnetic, Electromagnetic, piezo-electric and piezo-resistive actuators, Simple applications of Actuators.

UNIT II Temperature and Mechanical Sensors
Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors
Mechanical Sensors: Types of Mechanical sensors and their basic principle of working: Force sensors: strain gauges, tactile sensors, Pressure sensors: semiconductor, piezoresistive, capacitive, VRP.

UNIT III Optical and Acoustic Sensors
Optical Sensors: Basic principle and working of: Photodiodes, Phototransistors and Photo-resistors based sensors, Photomultipliers, Infrared sensors: thermal, PIR, thermopiles
Acoustic Sensors: Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones.

UNIT IV Magnetic, Electromagnetic Sensors and Actuators
Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magneto-strictive sensors and actuators, Voice coil actuators (speakers and speaker-like actuators).

UNIT V Chemical and Radiation Sensors
Chemical Sensors: Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.
Radiation Sensors: Principle and working of Ionization detectors, Scintillation detectors, Geiger-Mueller counters, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)

Textbooks:

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015
2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

Reference Books:

1. Sensors and Transducers- D.Patranabhis, Prentice Hall of India (Pvt) Ltd. 2003
2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999
3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.
4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.
5. Principles of Industrial Instrumentation By D. Patranabhis

NPTEL courses links

https://onlinecourses.nptel.ac.in/noc21_ee32/preview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem   **L T P C**
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(20A51702) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS
(OPEN ELECTIVE-III)

Course Objectives:
- To understand synthetic principles of Nanomaterials by various methods
- To characterize the synthetic nanomaterials by various instrumental methods
- To enumerate the applications of nanomaterials in engineering

Course Outcomes:
- Understand the state of art synthesis of nano materials
- Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
- Analyze nanoscale structure in metals, polymers and ceramics
- Analyze structure-property relationship in coarser scale structures
- Understand structures of carbon nano tubes

UNIT I
Introduction: Scope of nanoscience and nanotecnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.
Synthetic Methods**:** Bottom-Up approach**:** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

UNIT II
Top-Down approach: Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling.

UNIT III
Techniques for characterization: Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

UNIT IV
Studies of Nano-structured Materials: Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self- assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

UNIT V
Engineering Applications of Nanomaterials

Textbooks:
1. NANO: The Essentials: T Pradeep, MaGraw-Hill, 2007.
2. Textbook of Nanoscience and nanotechnology: B S Murty, P Shankar, BaldevRai,   BB Rath and James Murday, Univ. Press, 2012.

References:
1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin& Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Guozhong Cao, Imperial College Press, 2007.
3. Nanomaterials Chemistry, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech IV-I Sem	L	T	P	C
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(20A01705) HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT PRACTICES
(Open Elective Course-IV)

Course Objectives:
- To understand safety, health and environmental management.
- To be familiar with hazard classification and assessment, hazard evaluation and hazard . control, environmental issues and management
- To get exposed to accidents modeling, accident investigation and reporting, concepts of. HAZOP and PHA
- To be familiar with safety measures in design and process operations.
- To get exposed to risk assessment and management, principles and methods

Course Outcomes :
- To understand safety, health and environmental management.
- To be familiar with hazard classification and assessment, hazard evaluation and hazard.
- To get exposed to accidents modelling, accident investigation and reporting control, environmental issues and management
- To get concepts of HAZOP and PHA.
- To be familiar with safety measures in design and process operations.

UNIT I

Introduction to safety, health and environmental management - Basic terms and their definitions - Importance of safety - Safety assurance and assessment - Safety in design and operation - Organizing for safety.

UNIT II

Hazard classification and assessment - Hazard evaluation and hazard control.
Environmental issues and Management - Atmospheric pollution - Flaring and fugitive release - Water pollution - Environmental monitoring - Environmental management.

UNIT III

Accidents modelling - Release modelling - Fire and explosion modelling - Toxic release and dispersion Modelling

UNIT IV

Accident investigation and reporting - concepts of HAZOP and PHA.
Safety measures in design and process operations - Inserting, explosion, fire prevention, sprinkler systems.

UNIT V

Risk assessment and management - Risk picture - Definition and characteristics - Risk acceptance criteria - Quantified risk assessment - Hazard assessment - Fatality risk assessment - Risk management principles and methods.

Textbooks:
1. Process Safety Analysis, by Skelton. B, Gulf Publishing Company, Houston, 210pp., 1997.
2. Risk Management with Applications from Offshore Petroleum Industry, by TerjeAven and Jan Erik Vinnem, Springer, 200pp., 2007.

Reference Books:
1. Introduction to Safety and Reliability of Structures, by Jorg Schneider
2. Structural Engineering Documents Vol. 5, International Association for Bridge and Structural Engineering (IABSE), 138pp., 1997.
3. Safety and Health for Engineers, by Roger L. Brauer, John Wiley and Sons Inc. pp. 645-663, 2006.
4. Health, Safety and Environmental Management in Offshore and Petroleum Engineering, Srinivasan Chandrasekaran, John Wiley and Sons, 2016.

Online Learning Resources:
https://nptel.ac.in/courses/114106017

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B.Tech IV-I Sem   **L   T   P   C**
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(20A02705) RENEWABLE ENERGY SYSTEMS
(Open Elective Course – IV)

Course Objectives:
- Understand various sources of Energy and the need of Renewable Energy Systems.
- Understand the concepts of Solar Radiation, Wind energy and its applications.
- Analyze solar thermal and solar PV systems
- Understand the concept of geothermal energy and its applications, biomass energy, the concept of Ocean energy and fuel cells.

Course Outcomes:
- Understand various alternate sources of energy for different suitable application requirements
- Understand the concepts of solar energy generation strategies and wind energy system
- Analyze Solar and Wind energy systems
- Understand the basics of Geothermal Energy Systems, various diversified energy scenarios of ocean, biomass and fuel cells

UNIT I   SOLAR ENERGY
Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

UNIT II   PV ENERGY SYSTEMS
Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems.

UNIT III   WIND ENERGY
Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

UNIT IV   GEOTHERMAL ENERGY
Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

UNIT V   MISCELLANEOUS ENERGY TECHNOLOGIES
Ocean Energy: Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.
Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration
Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

Textbooks:
1. Stephen Peake, "Renewable Energy Power for a Sustainable Future", Oxford International Edition, 2018.
2. G. D. Rai, "Non-Conventional Energy Sources", 4th Edition, Khanna Publishers, 2000.

Reference Books:

1. S. P. Sukhatme, "Solar Energy",3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
2. B H Khan , " Non-Conventional Energy Resources", 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
3. S. Hasan Saeed and D.K.Sharma,"Non-Conventional Energy Resources",3rd Edition, S.K.Kataria& Sons, 2012.
4. G. N. Tiwari and M.K.Ghosal, "Renewable Energy Resource: Basic Principles and Applications", Narosa Publishing House, 2004.

Online Learning Resources:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/108108078

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B.Tech IV-I Sem	L	T	P	C
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(20A03705) INTRODUCTION TO COMPOSITE MATERIALS
(Open Elective-IV)

Course Objectives:
- Introduce composite materials and their applications.
- Build proper background for stress analysis in the design of composite structures.
- Familiarize various properties of composite materials.
- Focus on biodegradable composites.

Course Outcomes:
- Identify the practical applications of composites. (L3)
- Identify the polymer matrix composites. (L3)
- Classify of bio- degradable composites. (L2)
- Outline the various types of ceramic matrix materials. (L2)

UNIT I   Introduction to composites
Fundamentals of composites – Definition – classification– based on Matrix – based on structure – Advantages and applications of composites - Reinforcement – whiskers – glass fiber – carbon fiber - Aramid fiber – ceramic fiber – Properties and applications.

UNIT II   Polymer matrix composites
Polymers - Polymer matrix materials – PMC processes - hand layup processes – spray up processes – resin transfer moulding – Pultrusion – Filament winding – Auto clave based methods - Injection moulding – sheet moulding compound – properties and applications of PMCs.

UNIT III   Metal matrix composites
Metals - types of metal matrix composites – Metallic Matrices. Processing of MMC – Liquid state processes – solid state processes – In-situ processes. Properties and applications of MMCs.

UNIT IV   Ceramic matrix composites
Ceramic matrix materials – properties – processing of CMCs –Sintering - Hot pressing – Infiltration – Lanxide process – Insitu chemical reaction techniques – solgel polymer pyrolsis –SHS - Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Properties and Applications of CCMs.

UNIT V   Advances & Applications of composites
Advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Properties and applications of Carbon-carbon composites. Composites for aerospace applications.Bio degradability, introduction of bio composites, classification, processing of bio composites, applications of bio composites - Mechanical, Biomedical, automobile Engineering.

Textbooks:
1. Chawla K.K, Composite materials, 2/e, Springer – Verlag, 1998.
2. Mathews F.L. and Rawlings R.D., Chapman and Hall, Composite Materials: Engineering and Science, 1/e, England, 1994.

Reference Books:
1. H K Shivanand, B V Babu Kiran, Composite Materials, ASIAN BOOKS, 2011.
2. A.B. Strong , Fundamentals of Composite Manufacturing, SME Publications, 1989.
3. S.C. Sharma, Composite materials, Narosa Publications, 2000.
4. Maureen Mitton, Hand Book of Bio plastics & Bio composites for Engineering applications, John Wiley publications, 2011.

Online Learning Resources:
- https://nptel.ac.in/courses/112104229
- https://nptel.ac.in/courses/112104168
- https://nptel.ac.in/courses/101104010
- https://nptel.ac.in/courses/105108124
- https://nptel.ac.in/courses/112104221

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(20A05705a) CYBER SECURITY
(Open Elective-IV)

Course Objectives:

The course is designed to provide awareness on different cyber crimes, cyber offenses, tools and methods used in cybercrime.

Course Outcomes:

- Classify the cybercrimes and understand theIndian ITA 2000
- Analyse the vulnerabilities in any computing system and find the solutions
- Predict the security threats of the future
- Investigate the protection mechanisms
- Design security solutions for organizations

UNIT I   Introduction to Cybercrime

Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT II   Cyber Offenses: How Criminals Plan Them

Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing

UNIT III   Cybercrime: Mobile and Wireless Devices

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

UNIT IV   Tools and Methods Used in Cybercrime

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT V   Cyber Security: Organizational Implications

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Textbooks:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

Reference Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J.David Irwin. CRC Press T&F Group

Online Learning Resources:

http://nptel.ac.in/courses/106105031/40
http://nptel.ac.in/courses/106105031/39
http://nptel.ac.in/courses/106105031/38

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(20A05705b)INTRODUCTION TO FULL STACK DEVELOPMENT
(Open Elective Course – IV)

Course Objectives:
- To build foundation on HTML this will help developer to use HTML concepts for building responsive web application.
- To Develop HTML based Single application for Browsers.
- To Understand OOPs concepts and its applications by building competency in object –oriented Programming.
- To implement frontend and backend scenarios using Web Sockets.
- To become proficient in Bootstrap concepts.

Course Outcomes:
- Able to how to program a browser like using JavaScript, jQuery, Angular, or Vue.
- Distinguishing trends in multi-device implementation.
- Create webpages that function using external data.
- Disambiguate the different structures that a no SQL database may represent.
- Derive information from data and implement data into applications.

UNIT I
e The Modern Web: Rise of the Web, Mobile Web, The State of HTML, Applications vs Web Sites, Keeping Up.
Planning Your Work: Identifying Requirements, Defining the Work, Tracking the Work Continuous Improvement, Prioritization &Estimation, Managing Bugs, Continuous Delivery
User Experience: Information Architecture, Getting the User Experience Right, Polishing the User Experience, Implementing the User Experience.

UNIT II
Designing Systems: System Architectures, Identifying Concepts, Identifying User Interactions, Handling Commonalities, Working with Legacy and External Dependencies, Component Interactions, Applications vs. Modules, Cross-Functional Requirements, Caching, Designing for Failure, Designing Modules, Refactoring, Tools, Changing Your Architecture.
Ethics: Privacy, Cognitive Load, Energy Usage, Trust.
Front End: HTML, From Server to Browser, Styling, Components, Responsive Design, Progressive Enhancement to Progressively Enhance, or Not? Mobile First, Feature Detection, Progressive Enhancement of Style, When Not Using Progressive Enhancement, Search Engine Optimization, Build Tools.

UNIT III
Testing: Test-Driven Development, Test Pyramid, Behaviour-Driven Development, Three Amigos, Manual Testing, Visual Testing, Cross-Functional Testing,
JavaScript: Asynchronicity, JavaScript in the Browser, Offline-First Development, Document Object Model, Server-Side JavaScript, Table of Contents viii JavaScript Modules, Structuring Your JavaScript, JavaScript Types, Object-Oriented Programming, Functional Programming, Communicating Between Components, Connecting Components Together, Testing, Build Tools.
Accessibility: Accessible from the Start, Working with Assistive Technologies, Dealing with Interactive UI, Testing for Accessibility, Avoiding Common Mistakes.

UNIT IV
APIs: API Responsibilities, designing a REST API, Securing Your API, Event-Based APIs, Discovering APIs, Using APIs
Storing   Data: Types of Databases, To SQL, or NoSQL?,Where to Store Your Data, Accessing Data from Your App, Managing Your Data, Protecting Your Data.
Security: Trust, Responding to Incidents, The Golden Rule, Threats, Security Checklists, Passwords, Indirect Attacks.

UNIT V
Deployment: Twelve Factor Apps, Developer Machines, Production Environments, Moving Code into Production, Configuring Your Box, Infrastructure, Immutable Infrastructure, Continuous Delivery & Continuous Deployment.
In Production: Fire Drills, Run Books, Monitoring, Responding to Incidents
Constant Learning: Collecting, Experiments, Analysing Results, Hypothesis-Driven.

Textbook:
 1. Chris Northwood, The full Stack Developer, Apress, 2018.

Reference Books:
1. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker, Frank Zammetti.
2. Full Stack Web Development for Beginners, Riaz Ahmed.

Online Learning Resources:
1. Learn Full Stack Web Development with 40+ Projects and Exercises | Udemy

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B.Tech IV-I Sem   **L T P C**
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(20A27705) WASTE AND EFFLUENT MANAGEMENT
(OPEN ELECTIVE-IV)

Course Objectives:
- To understand the wastewater treatment process.
- To gain knowledge on waste disposal in various ways.
- To know about advances in wastewater treatment.

Course Outcomes:
- Acquires knowledge on technologies used for chemical and biological methods of waste water and effluent treatment

UNIT I
Wastewater Treatment an Overview: Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents. Process Analysis and Selection: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection

UNIT II
Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal. Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

UNIT III
Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry.
Chemical Unit Processes: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage

UNIT IV
Biological Treatment: Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

UNIT V
Advanced Wastewater Treatment: Technologies used in advanced treatment – Classification of technologies. Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration- Absorption – Ion Exchange – Advanced oxidation process.

Textbooks:
1. Herzka A & Booth RG; "Food Industry Wastes: Disposal and Recovery"; Applied Science Pub Ltd. 1981,
2. Fair GM, Geyer JC & Okun DA; "Water & Wastewater Engineering"; John Wiley & Sons, Inc. 1986,

References:
1. GE; "Symposium: Processing Agricultural & Municipal Wastes"; AVI. 1973,
2. Inglett Green JH & Kramer A; "Food Processing Waste Management"; AVI. 1979,
3. Rittmann BE & McCarty PL; "Environmental Biotechnology: Principles and Applications"; Mc-Grow-Hill International editions2001,.
4. Bhattacharyya B C & Banerjee R; "Environmental Biotechnology"; Oxford University Press.
5. Bartlett RE; " Wastewater Treatment; Applied Science" Pub Ltd.
6. G. Tchobanoglous, FI Biston, "Waste water Engineering Treatment and Reuse": Mc Graw Hill, 2002.
7. "Industrial Waste Water Management Treatment and Disposal by Waste Water" 3rd Edition Mc Graw Hill 2008

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B.Tech IV-I Sem   **L T P C**
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(20A54703) NUMBER THEORY AND ITS APPLICATIONS
(OPEN ELECTIVE-IV)

Course Objectives:
This course enables the students to learn the concepts of number theory and its applications to information security.

Course Outcomes:
- Understand number theory and its properties.
- Understand principles on congruences
- Develop the knowledge to apply various applications
- Develop various encryption methods and its applications.

UNIT I   Integers, Greatest common divisors and prime Factorization
The well-ordering property-Divisibility-Representation of integers-Computer operations with integers-Prime numbers-Greatest common divisors-The Euclidean algorithm -The fundamental theorem of arithmetic-Factorization of integers and the Fermat numbers-Linear Diophantine equations

UNIT II   Congruences
Introduction to congruences -Linear congruences-The Chinese remainder theorem-Systems of linear congruences

UNIT III   Applications of Congruences
Divisibility tests-The perpetual calendar-Round-robin tournaments-Computer file storage and hashing functions. Wilson's theorem and Fermat's little theorem- Pseudo primes- Euler's theorem-Euler's p hi-function- The sum and number of divisors- Perfect numbers and Mersenne primes.

UNIT IV   Finite fields & Primality, factoring
Finite fields- quadratic residues and reciprocity-Pseudo primes-rho method-fermat factorization and factor bases.

UNIT V Cryptology
Basic terminology-complexity theorem-Character ciphers-Block ciphers-Exponentiation ciphers-Public-key cryptography-Discrete logarithm-Knapsack ciphers- RSA algorithm-Some applications to computer science.

Textbooks:
1. Elementary number theory and its applications, Kenneth H Rosen, AT & T Information systems & Bell laboratories.
2. A course in Number theory & Cryptography, Neal Koblitz, Springer.

Reference Books:
1. An Introduction To The Theory Of Numbers, Herbert S. Zuckerman, Hugh L. Montgomery, Ivan Niven, wiley publishers
2. Introduction to Analytic number theory-Tom M Apostol, springer
3. Elementary number theory, VK Krishnan, Universities press

Online Learning Resources:
https://www.slideshare.net/ItishreeDash3/a-study-on-number-theory-and-its-applications

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(20A56703) SMART MATERIALS AND DEVICES
(OPEN ELECTIVE-IV)

Course Objectives:
- To provide exposure to smart materials and their engineering applications.
- To impart knowledge on the basics and phenomenon behind the working of smart materials
- To enlighten the properties exhibited by smart materials
- To educate various techniques used to synthesize and characterize smart materials
- To identify the required smart material for distinct applications/devices

Course Outcomes:
- to recognize the need of smart materials
- to understand the working principles of smart materials
- to know different techniques used to synthesize and characterize smart materials
- to exploit the properties of smart materials
- to make use of smart materials for different applications

UNIT I

Introduction: Historical account of the discovery and development of smart materials, Two phases: Austenite and Martensite, Temperature induced phase changes, Shape memory effect, Pseudoelasticity, One-way shape memory effect, Two-way shape memory effect.

UNIT II: Properties of Smart Materials: Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials

UNIT III: Synthesis of smart materials: Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Co-precipitaiton. Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Sol-gel, spray pyrolysis.

UNIT IV: Characterization techniques: X-ray diffraction, Raman spectroscopy (RS), Fourier-transform infrared reflection (FTIR), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy, Atomic force microscopy (AFM) and Differential Scanning Calorimetry (DSC).

UNIT V: Materials and Devices: Characteristics of shape memory alloys, Magnetostrictive, Optoelectronic, Piezoelectric, Metamaterials, Electro-rheological and Magneto-rheological materials and Composite materials.

Devices based on smart materials: Sensors & Actuators, MEMS and intelligent devices, Future scope of the smart materials.

Textbooks:
1. Encyclopaedia of Smart Materials- Mel Schwartz, John Wiley & Sons, Inc.2002
2. Smart Materials and Structures - M. V. Gandhi and B.S. Thompson, Champman and Hall, 1992

References:
1. Smart Materials and Technologies- M. Addington and D. L. Schodek, , Elsevier, 2005.
2. Characterization and Application of smart Materials -R. Rai, Synthesis, , Nova Science, 2011.
3. Electroceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, 2ndEdn., John Wiley & Sons, 2003.
4. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic 1. Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, 2002.
5. Optical Metamaterials: Fundamentals and Applications -W. Cai and V. Shalaev, springer,2010.
6. Smart Materials and Structures - P. L Reece, New Research, Nova Science, 2007

NPTEL courses links

https://nptel.ac.in/courses/112/104/112104173/
https://nptel.ac.in/courses/112/104/112104251/
https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec

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(20A51703) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT (OPEN ELECTIVE-IV)

Course Objectives:
- Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
- Understand the use of alternatives assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

Course Outcomes:
- Recognize and acquire green chemistry concepts and apply these ideas to develop respect for the inter connectedness of our world and an ethic of environmental care and sustainability.

UNIT I: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY
Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

UNIT II: CATALYSIS AND GREEN CHEMISTRY
Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples.

UNIT III: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS
Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water-based coatings, Ionic liquids as catalyst and solvent

UNIT IV: EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES
Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable feedstocks: Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency: Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis. Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions).

UNIT V: GREEN PROCESSES FOR GREEN NANOSCIENCE
Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

Textbooks:
1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford University Press, USA

References:
1. Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and AckmezMudhoo, CRC Press, 2010.
2. Edited by AlvisePerosa and Maurizio Selva , Hand Book of Green chemistry Volume 8:Green Nanoscience, wiley-VCH, 2013.

HONOURS

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B.Tech (ECE)	L T P C
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(20A04H01) ADAPTIVE SIGNAL PROCESSING

Course Objectives:
This course focuses on adaptive algorithms and solutions for processing signals in amanner that is responsive to a changing environment.

Course Outcomes:
- Design and apply optimal minimum mean square estimators and in particular line are estimators.
- Design, implement and apply Wiener Filters (FIR, non-casual, causal) and evaluate their performance.
- Develop systems on recursive, model-based estimation methods taking the advantage of the statistical properties of the received signals.
- Analyze the performance of adaptive filters and application to practical problems such as beam forming and echo cancellation signal.

UNIT 1
Introduction to Adaptive Systems Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description,
Weight Vectors, Desired Response Performance function - Gradient & Mean Square Error.

UNIT 2
Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonally - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.

UNIT 3
Steepest Descent Algorithms: Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of
convergence - Learning Curves Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

UNIT 4
LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability &Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms -Convergence of LMS algorithm. Applications: Adaptive BFSK, BPSK, ASK demodulators and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform.

UNIT 5
State Estimators: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

Textbooks:
1. Adaptive Signal Processing - Bernard Widrow, Samuel D.Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4 ed., 2002,PE Asia.

References:
1. Digital Signal Processing: A Practitioner's Approach, Kaluri V. Rangarao, Ranjan K.Mallik ISBN: 978-0-470-01769-2, 210 pages, November 2006, John Weley (UK)
2. Optimum signal processing: An introduction - Sophocles.J.Orfamadis, 2 ed., 1988,McGraw-Hill, Newyork
3. Adaptive signal processing-Theory and Applications, S.Thomas Alexander, 1986,Springer – Verlag.

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B.Tech. (ECE)   **L T P C**
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(20A04H02) SOFTWARE DEFINED RADIO

Course Objectives:
- Learn the design of the wireless networks based on the cognitive radio
- Understand the concepts of wireless networks and next generation networks

Course Outcomes:
- Describe basics of the software defined radios
- Understand the architectures of SDR
- Design the wireless networks based on the cognitive radios.
- Explain the concepts behind the wireless networks and next generation networks

UNIT I Introduction to Software Defined Radio
Introduction to Software Defined Radio: Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II   SDR Architecture
SDR Architecture: Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT III   Introduction to Cognitive Radios
Introduction to Cognitive Radios: Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

UNIT IV   Cognitive Radio Architecture
Cognitive Radio Architecture: Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT V   Next Generation Wireless Networks
Next Generation Wireless Networks: The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Textbooks:
1. Joseph MitolaIII, Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering, John Wiley & Sons Ltd., 2000.
2. Thomas W. Rondeau, Charles W. Bostain, Artificial Intelligence in Wireless communication, ARTECH house, 2009.

References:
1. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
2. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.
3. Hasari Celebi, Huseyin Arslan, Enabling Location and Environment Awareness in Cognitive Radios, Elsevier Computer Communications, Jan 2008.
4. Huseyin Arslan, Cognitive Radio, SDR and Adaptive System, Springer, 2009

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(20A04H03) MICRO ELECTROMECHANICAL SYSTEMS

Course Objectives:
- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond electrical and mechanical engineering.

Course Outcomes:
- Explain electrical and mechanical principles of MEMS
- Describe working of electrostatic, thermal and magnetic sensors and actuators
- Demonstrate piezoelectric effect and its applications
- Categorize micromachining processes
- Describe operation of polymer and optical MEMS

UNIT I INTRODUCTION

Intrinsic characteristics of MEMS – Energy domains and Transducers- Sensors and Actuators – Introduction to Micro Fabrication – Silicon based MEMS processes – new materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor Devices – Stress and Strain Analysis – Flexural Beam Bending- Torsional Deflection.

UNIT II SENSORS AND ACTUATORS-I

Electrostatic Sensors – Parallel Plate Capacitors – Applications – Interdigitated Finger Capacitor – Comb Drive Devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal Expansion – Thermal Couples – Thermal Resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micro magnetic Components – Case Studies of MEMS in Magnetic Actuators- Actuation using Shape Memory Alloys.

UNIT III SENSORS AND ACTUATORS-II

Piezoresistive Sensors – Piezoresistive Sensor Materials – Stress Analysis of Mechanical Elements – Applications to Inertia, Pressure, Tactile and Flow Sensors – Piezoelectric Sensors and Actuators – Piezoelectric Effects – Piezoelectric Materials – Applications to Inertia, Acoustic, Tactile and Flow Sensors.

UNIT IV MICROMACHINING

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case Studies – Basic Surface Micro Machining Processes – Structural and Sacrificial Materials – Acceleration of Sacrificial Etch – Striction and Antistriction Methods – LIGA Process – Assembly of 3D MEMS – Foundry Process.

UNIT VPOLYMER AND OPTICAL MEMS

Polymers in MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application to Acceleration, Pressure, Flow and Tactile Sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Textbooks:
1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro Systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

References:
1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-El-Hak, Editor, " The MEMS Handbook", CRC Press Baco Raton, 2001.

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(20A04H04) LOW POWER VLSI DESIGN

Course Objectives:
This course addresses a profound analysis on the development of the CMOS & Bi-CMOS digital circuits for a low voltage low power environment

Course Outcomes:
- Understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- Implement Low power design approaches for system level and circuit level measures.
- Design low power adders, multipliers and memories for efficient design of systems.

UNIT I
Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Static and Dynamic Power Dissipation, Short Circuit Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT II
Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT III
Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT IV
Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT V
Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trendand Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Textbooks:
1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici,TMH, 2011.
2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH ProfessionalEngineering.

References:
1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC
   Press, 2011.
2. Low Power CMOS Design – AnanthaChandrakasan, IEEE Press/Wiley International, 1998.
3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons,2000.

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(20A04H05) WIRELESS COMMUNICATIONS

Course Objectives:

- To impart knowledge on different wireless standards and their technical specifications.
- To teach different propagation models.
- To present concepts of 3G/4G Wireless Communication systems to solve the relevant problems.
- To dissimilate different Wireless Technologies such as CDMA, MIMO, and OFDM through performance metrics to find the merits and demerits.

Course Outcomes:

- List Wireless standards and their technical specifications
- Compare different propagation models
- Apply concepts of 3G/4G wireless communication systems to solve problems
- Analyze performance of various 3G/4G wireless communication systems under AWGN and small-scale Fading channel conditions
- Compare different wireless technologies through performance metrics

UNIT I Wireless Standards & Basics of Digital Communication Systems

Introduction to 3G/4G Wireless Communications - Introduction, 2G, 3G, and 4G Wireless standards, Overview of Cellular Service Progression, Problem Solving.

Basics of Digital Communication Systems - Gaussian RV, BER performance of Communication Systems in an AWGN channel - BER for BPSK, SER and BER for QPSK, BER for M-ary PAM, BER for M-ary QAM, BER for M-ary PSK, Binary Signal Detection Problem, Problem Solving.

UNIT II Principles of Wireless Communications

Wireless Communication Environment, Modeling of Wireless Systems, System model for Narrow band Signals, Rayleigh Fading Channel - Baseband model of a Wireless System, BER Performance of Wireless Systems - SNR, and derivation of BER expression under Rayleigh Channel Conditions, Channel Estimation in Wireless Systems, Diversity in Wireless Systems, Multiple Receive Antenna System Model, Symbol Detection in Multiple Antenna Systems, BER for Multi-Antenna Wireless Systems - BER derivation, Channel Estimation for Multi-Antenna Systems.

UNIT III Basics of Channel Modeling

Maximum Delay Spread, RMS delay Spread, Power delay profile, Coherence Bandwidth, Doppler Spread, Impact of Doppler spread on Wireless Channel, Coherence Time, Clarke's Model, Simulation Procedure for flat fading and Frequency Selective Fading Channels, Jakes Model for Wireless Channel Correlation, Implications of Coherence Time, Problem Solving.

UNIT IV

Code Division Multiple Access (CDMA) - Introduction to CDMA, Basic Mechanism, Fundamentals of CDMA Codes, PN sequences and their properties, Multi-User CDMA, Advantages, Near - Far Problem and Power Control, Performance of CDMA Uplink and Downlink Scenarios with Multi users, Asynchronous CDMA, Problem Solving.

Multiple Input Multiple Output (MIMO) Technology: Introduction to MIMO, System Model, MIMO zero-forcing (ZF) Receiver - Properties, Principle of orthogonality, Interpretation of ZF Receiver, MIMO MMSE Receiver - Robustness of MMSE to noise amplification, SNR calculations, Properties of MMSE Receiver, Singular Value Decomposition (SVD) of the MIMO channel, MIMO Capacity, Alamouti and Space Time Codes, Nonlinear MIMO Receiver, MIMO Beam Forming, Problem Solving.

UNIT V

Orthogonal Frequency -Division Multiplexing (OFDM): Motivation and Multicarrier Basics - Multicarrier Transmission, Cyclic Prefix in OFDM, Impact of Cyclic Prefix on Data Rate, Example, BER for OFDM system, MIMO-OFDM, Drawbacks in OFDM - Peak to Average Power Ratio (PAPR), Effect of Frequency offset in OFDM, SC-FDMA - Receiver, and Subcarrier Mapping in SC-FDMA.

Wireless System Planning: Free Space Propagation Model, Ground - Reflection Scenario, Okumura Model, Hata Model, Log normal Shadowing, Receiver Noise Computation, Link Budget Analysis.

Textbooks:
1. Aditya K Jagannatham, "Principles of Modern Communication Systems - Theory and Practice," McGraw Hill Education, 2016.
2. T. S. Rappaport, "Wireless Communications - Principles and Practice," Second Edition, Pearson, 2010.

References:
1. John Proakis, "Digital Communications," McGraw Hill, 2003
2. Modern Digital and Analog Communication Systems, B. P. Lathi. Zhi Ding, International Fourth Edition, 2010.

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(20A04H06) SPEECH PROCESSING

Course Objectives:
- To impart knowledge on anatomy and physiology of Speech Production system and perception model.
- To describe speech parameters in frequency domain for various applications
- To introduce concept of homomorphic system and its use in extracting the vocal tract information from speech

Course Outcomes:
- Formulate vocal tract model based on the speech production mechanism
- Solve features of speech in Time Domain
- Describe feature extraction techniques in frequency domain
- Use LPC coefficients for Pitch and Formant detection
- Analyze the given speech using homomorphic system

UNIT I

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production – Uniform lossless tube model, effect of losses in vocal tract and radiation at lips, Digital models for speech signals.

UNIT II

Time Domain Methods for Speech Processing: Time domain parameters of speech, methods for extracting the parameters: Zero crossings, Auto-correlation function, pitch estimation.

UNIT III

Frequency Domain Methods for Speech Processing: Short time Fourier analysis, Filter bank analysis, Spectrographic analysis, Formant extraction, Pitch extraction.

UNIT IV

Linear predictive Coding (LPC) for Speech: Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains, Method of Solution of the LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT V

Homomorphic Speech Processing: Introduction Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, pitch Detection and Formant Estimation; Applications of speech processing – Speech Enhancement, Speech recognition, Speech synthesis and Speaker Verification.

Textbooks:
1. L.R. Rabiner and S. W. Schafer, Digital Processing of Speech Signals, Pearson Education.
2. Douglas O' Shaughnessy, Speech Communications: Human &Machine, 2nd Ed., Wiley-IEEE Press.

References:
1. Thomas F. Quatieri, Discrete Time Speech Signal Processing: Principles and Practice, 1st Ed., Pearson Education.
2. Ben Gold & Nelson Morgan, Speech and Audio Signal Processing: Processing and Perception of Speech and Music ,1st Ed., Wiley.