ACADEMIC REGULATIONS

Course Structure & Detailed Syllabus

R22

ELECTRONICS & COMMUNICATION ENGINEERING

Bachelor of Technology (B.Tech)

B. Tech. - Regular Four Year Degree Programme
(For batches admitted from the academic year 2022-2023)
&
(For batches admitted Lateral Entry Scheme from the academic year 2023-2024)

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ACADEMIC REGULATIONS (R22)
B. Tech. - Regular Four Year Degree Programme
(For batches admitted from the academic year 2022-23)

1.0 For pursuing four year Under Graduate Degree Programme of study in Engineering & Technology (UGP in E&T) offered by MLR Institute of Technology under Autonomous status is herein referred to as MLRIT (Autonomous):

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year 2022-23 onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for M L R Institute of Technology (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, M L R Institute of Technology shall be the chairman Academic Council.

2.0 Eligibility for Admission

2.1 Admission to the undergraduate(UG) programme shall be made either on the basis of the merit rank obtained by the qualified student in entrance test conducted by the Telangana State Government (EAMCET) or the College or on the basis of any other order of merit approved by the University/TSHE, subject to reservations as prescribed by the government from time to time.

2.2 The medium of instructions for the entire undergraduate programme in Engineering & Technology will be **English** only.

3.0 B.Tech. Programme Structure

3.1 A student after securing admission shall complete the B.Tech. programme in a minimum period of **four** academic years (8 semesters), and a maximum period of **eight** academic years (16 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech course. Each student shall secure 160 credits (with CGPA $\geq$ 5) required for the completion of the undergraduate programme and award of the B.Tech. degree.

3.2 **UGC/ AICTE** specified definitions/ descriptions are adopted appropriately for various terms and abbreviations used in these academic regulations/ norms, which are listed below.

3.2.1 Semester Scheme

Each undergraduate programme is of 4 academic years (8 semesters) with the academic year divided into two semesters of 22 weeks ($\geq$ 90 instructional days) each and in each semester - „Continuous Internal Evaluation (CIE)" and „Semester End Examination(SEE)" under Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) indicated by UGC, and curriculum/course structure suggested by AICTE are followed.

3.2.2 Credit Courses

All subjects/ courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

- One credit for one hour/ week/ semester for Theory/ Lecture (L) courses or Tutorials.
- One credit for two hours/ week/ semester for Laboratory/ Practical (P) courses.

Courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization Lab are mandatory courses. These courses will not carry any credits.

3.2.3 Subject Course Classification

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

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Foundation Courses (FnC)	BS–Basic Sciences	Includes Mathematics, Physics and Chemistry Subjects.
2		ES-Engineering Sciences	Includes Fundamental Engineering Subjects.
3		HS–Humanities and Social Sciences	Includes subjects related to Humanities, Social Sciences and Management.
4	Core Courses (CoC)	PC–Professional Core.	Includes core subjects related to the parent discipline/ department/ branch of Engineering.
5	Elective Courses (EℓC)	PE–Professional Electives	Includes elective subjects related to the parent discipline/ department/ branch of Engineering.
6		OE–Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering.
7	Core Courses	Project Work	B.Tech. Project or UG Project or UG Major Project or Project Stage I & II.
8		Industry Training/ Internship / Industry Oriented Mini- project/ Mini- Project/ Skill Development Courses.	Industry Training/ Internship/ Industry Oriented Mini-Project/ Mini-Project/ Skill Development Courses.
9		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
10	Minor Courses	-	1 or 2 Credit Courses (subset of HS)
11	Mandatory Courses (MC)	-	Mandatory Courses (non-credit)

4.0 Course Registration

4.1 A „faculty advisor or counselor" shall be assigned to a group of 20 students, who will advise the students about the undergraduate programme, its course structure and curriculum, choice/option for subjects/ courses, based on their competence, progress, pre-requisites and interest.

4.2 The academic section of the college invites „registration forms" from students before the beginning of the semester through „on-line registration", ensuring „date and time stamping". The on-line registration requests for any „current semester" shall be **completed before the commencement of SEEs (Semester End Examinations) of the 'preceding semester'**.

4.3 A student can apply for **on-line** registration, **only after** obtaining the „**written approval**" from faculty advisor/counselor, which should be submitted to the college academic section through the Head of the Department. A copy of it shall be retained with the Head of the Department, Faculty Advisor/ Counselor and the student.

4.4 A student may be permitted to register for all the subjects/ courses in a semester as specified in the course structure with maximum additional subject(s)/course(s) limited to6 Credits (any 2 elective subjects), based on **progress** and SGPA/ CGPA, and completionof the „**pre-requisites'** as indicated for various subjects/ courses, in the department coursestructure and syllabus contents.

4.5 Choice for „**additional subjects/ courses**", not more than any 2 elective subjects in any Semester, must be clearly indicated, which needs the specific approval and signature of the Faculty Advisor/Mentor/HOD.

4.6 If the student submits ambiguous choices or multiple options or erroneous entries during **on-line** registration for the subject(s) / course(s) under a given/ specified course group/ category as listed in the course structure, only the first mentioned subject/ course in that category will be taken into consideration.

4.7 Subject/ course options exercised through **on-line** registration are final and **cannot** be changed or inter-changed; further, alternate choices also will not be considered. However, if the subject/ course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any inevitable or unexpected reasons, then the student shall be allowed to have alternate choice either for a new subject(subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the Head of the Department, with due notification and time-framed schedule, within **a week** after the commencement of class-work for that semester.

4.8 Dropping of subjects/ courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor „within a period of 15 days" from the beginning of the current semester.

4.9 **Open Electives**: The students have to choose three Open Electives (OE-I, II & III) from the list of Open Electives given by other departments. However, the student can opt for an Open Elective subject offered by his own (parent) department, if the student has not registered and not studied that subject under any category (Professional Core, Professional Electives, Mandatory Courses etc.) offered by parent department in any semester. Open Elective subjects already studied should not repeat/should not match withany category (Professional Core, Professional Electives, Mandatory Courses etc.) ofsubjects even in the forthcoming semesters.

4.10 **Professional Electives**: The students have to choose six Professional Electives (PE-I to VI) from the list of professional electives given.

5.0 **Subjects/ courses to be offered**

5.1 A subject/ course may be offered to the students, **only if** a minimum of 15 students opt for it.

5.2 More than **one faculty member** may offer the **same subject** (lab/ practical may be included with the corresponding theory subject in the same semester) in any semester. However, selection of choice for students will be based on - „**first come first serve** basis and CGPA criterion‟ (i.e. the first focus shall be on early **on-line entry** from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

5.3 If more entries for registration of a subject come into picture, then the Head of the Department concerned shall decide, whether or not to offer such a subject/ course for **two (or multiple) sections**.

5.4 In case of options coming from students of other departments/ branches/ disciplines (not considering **open electives**), first **priority** shall be given to the student of the „**parent department**‟.

6.0 **Attendance requirements:**

6.1 A student shall be eligible to appear for the semester end examinations, if the student acquires a minimum of 75% of attendance in aggregate of all the subjects/ courses (including attendance in mandatory courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization Lab) for that semester. **Two periods** of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject.

6.2 Shortage of attendance in aggregate upto 10% (65% and above, and below 75%) in each semester may be condoned by the college academic committee on genuine and valid grounds, based on the student‟s representation with supporting evidence.

6.3 A stipulated fee shall be payable for condoning of shortage of attendance.

6.4 Shortage of attendance below 65% in aggregate shall in **NO** case be condoned.

6.5 **Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled,** including all academic credentials (internal marks etc.) of that semester**. They will not be promoted to the next semester.** They may seek re-registration for all those subjects registered in that semester in which the student is detained, by seeking re-admission into that semester as and when offered; ifthere are any professional electives and/ or open electives, the same may also be re- registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

6.6 A student fulfilling the attendance requirement in the present semester shall not beeligible for readmission into the same class.

7.0 Academic Requirements

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in Item No. **6**.

7.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% (21 marks out of 60 marks) in the semester end examination, and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE(Semester End Examination) taken together; in terms of letter grades, this implies securing **'C'** grade or above in that subject/ course.

7.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Real-time Research Project (or) Field Based Research Project (or) Industry Oriented Mini Project (or) Internship (or) Seminar, if the student secures not less than 40% marks (i.e. 40 out of 100 allotted marks) in each of them. The student isdeemed to have failed, if he (i) does not submit a report on Industry Oriented Mini Project/Internship, or (ii) not make a presentation of the same before the evaluation committee as per schedule, or (iii) secures less than 40% marks in Real-time Research Project (or) Field Based Research Project (or) Industry Oriented Mini Project (or) Internship evaluations.

A student may reappear once for each of the above evaluations, when they are scheduled again; if the student fails in such „one reappearance" evaluation also, the student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

7.3 Promotion Rules

S. No.	Promotion	Conditions to be fulfilled
1	First year first semester to first year second semester	Regular course of study of first year first semester.
2	First year second semester to Second year first semester	(i) Regular course of study of first year second semester. (ii) Must have secured at least 20 credits out of 40 credits i.e., 50% credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3.	Second year first semester to Second year second semester	Regular course of study of second year first semester.
4	Second year second semester to Third year first semester	(i) Regular course of study of second year second semester. (ii) Must have secured at least 48 credits out of 80 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Third year first semester to Third year second semester	Regular course of study of third year first semester.

6	**Third year second semester to Fourth year first semester**	**(i) Regular course of study of third year second semester.** **(ii) Must have secured at least 72 credits out of 120 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
7	**Fourth year first semester to Fourth year second semester**	**Regular course of study of fourth year first semester.**

7.4 A student (i) shall register for all courses/subjects covering 160 credits as specified and listed in the course structure, (ii) fulfills all the attendance and academic requirements for 160 credits, (iii) earn all 160 credits by securing SGPA ≥ 5.0 (in each semester), andCGPA ≥ 5 (at the end of 8 semesters), (iv) **passes all the mandatory courses,** to successfully complete the undergraduate programme. The performance of the student in these 160 credits shall be considered for the calculation of the final CGPA **(at the end of undergraduate programme),** and shall be indicated in the grade card / marks memo of IV-year II semester.

7.5 If a student registers for **„extra subjects'** (in the parent department or other departments/branches of Engg.) other than those listed subjects totaling to 160 credits as specified in the course structure of his department, the performances in those **„extra subjects"** (although evaluated and graded using the same procedure as that of the required 160 credits) will not be considered while calculating the SGPA and CGPA. For such **„extra subjects'** registered, percentage of marks and letter grade alone will beindicated in the grade card / marks memo as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations Items 6 and 7.1 – 7.4 above.

7.6 A student eligible to appear in the semester end examination for any subject/ course, but absent from it or failed (thereby failing to secure **'C'** grade or above) may reappearfor that subject/ course in the supplementary examination as and when conducted. In such cases, internal marks (CIE) assessed earlier for that subject/ course will be carried over, and added to the marks to be obtained in the SEE supplementary examination forevaluating performance in that subject.

7.7 A student **detained in a semester due to shortage of attendance may be re-admittedin the same semester in the next academic year for fulfillment of academicrequirements**. The academic regulations under which a student has been re-admitted shall be applicable. Further, no grade allotments or SGPA/ CGPA calculations will be done for the entire semester in which the student has been detained.

7.8 A student detained **due to lack of credits, shall be promoted to the next academic year only after acquiring the required number of academic credits.** The academic regulations under which the student has been readmitted shall be applicable to him.

8.0 Evaluation - Distribution and Weightage of Marks

8.1 The performance of a student in every subject/course (including practicals and Project Stage – I & II) will be evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination).

8.2 In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each Mid-Term examination consists of two parts i) **Part – A** for 10 marks, ii) **Part – B** for 20 marks with a total duration of 2 hours as follows:

1. Mid Term Examination for 30 marks:
   a. Part - A : Objective/quiz paper for 10 marks.
   b. Part - B : Descriptive paper for 20 marks.

The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks. The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks. The **average of the two Mid Term Examinations** shall be taken as the final marks for Mid Term Examination (for 30 marks).

The remaining 10 marks of Continuous Internal Evaluation are distributed as:

2. Assignment for 5 marks. (**Average of 2 Assignments** each for 5 marks)
3. Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks.

While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shallbe taken as the final marks for assignment (for 5 marks).

Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the subject concerned for 5 marks before II Mid-Term Examination.

- The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Over all 40% of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks),his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

There is NO Computer Based Test (CBT) for R22 regulations.

The details of the end semester question paper pattern are as follows:

8.2.1 The semester end examinations (SEE), for theory subjects, will be conducted for 60 marks consisting of two parts viz. i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from each unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.
- The duration of Semester End Examination is 3 hours.

8.3 For practical subjects there shall be a Continuous Internal Evaluation (CIE) during the semester for 40 marks and 60 marks for semester end examination. Out of the 40 marksfor internal evaluation:

1. A write-up on day-to-day experiment in the laboratory (in terms of aim, components/procedure, expected outcome) which shall be evaluated for 10 marks
2. **10 marks for viva-voce (**or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.
3. Internal practical examination conducted by the laboratory teacher concerned shallbe evaluated for 10 marks.
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratorycourse and before semester end practical examination.

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the other colleges which will be decided by the principal of the College.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the samelaboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

- The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Over all 40% of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned

subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks),his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

8.4 The evaluation of courses having ONLY internal marks in I Year I Semester and II Year II Semester is as follows:

1. I Year I,II Semester course (*ex., Elements of CE/ME/EEE/ECE/CSE/Seminar & etc*): The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two MID-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The studentis deemed to have failed, if he (i) is absent as per schedule, or (ii)secures less than 40% marks in this course.

2. II Year II Semester *Real-Time (or) Field-based Research Project* course: The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination andII Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks fromaverage of the two examinations. There shall be NO external evaluation. The studentis deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the internal committee as per schedule, or (ii) secures less than 40% marks in this course.

8.5 There shall be an Industry training (or) Internship (or) Industry oriented Mini-project (or) Skill Development Courses (or) Paper presentation in reputed journal (or) Industry Oriented Mini Project in collaboration with an industry of their specialization. Students shall register for this immediately after II-Year II Semester Examinations and pursue it during summer vacation/semester break & during III Year without effecting regularcourse work. Internship at reputed organization (or) Skill development courses (or) Paper presentation in reputed journal (or) Industry Oriented Mini Project shall be submitted in a report form and presented before the committee in III-year II semester before end semester examination. It shall be evaluated for 100 external marks. The committee consists of an External Examiner, Head of the Department, Supervisor of the Industry Oriented Mini Project (or) Internship etc, Internal Supervisor and a Senior Faculty Member of the Department. There shall be **NO internal marks** for Industry Training (or)Internship (or) Mini-Project (or) Skill Development Courses (or) Paper Presentation in reputed journal (or) Industry Oriented Mini Project.

8.6 The UG project shall be initiated at the end of the IV Year I Semester and the durationof the project work is one semester. The student must present Project Stage – I during IV Year I Semester before II Mid examinations, in consultation with his Supervisor, the title, objective and plan of action of his Project work to the departmental committeefor approval before commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start his project work.

8.7 UG project work shall be carried out in two stages: Project Stage – I for approval of project before Mid-II examinations in IV Year I Semester and Project Stage – II duringIVYear II Semester. Student has to submit project work report at the end of IV Year II Semester. The project shall be evaluated for 100 marks before commencement of SEE Theory examinations.

8.8 For Project Stage – I, the departmental committee consisting of Head of the Department, project supervisor and a senior faculty member shall approve the project work to begin before II Mid-Term examination of IV Year I Semester. The student is deemed to be not eligible to register for the Project work, if he does not submit a reporton Project Stage - I or does not make a presentation of the same before the evaluation committee as per schedule.

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if he fails in such „one reappearance" evaluation also, he has to reappearfor the same in the next subsequent semester, as and when it is scheduled.

8.9 For Project Stage – II, the external examiner shall evaluate the project work for 60 marks and the internal project committee shall evaluate it for 40 marks. Out of 40 internal marks, the departmental committee consisting of Head of the Department, Project Supervisor and a Senior Faculty Member shall evaluate the project work for 20marks and Project Supervisor shall evaluate for 20 marks. The topics for Industry Oriented Mini Project/ Internship/SDC etc. and the main Project shall be different fromthe topic already taken. The student is deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the External Examiner as per schedule, or (iii) secures less than 40% marks in the sum total of the CIE and SEE taken together.

For conducting viva-voce of project, Principal/COE selects an external examiner from the list of experts in the relevant branch submitted by the Principal of the College.

A student who has failed, may reappear once for the above evaluation, when it isscheduled again; if student fails in such „one reappearance" evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

8.10 A student shall be given only one time chance to re-register for a maximum of two subjects in a semester:

- If the internal marks secured by a student in the Continuous Internal Evaluation marks for 40 (Sum of average of two mid-term examinations consisting of Objective & descriptive parts, Average of two Assignments & Subject Viva- voce/PPT/ Poster presentation/ Case Study on a topic in the concerned subject) areless than 35% and failed in those subjects.

A student must re-register for the failed subject(s) for 40 marks within four weeks of commencement of the classwork in next academic year.

In the event of the student taking this chance, his Continuous Internal Evaluation marksfor 40 and Semester End Examination marks for 60 obtained in the previous attempt stand cancelled.

8.11 ***For mandatory non-credit Audit courses,*** The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two MID-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

8.12 For Mandatory Non-Credit Courses offered in a Semester, after securing ≥ 65% attendance and has secured not less than 40% of marks in the sum Total. Then the student is **PASS** and will be qualified for the award of the degree. No marks or Letter Grade shall be allotted for these courses/activities. However, for non credit courses „**Satisfactory'** or "**Unsatisfactory'** shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

9.0 Grading Procedure

9.1 Grades will be awarded to indicate the performance of students in each Theory Subject, Laboratory/Practicals/ Industry-Oriented Mini Project/Internship/SDC and Project Stage. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 8 above, a corresponding letter grade shall be given.

9.2 As a measure of the performance of a student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured in a Subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
Greater than or equal to 90%	O (Outstanding)	10
80 and less than 90%	A^+ (Excellent)	9
70 and less than 80%	A (Very Good)	8
60 and less than 70%	B^+ (Good)	7
50 and less than 60%	B (Average)	6
40 and less than 50%	C (Pass)	5
Below 40%	F (FAIL)	0
Absent	Ab	0

9.3 A student who has obtained an „**F'** grade in any subject shall be deemed to have „**failed'** and is required to reappear as a „supplementary student" in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as those obtained earlier.

9.4 To a student who has not appeared for an examination in any subject, „**Ab'** grade will be allocated in that subject, and he is deemed to have „**Failed'**. A student will be required to reappear as a „supplementary student" in the semester end examination, as and when offered next. In this case also, the internal marks in those subjects will remain the same as those obtained earlier.

9.5 A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.

9.6 A student earns Grade Point (GP) in each subject/ course, on the basis of the letter grade secured in that subject/ course. The corresponding „Credit Points" (CP) are computed by multiplying the grade point with credits for that particular subject/ course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a course

9.7 A student passes the subject/ course only when **GP ≥ 5 ('C' grade or above)**

9.8 The Semester Grade Point Average (SGPA) is calculated by dividing the sum of credit points (ΣCP) secured from all subjects/ courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimal places. SGPA is thus computed as

SGPA = $\{\sum_{i=1}^{N} C_i G_i\} / \{\sum_{i=1}^{N} C_i\}$ **…. For each Semester**,

where „i" is the subject indicator index (considering all subjects in a semester), „N" is the no. of subjects „**registered'** for the semester (as specifically required and listed under the course structure of the parent department), C_i is the no. of credits allotted to the i^{th} subject, and G_i represents the grade points (GP) corresponding to the letter grade awardedfor that i^{th} subject.

9.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in **all** registered courses (of 160) in **all** semesters, and the total number of credits registered in **all** the semesters. CGPA is rounded off to **two** decimal places. CGPA is thus computed from the I year II semester onwards at the end of each semester as per the formula

$$\textbf{CGPA} = \{\sum_{j=1}^{M} C_j G_j\} / \{\sum_{j=1}^{M} C_j\}$$ **… for all S Semesters registered**

(i.e., up to and inclusive of S Semesters, S ≥ 2),

where „M" is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has „REGISTERED" from the 1st Semester onwards up to and inclusive of the Semester S (obviously M > N), „j" is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the jth Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA:

Course/Subject	Credits	Letter Grade	Grade Points	Credit Points
Course 1	4	A	8	4 x 8 = 32
Course 2	4	O	10	4 x 10 = 40
Course 3	4	C	5	4 x 5 = 20
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	C	5	3 x 5 = 15
	21			152

SGPA = 152/21 = 7.24

Illustration of Calculation of CGPA up to 3rd Semester:

Semester	Course/ Subject Title	Credits Allotted	Letter Grade Secured	Corresponding Grade Point (GP)	Credit Points (CP)
I	Course 1	3	A	8	24
I	Course 2	3	O	10	30
I	Course 3	3	B	6	18
I	Course 4	4	A	8	32
I	Course 5	3	A+	9	27
I	Course 6	4	C	5	20
II	Course 7	4	B	6	24
II	Course 8	4	A	8	32
II	Course 9	3	C	5	15
II	Course 10	3	O	10	30
II	Course 11	3	B+	7	21
II	Course 12	4	B	6	24
II	Course 13	4	A	8	32
II	Course 14	3	O	10	30
III	Course 15	2	A	8	16
III	Course 16	1	C	5	5
III	Course 17	4	O	10	40
III	Course 18	3	B+	7	21
III	Course 19	4	B	6	24
III	Course 20	4	A	8	32
III	Course 21	3	B+	7	21
	Total Credits	**69**		**Total Credit Points**	**518**

CGPA = 518/69 = 7.51

The calculation process of CGPA illustrated above will be followed for each subsequent semester until 8th semester. The CGPA obtained at the end of 8th semester will become the final CGPA secured for entire B.Tech. programme.

9.10 For merit ranking or comparison purposes or any other listing, **only** the „**rounded off'** values of the CGPAs will be used.

9.11 SGPA and CGPA of a semester will be mentioned in the semester Memorandum of Grades if all subjects of that semester are passed in first attempt. Otherwise the SGPAand CGPA shall be mentioned only on the Memorandum of Grades in which sitting he passed his last exam in that semester. However, mandatory courses will not be taken into consideration.

10.0 Passing Standards

10.1 A student shall be declared successful or „passed" in a semester, if he secures a GP ≥ 5 (**'C'** grade or above) in every subject/course in that semester (i.e. when the student gets an SGPA ≥ 5.0 at the end of that particular semester); and he shall be declared successful or „passed" in the entire undergraduate programme, only when gets a CGPA ≥ 5.00 (**'C'** grade or above) for the award of the degree as required.

10.2 After the completion of each semester, a grade card or grade sheet shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, grade earned, etc.) and credits earned. **There is NO exemption of credits in any case.**

11.0 Declaration of results

11.1 Computation of SGPA and CGPA are done using the procedure listed in 9.6 to 9.9.

11.2 For final percentage of marks equivalent to the computed final CGPA, the following formula may be used.

% of Marks = (final CGPA – 0.5) x 10

12.0 Award of Degree

12.1 A student who registers for all the specified subjects/ courses as listed in the course structure and secures the required number of 160 credits (with CGPA ≥ 5.0), within 8 academic years from the date of commencement of the first academic year, shall be declared to have „**qualified'** for the award of B.Tech. degree in the branch of Engineering selected at the time of admission.

12.2 A student who qualifies for the award of the degree as listed in item 12.1 shall be placed in the following classes.

12.3 A student with final CGPA (at the end of the undergraduate programme) > 8.00, and fulfilling the following conditions - shall be placed in „**First Class with Distinction'**. However, he

(i) Should have passed all the subjects/courses in „**First Appearance'** within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(ii) Should not have been detained or prevented from writing the semester end examinations in any semester due to shortage of attendance or any other reason.

A student not fulfilling any of the above conditions with final CGPA > 8 shall be placed in **'First Class'.**

12.4 Students with final CGPA (at the end of the undergraduate programme) ≥ 7.0 but <

8.00 shall be placed in **'First Class'.**

12.5 Students with final CGPA (at the end of the undergraduate programme) ≥ 6.00 but < 7.00, shall be placed in „**Second Class'**.

12.6 All other students who qualify for the award of the degree (as per item 12.1), with final CGPA (at the end of the undergraduate programme) ≥ 5.00 but < 6, shall be placed in „**pass class**".

12.7 A student with final CGPA (at the end of the undergraduate programme) < 5.00 will not be eligible for the award of the degree.

12.8 Students fulfilling the conditions listed under item 12.3 alone will be eligible for award of „**Gold Medal**".

12.9 Award of 2-Year B.Tech. Diploma Certificate

1. A student is awarded 2-Year UG Diploma Certificate in the concerned engineeringbranch on completion of all the academic requirements and earned all the 80 credits (within 4 years from the date of admission) upto B. Tech. – II Year – II Semester, if the studentwant to exit the 4-Year B. Tech. program. The student **once opted and awarded for 2- Year UG Diploma Certificate, the student will not be permitted to join** in B. Tech. IIIYear – I Semester and continue for completion of remaining years of study for 4-Year B. Tech. Degree.
2. A student may be permitted to take one year break after completion of II Year – II Semester or B. Tech. – III Year – II Semester (with Principal permission through the HOD of the department well in advance) and can re-enter the course in **next Academic Year in the same college** and complete the course on fulfilling all the academic credentials within a stipulated duration i.e. double the duration of the course (Ex. within8 Years for 4-Year program).

13.0 Withholding of results

13.1 If the student has not paid the fees to the College at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and the student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

14.0 Transitory Regulations

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of R18 Regulations due to lack of attendance, shall be permitted to join I year I Semester of R22 Regulations and he is required to complete the study of B.Tech./B. Pharmacy programme within the stipulated period of eight academic years from the date of first admission in I Year.
2. A student who has been detained in any semester of II, III and IV years of R18 regulations for want of attendance, shall be permitted to join the corresponding semester of R22 Regulations and is required to complete the study of B.Tech./B. Pharmacy within the stipulated period of eight academic years from the date of first admission in I Year. The R22 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester. See rule (C) for further Transitory Regulations.
3. For students detained due to shortage of credits: A student of MLR18 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of R22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. The total credits required are 160 including both MLR18 & R22 regulations. The student is required to complete the study of B.Tech. within the stipulated period of eight academic years from the year of first admission. The R22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

B. For readmitted students in R22 Regulations:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R22 Regulations. **There is NO exemption of credits in any case**.
6. If a student is readmitted to R22 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R22 Regulations will be substituted by another subject to be suggested by the Concerned BOS.

15.0 Student Transfers

15.1 There shall be no branch transfers after the completion of admission process.

15.2 There shall be no transfers from one college/stream to another within the constituent colleges and units of Jawaharlal Nehru Technological University Hyderabad.

15.3 The students seeking transfer to colleges affiliated to JNTUH from various other Universities/institutions have to pass the failed subjects which are equivalent to thesubjects of JNTUH, and also pass the subjects of JNTUH which the students have not studied at the earlier institution. Further, though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of JNTUH, the students have to study those subjects in JNTUH in spite of the fact that those subjects are repeated.

15.4 The transferred students from other Universities/Institutions to College who are on rolls are to be provided one chance to write the CBT (for internal marks) in the **equivalent subject(s)** as per the clearance letter issued by the University.

15.5 The college have to provide one chance to write the internal examinations in the **equivalent subject(s)** to the students transferred from other universities/institutions to JNTUH autonomous affiliated colleges who are on rolls, as per the clearance (equivalence) letter issued by the University.

16.0 Malpractice Prevention Committee

A malpractice prevention committee shall be constituted to examine and punish the students who involve in malpractice / indiscipline in examinations. The committee shall consist of:

a) Controller of examinations - Chairman
b) Addl. Controller of examinations.- Member Convener
c) Subject expert - member
d) Head of the department of which the student belongs to. - Member
e) The invigilator concerned - member

The committee shall conduct the meeting after taking explanation of the student and punishment will be awarded by following the malpractice rules meticulously.

Any action on the part of candidate at the examination like trying to get undue advantage in the performance at examinations or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the Staff who are in charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations, in such acts (inclusive of providing incorrect or misleading information)

that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and will be recommended for appropriate punishment after thorough enquiry.

17.0 Scope

17.1 The academic regulations should be read as a whole, for the purpose of any interpretation.

17.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of Academic Council is final.

17.3 The College may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the dates notified by the college authorities.

17.4 Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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ACADEMIC REGULATIONS FOR B.TECH (LATERAL ENTRY SCHEME) FROM THE AY 2023-24

1. Eligibility for the award of B.Tech Degree (LES)

The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years.

2. The student shall register for 120 credits and secure 120 credits with CGPA ≥ 5 from II year to IV-year B.Tech. programme (LES) for the award of B.Tech. degree.

3. The students, who fail to fulfil the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their seat in B.Tech.

4. The attendance requirements of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

5. Promotion rule

S. No	Promotion	Conditions to be fulfilled
1	Second year first semester to second year second semester	Regular course of study of second year first semester.
2	Second year second semester to third year first semester	(i) Regular course of study of second year second semester. (ii) Must have secured at least 24 credits out of 40 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Third year first semester to third year second semester	Regular course of study of third year first semester.
4	Third year second semester to fourth year first semester	i) Regular course of study of third year second semester. ii) Must have secured at least 48 credits out of 80 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Fourth year first semester to fourth year second semester	Regular course of study of fourth year first semester.

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

7. LES students are not eligible for 2-Year B. Tech. Diploma Certificate.

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Malpractices Rules
Disciplinary Action For / Improper Conduct in Examinations

	Nature of Malpractices/ Improper conduct	Punishment
	If the student:	
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 student is appearing but has not made use of (material shall include any marks on the body of the student whichcan 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 student orally or by any other body language methods or communicates through cell phones with any student 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 students 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 fromany 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 student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student 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 student is to be cancelled
3.	Impersonates any other student in connection with the examination.	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student 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 student is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the student 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 student 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 student is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the chief superintendent/COE/ACoE/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 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 student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears off 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 student 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 student is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.

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

Malpractices identified by squad or special invigilators

1. Punishments to the students as per the above guidelines.
2. Punishment for staff: (if the squad reports that the staff is also involved in encouraging malpractices)
   a. A show-cause notice shall be issued to the staff.
   b. Impose a suitable fine on the staff.

* * * * *

COURSE STRUCTURE
B. TECH – Electronics and Communication Engineering
REGULATIONS: R22

I YEAR I SEMESTER									
Induction program for one weeks									
Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6BS01	Linear Algebra and Calculus	BSC	3	1	0	4	40	60	100
A6HS01	English for skill Enhancement	HSC	3	0	0	3	40	60	100
A6BS09	Engineering Chemistry	BSC	3	1	0	4	40	60	100
A6EE62	Basic Electrical Engineering	ESC	3	0	0	3	40	60	100
A6HS02	English Language and Communication skills Lab	HSC	0	0	3	1.5	40	60	100
A6BS14	Engineering Chemistry Lab	BSC	0	0	3	1.5	40	60	100
A6EE63	Basic Electrical Engineering Lab	ESC	0	0	3	1.5	40	60	100
A6ME04	Engineering Work Shop	ESC	0	0	3	1.5	40	60	100
		TOTAL	12	2	12	20	320	480	800
A6BS11	Environmental Science	MC	3	0	0	0	50	--	50
I YEAR II SEMESTER									
Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6BS02	Numerical Methods and Integral Transforms	BSC	3	1	0	4	40	60	100
A6BS07	Applied Physics	BSC	3	1	0	4	40	60	100
A6CS02	Programming for Problem Solving	ESC	3	0	0	3	40	60	100
A6ME02	Engineering Drawing	ESC	1	0	3	2.5	40	60	100
A6EC01	Electronic Devices and Circuits	ESC	2	0	0	2	40	60	100
A6BS08	Applied Physics Lab	BSC	0	0	3	1.5	40	60	100
A6CS03	Programming for Problem Solving Lab	ESC	0	0	3	1.5	40	60	100
A6EC02	Electronic Devices and Circuits Lab	ESC	0	0	3	1.5	40	60	100
		TOTAL	12	2	12	20	320	480	800

II YEAR I SEMESTER									
Course Code	Course Title	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6EC05	Analog Circuits	PCC	3	0	0	3	40	60	100
A6CS05	Data Structures	PCC	3	0	0	3	40	60	100
A6EC06	Signals and Systems	PCC	3	1	0	4	40	60	100
A6EC07	Electronic Measurements and Instrumentation	ESC	3	0	0	3	40	60	100
A6EC08	Probability Theory and Stochastic Processes	ESC	3	1	0	4	40	60	100
A6EC09	Analog Circuits Lab	PCC	0	0	2	1	40	60	100
A6CS06	Data Structures Lab	ESC	0	0	2	1	40	60	100
A6EC10	Basic Simulation Lab	ESC	0	0	2	1	40	60	100
	TOTAL		**15**	**2**	**6**	**20**	**320**	**480**	**800**
Mandatory Course (Non-Credit)									
A6HS06	Constitution of India	MC	2	0	0	-	50	--	50

II YEAR II SEMESTER									
Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6EC11	Internet of Things and Applications	PCC	3	0	0	3	40	60	100
A6EC12	Digital System Design	PCC	3	0	0	3	40	60	100
A6EC13	Analog and Digital Communication	PCC	3	0	0	3	40	60	100
A6BS04	Vector Calculus and Complex Analysis	BSC	3	0	0	3	40	60	100
A6EC14	Electromagnetic and Transmission Lines	PCC	3	0	0	3	40	60	100
A6EC15	IoT Architecture Lab	PCC	0	0	2	1	40	60	100
A6EC16	Digital System Design Lab	PCC	0	0	2	1	40	60	100
A6EC17	Analog and Digital Communications Lab	PCC	0	0	2	1	40	60	100
A6EC18	Real Time Projects/Field based Projects	PWC	0	0	4	2	50	--	50
TOTAL			**15**	**0**	**10**	**20**	**370**	**480**	**850**
Mandatory Course (Non-Credit)									
A6HS05	Gender sensitization	MC	2	0	0	-	50	--	50

III YEAR I SEMESTER

Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6EC19	Linear and Digital Integrated Circuit Applications	PCC	3	0	0	3	40	60	100
A6EC20	Control Systems	PCC	3	1	0	4	40	60	100
A6EC21	Microprocessors and Microcontrollers	PCC	3	0	0	3	40	60	100
	Professional Elective – 1	PEC	3	0	0	3	40	60	100
	Open Elective-1	OEC	3	0	0	3	40	60	100
A6EC22	Microprocessors and Microcontrollers Lab	PCC	0	0	2	1	40	60	100
A6EC23	Analog & Digital IC Applications Lab	PCC	0	0	2	1	40	60	100
A6IT41	Object Oriented Programming Lab	PCC	0	0	2	1	40	60	100
A6EC24	Independent Study/ MOOC'S	PWC	-	-	2	1	--	100	100
TOTAL			**15**	**1**	**08**	**20**	**320**	**580**	**900**
Mandatory Course (Non-Credit)									
A6HS10	Human Values and Professional Ethics	MC	**2**	**0**	**0**	**-**	50	--	50

III YEAR II SEMESTER

Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6EC25	Digital Signal Processing	PCC	3	0	0	3	40	60	100
A6EC26	Antennas and Wave propagation	PCC	3	0	0	3	40	60	100
	Professional Elective – 2	PEC	3	0	0	3	40	60	100
	Professional Elective – 3	PEC	3	0	0	3	40	60	100
	Open Elective-2	OEC	3	0	0	3	40	60	100
A6EC27	Digital Signal Processing Lab	PCC	0	0	2	1	40	60	100
A6EC28	Antennas and Wave propagation Lab	PCC	0	0	2	1	40	60	100
A6HS03	Advanced English Communication Skills Lab	HSMC	0	0	2	1	40	60	100
A6EC29	Mini Projects/Internships*	PWC	0	0	4	2	--	100	100
TOTAL			**15**	**0**	**10**	**20**	**320**	**580**	**900**
Mandatory Course (Non-Credit)									
A6BS11	Environmental Science*	MC	3	0	0	0	50	--	50

*Applicable to lateral entry students

IV YEAR I SEMESTER									
Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
A6EC30	VLSI Design	PCC	3	1	0	4	40	60	100
A6EC31	Embedded System & RTOS	PCC	3	0	0	3	40	60	100
A6EC32	Microwave Engineering	PCC	3	0	0	3	40	60	100
A6EC61	Computer Networks	PCC	3	0	0	3	40	60	100
	Professional Elective -4	PEC	3	0	0	3	40	60	100
A6EC33	VLSI Design Lab	PCC	0	0	2	1	40	60	100
A6EC34	Embedded and RTOS Lab	PCC	0	0	2	1	40	60	100
A6EC35	Research Project Stage-I	PWC	0	0	4	2	100	--	100
	TOTAL		**15**	**0**	**08**	**20**	**380**	**420**	**800**

IV YEAR II SEMESTER									
Code	Course	Category	Periods per Week			Credits	Scheme of Examination Maximum Marks		
			L	T	P		Internal	External	Total
	Professional Elective -5	PEC	3	0	0	3	40	60	100
	Professional Elective -6	PEC	3	0	0	3	40	60	100
	Open Elective-3	OEC	3	0	0	3	40	60	100
A6EC36	Research Project Stage-II	PWC	0	0	22	11	40	60	100
	TOTAL		**9**	**0**	**22**	**20**	**160**	**240**	**400**

Note:

BSC- Basic Science Courses
ESC-Engineering Science Courses
HSMC-Humanities and Social Science including Management Courses
PCC- Professional Core Courses
PEC- Program Elective Courses
OEC- Open Elective Courses
PWC- Project work Related Courses

PROFESSIONAL ELECTIVES			
PE-I		**PE-II**	
A6EC37	Digital Design through Verilog	**A6EC40**	Fiber Optic Communication
A6EC38	Sensors and Actuators	**A6EC41**	Introduction to MEMS
A6EC39	Introduction to Artificial Intelligence	**A6EC42**	ASIC Design
PE-III		**PE-IV**	
A6EC43	Digital Image Processing	**A6EC46**	Satellite Communication
A6EC44	IoT Architecture and Protocol	**A6EC47**	Machine Learning Techniques
A6EC45	Physical Design Basics	**A6EC48**	Design of Testability
PE- V		**PE-VI**	
A6EC49	Cellular Mobile Communications	**A6EC52**	Radar Systems
A6EC50	Artificial Neural Networks	**A6EC53**	Deep Learning Algorithms
A6EC51	CMOS Analog Design	**A6EC54**	Low Power VLSI

OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSE-I			
S. No.	**Course Code**	**Course Name**	**Offering Department**
1.	**A6EC55**	Microprocessors and Interfacing	Electronics and Communication Engineering
2.	**A6EC56**	Principles of Communications	
OPEN ELECTIVE COURSE-II			
3.	**A6EC57**	Microcontrollers and Applications	Electronics and Communication Engineering
4.	**A6EC58**	Fundamentals of Image processing	
OPEN ELECTIVE COURSE-III			
5.	**A6EC59**	Introduction to Sensors and Actuators	Electronics and Communication Engineering
6.	**A6EC60**	Introduction to Computer Vision	

I YEAR-
I SEMESTER

LINEAR ALGEBRA & CALCULUS

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6BS01	BSC	3	1	-	4	40	60	100
Contact Classes: 44	Tutorial Classes: 08	Practical Classes:--				Total Classes: 52		

Course Objectives

To learn

1. Concept of Rank of a matrix, Consistency and solving system of linear equations.
2. Concept of eigen values, eigen vectors and diagonalization of the matrix.
3. The concept of differential equations and solvethem using appropriate methods.
4. Evaluate multiple integrals and improper integrals
5. The partial derivatives of several variable functions.

UNIT-I	MATRICES AND THEIR APPLICATIONS	Classes: 08

Real matrices: Symmetric-skew-symmetric and orthogonal matrices –Complex matrices: Hermitian, Skew – Hermitian and Unitary matrices –Elementary row and column transformations –Elementary matrix-Finding rank of a matrix by reducing to Echelon form and Normal form-Finding the inverse of a matrix using elementary row/column transformations (Gauss-Jordan method)-Consistency of system of linear equations (homogeneous and non-homogeneous) using the rank of a matrix –Solving m n and n n linear system of equations by Gauss Elimination, Gauss siedel Method

UNIT-II	EIGEN VALUES, EIGEN VECTORS	Classes: 08

Eigen values and Eigen vectors and its properties (without proof),Cayley-Hamilton theorem (Statement and verification)-Finding inverse and powers of a matrix by Cayley-Hamilton theorem, Diagonalization of matrices. Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to Canonical forms by Orthogonal Transformation.

UNIT-III	ORDINARY DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS	Classes: 10

Introduction- Exact and reducible to Exact differential equations-Newton's Law of cooling-Law of Growth and Decay. Linear differential equations of second and higher order with constant coefficients - Non-Homogeneous term of the type $Q(x) = e^{ax}$, Sin ax, Cosax, $e^{ax}v(x)$, $x^n v(x)$ - Method of variation of parameters L-C-R Circuits.

UNIT-IV	MULTIPLE INTEGRALS, BETA AND GAMMA FUNCTIONS	Classes: 10

Double and triple integrals (Cartesian and polar), Change of order of integration in double integrals, Change of variables (Cartesian to polar) in double integrals. Finding the area and volume of a region using double and triple integral.

Beta- Gamma Functions and their Properties-Relation between them- Evaluation of improper integrals using Gamma and Beta functions.

UNIT-V	CALCULUS OF SEVERAL VARIABLES	Classes: 08

Limit, Continuity - Partial derivative- Partial derivatives of higher order -Total derivative - Chain rule,Jacobians-functional dependence & independence. Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

Text Books:

1. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.

Reference Books:

1. G.B.Thomas, calculus and analytical geometry,9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal ,A Text of Engineering Mathematics,Laxmi publications,2008.
3. E.L.Ince, Ordinary differential Equations,Dover publications,1958.

Web references:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://www.ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E -Text Books:

1.https://www.e-booksdirectory.com/details.php?ebook=10166

MOOCS Course:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/

Course Outcomes

at the end of the course, student will be able to:

1. Solve the system of linear equations using rank of the matrices.
2.Find the Eigen values and Eigen vectors of a matrix
3.Identify the different types of differential equations and solve them using appropriate methods.
4. Evaluate the improper integrals using beta and gamma functions.
5. Find the Maxima and Minima of several variable functions.

ENGLISH FOR SKILL ENHANCEMENT

Course Code	Category	Hours /Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6HS01	HSMC	3	0		3	40	60	100
Contact Classes:42	TutorialClasses:0	Practical Classes: 00				TotalClasses:42		

COURSEOBJECTIVES:

The course will enable the students to:

1. Develop language proficiency with emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Apply the theoretical and practical components of English syllabus to study academic subjects more effectively and critically.
3. Analyzeavarietyoftextsandinterpretthemtodemonstrateinwritingorspeech.
4. Write/compose clearly and creatively, and adjust writing style appropriately to the content,thecontext, and nature of the subject.
5. Developlanguagecomponentstocommunicateeffectivelyinformalandinformalsituations.

UNIT-I	'Toasted English' by R.K.Narayan	Classes: 8
Vocabulary	: The Concept of Word Formation -The Use of Prefixes and Suffixes - AcquaintancewithPrefixesandSuffixesfromForeignLanguagestoformDerivatives- Synonyms and Antonyms	
Grammar	:IdentifyingCommonErrorsinWritingwithReferencetoArticlesandPrepositions	
Reading:	:Reading and Its Importance-Techniques for Effective Reading	
Writing	:Sentence Structures–Use of Phrases and Clauses in Sentences–Importance of Proper Punctuation – Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence–Organizing Principles of Paragraphs in Documents.	

UNIT-II	'ApproJRD'bySudhaMurthy	Classes: 9
Vocabulary	:Words Often Misspelt–Homophones, Homonyms and Homographs	
Grammar	:Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement	
Reading	:Sub-Skills of Reading–Skimming and Scanning–Exercises for Practice	
Writing	:Nature and Style of Writing-Defining/Describing People, Objects, Places and Events–Classifying-Providing Examples or Evidence.	

UNIT-III	'LessonsfromOnlineLearning'byF.HaiderAlvi,DeborahHurstetal	Classes: 9
Vocabulary	:Words Often Confused–Words from Foreign Languages and their Use in English.	

Grammar	**:**IdentifyingCommonErrorsinWritingwithReferencetoMisplacedModifiersand Tenses	
Reading	**:**Sub-SkillsofReading–IntensiveReadingandExtensiveReading–ExercisesforPractice	
Writing	**:**Format of a Formal Letter-Writing Formal Letters E.g..,Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/Resume	
UNIT-IV	**Art and Literature**	**Classes: 8**
Vocabulary	**:**Standard Abbreviations in English	
Grammar	**:**Redundancies and Clichés in Oral and Written Communication	
Reading	**:**Survey,Question,Read,ReciteandReview(SQ3RMethod)-ExercisesforPractice	
Writing	**:**WritingPractices-EssayWriting-WritingIntroductionandConclusion-PrécisWriting	
UNIT-V	**Go, Kiss the World' by SubrotoBagchi**	**Classes: 8**
Vocabulary	**:**Technical Vocabulary and their Usage	
Grammar	**:**Common Errors in English(*Covering all the other aspects of grammar which were not covered in the previous units*)	
Reading	**:**Reading Comprehension-Exercises for Practice	
Writing	**:** Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats-Structure of Reports(Manuscript Format)-Types of Reports -Writing a Report	

Text Books:

1. "English: Language, ContextandCulture"byOrientBlackSwanPvt.Ltd,Hyderabad.2022.Print.

Reference Books:

1. Effective Academic Writing by Liss and Davis(OUP)
2. Richards,JackC.(2022)Interchange Series. Introduction, 1,2,3.CambridgeUniversityPress
3. Wood,F.T.(2007).Remedial English Grammar.Macmillan.
4. Chaudhuri,SantanuSinha.(2018).LearnEnglish:AFunBookofFunctionalLanguage, Grammar and Vocabulary.(2nded.,).Sage Publications IndiaPvt.Ltd.
5. (2019).Technical Communication. Wiley India Pvt.Ltd.
6. Vishwa mohan, Aysha. (2013). English for Technical Communication for Engineering Students. McGraw-Hill Education India Pvt. Ltd.
7. Swan, Michael. (2016).Practical English Usage. Oxford University Press. FourthEdition

Web References:

1. http//www.bbc.co.uk/learningenglish
2. http//learnenglish.britishcouncil.org
3. https//www.cambridgeenglish.org/learning-english/
4. https//study.com/academy/subj/english.html

E-Text Books:

1.https//www.pdfdrive.com/advanced-english-books.html

MOOC Courses:

1.http//nptel.ac.in/courses/109/106/109106067
2.https//www.britishcouncil.org.tr/en/english/mooc

Course Outcomes:

1. Will be able to acquire language proficiency with emphasis on Vocabulary,Grammar, Reading and Writing skills.
2. Apply the theoretical and practical components of English syllabus to study academic subjects more effectively and critically.
3. Analyze a variety of texts and interpret them to demonstrate in writing or speech.
4. Write/compose clearly and creatively, and adjust writing style appropriately to the content, the context, and nature of the subject.
5. Use language components to communicate effectively informal and informal situations

ENGINEERING CHEMISTRY

I Semester:: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6BS09	BSC	3	1	0	4	40	60	100

UNIT-I WATER AND ITS TREATMENT

Introduction to hardness of water – Estimation of hardness of water by complexometric method and related numerical problems. Specifications and Disinfection of potable water by chlorination and break - point chlorination. Boiler troubles: Sludges, Scales and Caustic embrittlement. Internal treatment of Boiler feed water- Calgon conditioning - Phosphate conditioning - Colloidal conditioning, External treatment methods -Softening of water by ion- exchange processes. Desalination of water – Reverse osmosis.

UNIT-II BATTERY CHEMISTRY AND CORROSION

Introduction - Classification of batteries- primary, secondary and reserve batteries with examples. Basic requirements for commercial batteries. Construction, working and applications of: Zn-air and Lithium ion battery.

Fuel Cells- Differences between battery and a fuel cell, Construction and applications of Methanol Oxygen fuel cell and Solid oxide fuel cell.

Corrosion: Causes and effects of corrosion. Factors affecting rate of corrosion, Mechanism of dry and electrochemical corrosion. Types of corrosion: Galvanic, water-line corrosion. Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current methods.

UNIT-III POLYMERIC MATERIALS

Definition – Classification of polymers with examples – Types of polymerization – addition (free radical addition) and condensation polymerization with examples – Nylon 6:6, Terylene

Plastics: Definition and characteristics- thermoplastic and thermosetting plastics, Preparation, Properties and engineering applications of PVC and Bakelite.

Elastomers: Characteristics –preparation – properties and applications of Buna-S, Butyl and Thiokol rubber.

Conducting polymers: Characteristics and Classification with examples-mechanism of conduction in trans-polyacetylene and applications of conducting polymers.

Biodegradable polymers: Concept and advantages – Poly lactic acid and poly vinyl alcohol and their applications.

UNIT-IV ENERGY SOURCES

Introduction, Calorific value of fuel – HCV, LCV- Dulongs formula. Liquid fuels – petroleum and its refining, cracking types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG, Biodiesel – Transesterification, advantages.

UNIT-V ENGINEERING MATERIALS

Smart materials and their engineering applications

Shape memory materials- Poly L- Lactic acid. Thermo response materials- Polyacryl amides, Poly vinyl amides

Lubricants: Classification of lubricants with examples-characteristics of a good lubricants – mechanism of lubrication (thick film, thin film and extreme pressure)- properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.

TEXT BOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010
2. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, 2016
3. A text book of Engineering Chemistry by M. Thirumala Chary, E. Laxminarayana and K. Shashikala, Pearson Publications, 2021.

4. 4. Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley Publications

REFERENCE BOOKS:

1. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)
2. 2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi (2011)

BASIC ELECTRICAL ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EE62	ESC	3	0	0	3	40	60	100
Contact Classes: 50	Tutorial Classes: 0	Practical Classes: Nil				Total Classes:50		

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand basics in electrical circuits with nodal and mesh analysis.
2. Understand the use of circuit analysis theorems and methods.
3. Analyze two port network parameters.
4. Apply Laplace Transform to steady state and transient state response.
5. Understand the use of Electrical Machines.

UNIT-I	DC CIRCUITS	Classes: 10

Electrical circuit elements (R, L and C), voltage and current sources, ohm's law, Kirchhoff's current and voltage laws, Source transformations, star-delta transformation, nodal, Super nodeand mesh, super mesh analysis

UNIT-II	NETWORK THEOREMS	Classes: 10

Super position theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem–with DC excitation.

UNIT-III	TWO PORT NETWORKS	Classes:10

Two port network parameters-Z, Y, ABCD and Hybrid parameters. Interconnection of Two port networks in series, parallel and cascaded connections.

UNIT-IV	TRANSIENT ANALYSIS	Classes: 10

Analysis of RL, RC, and RLC networks with and without initial conditions using Differential equations and Laplace transforms for DC excitations. Evaluation of initial conditions for various electrical circuits. Resonance in series and parallel R-L-C circuit.

UNIT-V	ELECTRICAL MACHINES	Classes: 10

DC Machines: Construction and working principle of DC Motor, Torque equation, Types, Construction and working principle of DC Generator, EMF Equation and Problems

AC Machines:

Construction and working of Transformer & EMF equation, Construction and working of a three-phase induction motor, Significance of torque-slip characteristics, problems.

Text Books:

1. Charles K. Alexander, Matthew N.O. Sadiku, "Fundamentals of Electric Circuit" 5th Edition, Tata Mc Graw Hill New Delhi, 2013
2. Sudhakar, A., Shyammohan, S. P. "Circuits and Network" Tata McGraw-Hill New Delhi,1994.
3. "Circuit theory analysis and Synthesis" by Abhijit Chakrabarti, DHANPAT RAI &CO.

ENGLISH LANGUAGE AND COMMUNICATION SKILLS								
Course Code	**Category**	**Hours /**			**Credits**	**Maximum Marks**		
A6HS02	**HSMC**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
		0	0	3	1.5	40	60	100
Contact Classes:00	**Tutorial Classes:00**	**Practical Classes: 39**				**Total Classes:39**		

COURSEOBJECTIVES:

The course should enable the students:

1. To facilitate computer- assisted multimedia instruction enabling individualized and independent language learning
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
3. To improve the fluency of students in spoken English and neutralize the impact of dialects.
4. To train students to use language appropriately for public speaking, group discussions and interviews

English Language and Communication SkillsLab(ELCS)shall have two parts:

a. Computer Assisted Language Learning(CALL)Lab

b. Interactive Communication Skills(ICS)Lab

Listening Skills Objectives

1. To enable students develop their listening skills to appreciate its role in the LSRW skills approach to language and improve their pronunciation.
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions.

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right in to nation in sentences.

Listening for general content

- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. Toenablestudentsexpressthemselvesfluentlyandappropriatelyinsocialandprofessionalcontexts
   - Oral practice
   - Describing objects/situations/people
   - Role play–Individual/Groupactivities
   - Just A Minute(JAM) Sessions

ENGINEERING CHEMISTRY LABORATORY								
Course Code:	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A6BS14	**BSC**	0	0	3	1.5	40	60	100
Contact Classes: 0	**Tutorial Classes: 0**	**Practical Classes: 39**				**Total Classes: 39**		

Course Objectives:

The course consists of experiments related to the principles of chemistry required for engineering student.
The student will learn:

- Estimation of hardness of water to check its suitability for drinking purpose.
- Students are able to perform estimations of acids and bases using conductometry, potentiometry and pH metry methods.
- Students will learn to prepare polymers such as Bakelite and nylon-6 in the laboratory.
- Students will learn skills related to the lubricant properties such as saponification value, surface tension and viscosity of oils

Course Outcomes:

The experiments will make the student gain skills on:

- Determination of parameters like hardness of water and rate of corrosion of mild steel in various conditions.
- Able to perform methods such as conductometry, potentiometry and pH metry in order to find out the concentrations or equivalence points of acids and bases.
- Students are able to prepare polymers like bakelite and nylon-6,6.
- Estimations saponification value, surface tension and viscosity of lubricant oils.

LIST OF EXPERIMENTS

Experiment-1 Determination of total hardness of water by complexometric method using EDTA
Experiment-2 Determination of Alkalinity of given water sample
Experiment-3 Estimation of Chloride content of water by Argentometry.
Experiment-4 Estimation of the concentration of an acid by Conductometry
Experiment-5 Estimation of amount of ferrous ion by potentiometry using potassium dichromate
Experiment-6 Estimation of HCl by potentiometry
Experiment-7 Preparation of Bakelite
Experiment-8 Preparation of Thiokol Rubber
Experiment-9 Estimation of acid value of given lubricant oil
Experiment-10 Estimation of Viscosity of lubricant oil using Ostwald's Viscometer.
Experiment-11 Determination of rate of corrosion of mild steel in the presence and absence of inhibitor
Experiment-12 Estimation of Surface tension of a given liquids using Stalagmometer

VIRTUAL LABS

Experiment-13 Construction of Fuel cell and its working
Experiment-14 Smart materials for Biomedical applications
Experiment-15 Batteries for electrical vehicles
Experiment-16 Functioning of solar cell and its applications

Reference Books:

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. Vogel's textbook of practical organic chemistry 5th edition
3. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
4. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007)

BASIC ELECTRICAL ENGINEERINGLABORATORY								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
A6EE63	**ESC**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	3	1.5	40	60	100
Tutorial Classes: Nil		**Practical Classes: 24**				**Total Classes:24**		

OBJECTIVES:

The course should enable the students to:

I. Get an exposure to common electrical components and their ratings.
II. Make electrical connections by wires of appropriate ratings.
III. Understand the usage of common electrical measuring instruments.
IV. Understand the basic characteristics of transformers and electrical machines

COURSE OUTCOMES:

Upon successful completion of this course, student will be able to:

1. Analyze the circuit using Kirchhoff's law and Resonance of series and parallel network simplification theorems.
2. Evaluate the efficiency of single-phase alternating quantities.
3. Evaluate the efficiency and critical speed and critical field resistance of DC Machine
4. Evaluate the Torque-Slip characteristics of 3 phase Induction Motor

LIST OF EXPERIMENTS	
INTRODUCTION AND USE OF MEASURING INSTRUMENTS & SAFETY PRECAUTIONS	
Identify the different passive and active components, Color code of resistors, Measure the voltage and current using voltmeter and ammeter, Measure the voltage, current with Multimeter and study the other measurements using Multimeter	
Week-1	**KIRCHOFF'S LAWS (KVL & KCL)**
To Verify KVL and KCL	
Week-2	**SUPERPOSITION THEOREM**
To Verify Superposition Theorem	
Week-3	**THEVENIN'S THEOREM**
To Obtain Equivalent Circuit Of A Complex Network	
Week-4	**NORTON'S THEOREM**
To obtain Equivalent Circuit of a Complex Network	
Week-5	**MAXIMUM POWER TRANSFER THEOREM**
To Obtain Equivalent Circuit of a Complex Network	
Week-6	**SERIES RESONANCE IN RLC CIRCUIT**

To find the Resonance Frequency, Band Width & Quality Factor of Series And Parallel Circuit	
Week-7	**PARALLEL RESONANCE IN RLC CIRCUIT**
To find the Resonance Frequency, Band Width & Quality Factor of Series And Parallel Circuit	
Week-8	**IMPEDANCE AND ADMITTANCE PARAMETERS**
Evaluate The Z And Y Parameter of the Electrical Networks.	
Week-9	**TRANSMISSION AND HYBRID PARAMETERS**
Evaluate The Abcd And H Parameter of the Electrical Networks.	
Week-10	**OPEN CIRCUIT, SHORT CIRCUIT & LOAD TEST ON SINGLE PHASE TRANSFORMER**
To Calculate The Efficiency of Single-Phase Transformer.	

Week-11	**PERFORMANCE CHARACTERISTICS OF A DC SHUNT MOTOR**
To find the Torque-Speed Characteristics of DC Shunt Motor.	
Week-12	**MAGNETIZATION CHARACTERISTICS OF DC SHUNT GENERATOR**
To Draw Theopen Circuit Characteristics of DC Shunt Generator	
Week-13	**TORQUE-SPEED CHARACTERISTICS OF A THREE-PHASE INDUCTION MOTOR.**
To find the Torque-Slip Characteristics of Induction Motor	

Reference Books:

1. Department Lab Manual
2. A. Chakrabarthi, " Circuit Theory", DhanpatRai Publications, 6th Edition,2006
3. V K Mehta, Rohit Mehta, "Principles of Electrical Machines", S Chand Publications, 1st Edition,2006
4. I Nagrath& DP Kothari, "Electrical Machines", Mcgraw Hill Education Publications, 4th Edition, 2010.

Web References:

1. http://www.ee.iitkgp.ac.in
2. http://www.citchennai.edu.in

ENGINEERING WORKSHOP

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6ME04	ESC	0	0	3	1.5	40	60	100

COURSE OUTCOMES:

At the end of the course the student should be able to:

1. Assemble the different components
2. Identify and apply suitable tools for different trades of Engineering processes.
3. Practice on manufacturing of components using workshop trades including Soldering, Carpentry, Fitting and Tin smithy & Fabricate Components with their own hands.
4. Apply basic electrical engineering knowledge for house wiring practice.
5. Learn the safety precautions for various operations in basic trades.

WEEKS	TRADES FOR EXERCISES
	Fitting
Week 1	Filing Four Sides of MS Work piece
Week 2	L Fit
	Carpentry
Week 3	Half Lap Joint
Week 4	Dove Tail Joint
	Tin Smithy
Week 5	Prepare a Rectangular Tray
Week 6	Prepare A Square Tin
	Electrical
Week 7	Series and Parallel Connection One Way Switch
Week 8	Two Way Switch Connection Stair Case Wiring
	Electronics
Week 9	Soldering - Series Connection & Parallel Connection
Week 10	Desoldering& Construction of Wheat stone bridge
	TRADES FOR DEMONSTRATION AND EXPOSURE
Week 11	Introduction to Black smithy
Week 12	Introduction to Plumbing

TEXT BOOKS

1. Work shop Manual - P. Kannaiah/ K.L. Narayana/ Scitech.
2. Workshop Manual / K. Venugopal / Anuradha.

REFERENCE BOOKS:

1. HajraChoudhury S.K., HajraChoudhuryA.K.andNirjhar Roy S.K., “Elements of Workshop Technology”, Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2. Workshop Manual / Venkat Reddy/ BSP

ENVIRONMENTAL SCIENCE								
CourseCode:	**Category**	**Hours/Week**			**Credits**	**MaximumMarks**		
		L	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
A6BS11	**MC**	3	0	0	0	40	60	100
Contact Classes: 30	**Tutorial Classes:0**	**Practical Classes:--0**				**Total Classes:30**		

COURSEOUTCOMES:

OnSuccessfulcompletionofthiscourse,Studentswillbeableto

1. Identify the consequences of human actions on the web of life, global economy and quality of human life.
2. Evaluate the strategies for scientific, social, economic and legal environmental protection.
3. Study the impact of conservation of biodiversity.
4. Analyze the reasons for environmental pollution.
5. Assess the environmental impact of air, water, biological and socio-economical aspects and risk assessment towards sustainable future.

UNIT-I	ECOSYSTEMS	CLASSES:7

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structureandfunctionofanecosystem,Foodchains,foodwebandecologicalpyramids.

Flow of energy,Biogeochemicalcycles,Bioaccumulation,Biomagnification,ecosystemvalue,servicesandcarryingcapacity.

UNIT-II	NATURAL RESOURCES	CLASSES: 8

NaturalResources: Classification of Resources: Living and Non-Living resources,water resources: use and over utilization of surface and ground water, floods anddroughts, Dams: benefitsand problems-case studies. Mineral resources: useandexploitation,environmentaleffects of extracting andusingmineralresources.Landresources:Forestresources.

Energyresources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT-III	BIODIVERSITY AND BIOTIC RESOURCES	CLASSES: 5

BiodiversityandBioticResources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values.

India as a mega diversity nation: Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity Act-Case studies.

UNIT-IV	ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES	CLASSES:5

EnvironmentalPollutionandControlTechnologies: Environmental Pollution: Classification of pollution, Air Pollution, Water Pollution drinking water quality standards. Soil Pollution Impacts of modern agriculture, Noise Pollution Health hazards, standards. Concepts of bioremediation.

GlobalEnvironmentalProblemsandGlobalEfforts: Ozone depletion and Ozone depleting substances (ODS) Concepts of Bioremediation International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol; NAPCC-GoI Initiatives, COP 24, COP25.

UNIT-V	ENVIRONMENTAL POLICY, LEGISLATION & EIA	CLASSES:5

EnvironmentalPolicy,Legislation&EnvironmentalImpactAssessment(EIA): Environmental Protection act, Legal aspects Air Act1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management, biomedical waste management hazardous waste management and handling rules.

Environmental Impact Assessment: EIA structure, methods of baseline data acquisition. Strategies for risk assessment, Towards Sustainable Future: Concept of Sustainable Development, Urban Sprawl, Concept of Green Building.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharuch a for University Grants Commission.

2. Environmental Studies by R.Rajagopalan, Oxford University Press.

I YEAR-
II SEMESTER

NUMERICAL METHODS AND INTEGRAL TRANSFORMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6BS02	BSC	3	1	-	4	40	60	100
Contact Classes: 44	Tutorial Classes: 08	Practical Classes: Nil				Total Classes: 52		

Course Objectives

To learn
1. Curve fitting and Interpolation techniques.
2. Numerical techniques.
3. Fourier series for periodic function
4. Laplace transforms
5. Concept and application of Fourier Transforms and Vector differentiation.

UNIT-I	INTERPOLATION AND CURVE FITTING	Classes: 08

INTERPOLATION: Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Difference of a polynomial – Missing terms - Newton's forward interpolation, Newton's backward interpolation, Gauss's forward and backward interpolation formulae. Interpolation with unequal intervals – Lagrange's interpolation.
CURVE FITTING: Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of theform $y= a e^{bx}$, $y= a x^{b}$, $y = a b^{x}$ by the method of least squares.

UNIT-II	NUMERICAL TECHNIQUES	Classes: 08

ROOT FINDING TECHNIQUES:
Bisection method Regulafalsimethod,Iteration method and Newton Raphson method.
NUMERICAL INTEGRATION :
Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule.
NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:
Taylor's series method – Euler's - modified Euler's Method – Runge-Kutta method.

UNIT-III	FOURIER SERIES	Classes:10

Periodic function-Determination of Fourier Coefficients-Fourier Series-Even and Odd functions-Fourier series in arbitrary interval-Half range Fourier sine and cosine expansions.

UNIT-IV	LAPLACE TRANSFORMS	Classes: 10

Laplace transforms of elementary functions- First shifting theorem - Change of scale property – Multiplication by t^n- Division by t – Laplace transforms of derivatives and integrals – Unit step function – Second shifting theorem – Periodic function – Evaluation of integrals by Laplace transforms – Inverse Laplace transforms- Method of partial fractions – Other methods of finding inverse transforms – Convolution theorem – Applications of Laplace transforms to ordinary differential equations.

UNIT-V	FOURIER TRANSFORMS AND VECTOR DIFERENTIATION	Classes: 10

Fourier Integral theorem (Statement only)-Fourier Sine and Cosine Integrals, Fourier Transforms, Cosine and Sine transforms, properties, Inverse transforms.
Vector functions, vector differentiation, gradient, directional derivative, divergence, curl and scalar potential.

Text Books:

1. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.

Reference Books:

1. G.B.Thomas, calculus and analytical geometry,9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal ,A Text of Engineering Mathematics,Laxmi publications,2008.
3. E.L.Ince, Ordinary differential Equations,Dover publications,1958.

Web references:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://www.ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E -Text Books:

1.https://www.e-booksdirectory.com/details.php?ebook=10166

CS Course:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/

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

1. Apply Curve fitting and Interpolation techniques.
2. Apply various numerical techniques
3. Find the Fourier series of the periodic functions.
4. Obtain the Laplace tranforms of functions
5. Find Fourier transforms and apply vector differentiation techniques.

APPLIED PHYSICS

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6BS07	BSC	3	1	0	4	40	60	100
Contact Classes: 44	Tutorial Classes: 08	Practical Classes: Nil				Total Classes: 52		

Course Objectives:
The course should enable the students to:
1. Learn the basic principles of quantum physics and its applications
2. Understand the formation of energy bands and atomic structure in solids for material classification
3. Understand the underlying mechanism involved in construction and working properties of different types of semiconductor devices
4. Learn the basic principles of laser and optical fiber in information technology
5. Identify the importance of nanoscale and various fabrication and characterization techniques and quantum computations in engineering applications

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

1. **Analyze** the microscopic properties of materials using principles of quantum physics for engineering applications
2. **Explain** the behavior of different electronic materialsbased on the concepts of band theory
3. **Apply** the knowledge of Solar PV cells for choice of materials in efficient alternate energy generation
4. **Gain** the knowledge of production of laser and usage of fibers in fiber optic communication technology
5. **Comprehend** the knowledge of quantum physics in quantum computation for secure information Technology

UNIT-I	Quantum Physics	Classes: 10

Black body radiation, Stefen-Boltzmann"s law, Planck's radiation law (Qualitative treatment), Photoelectric effect, Waves and Particles, de Broglie Hypothesis, Matter Waves, Davisson and Germer's experiment, Heisenberg's Uncertainty Principle, Schrodinger's Time Independent Wave Equation, Physical Significance of the wave Function, Particle in One Dimensional Potential Box.

UNIT-II	Electronic properties of Materials&Band theory of solids	Classes: 10

Electronic properties of Materials: Classical free electron theory and Quantum free electron theories of metals, success and drawbacks,Bloch theorem, Kronig-Penny model (Qualitative treatment), E-k diagram, effective mass of electron.
Band theory of solids: Origin of energy band formation in solids, Fermi energy level, Fermi-Dirac distribution law, Classification of materials as conductors, insulators and semiconductors.

UNIT-III	Semi-conductors & Semiconductor Devices	Classes: 08

Semiconductors: Intrinsic and Extrinsic Semiconductors, formation of PN junction diode and its V-I characteristics, Direct and Indirect band gap semiconductors, Hall effect and its applications.

Semiconductor Devices: Construction, working and V-I characteristics of PIN Diode, LED, Solar cell and their applications.

UNIT-IV	Laser & Fiber Optics	Classes: 12

Laser: Characteristics of Laser, Absorption, Spontaneous and Stimulated emission of radiations. Lasing actions-Pumping mechanism, Meta stable state and Population inversion, Nd-YAG laser, CO2 laser, Applications of lasers in different fields.

Fiber Optics: Structure of fibers, Total Internal Reflection, Acceptance angle – Numerical Aperture, Types of fibers- SI and GI fibers, Single and Multimode fibers - SMSI, MMSI, MMGI, Fiber Optic Communication system, Signal Degradation - Attenuation mechanism, Dispersion, Applications of fibers in different fields.

UNIT-V	Physics of Quantum computing &Quantum gates	Classes: 10

Physics of Quantum computing: Idea of classical bits and qubits, advantages with qubits over classical bits, Bloch vector representation of state of qubits.

Quantum gates-Single qubit logic gates- Pauli X, Y, Z and Hadmard gate in matrix form, Two level gates-CNOT and SWAP gates and representation in matrix form, Comments on No cloning theorem, Entanglement, Quantum Teleportation – Basic Idea, Quantum Key distribution protocol - BB84 protocol.

Text Books:

1. P.K Palanisamy, Engineering Physics, Sitech Publications, 2013, IVth Ed.
2. Nielsen M. A., I. L Chung, Quantum Computation & Quantum Information, Cambridge Univ. Press.
3. M. N. Avadhanulu, P.G. Kshirsagar& TVS Arun Murthy" A Text book of Engineering Physics"- S. Chand Publications, 11th Edition 2019.

Reference Books:

1. Quantum Physics, H.C. Verma, TBS Publiication, 2nd Edition 2012
2. Fundamenttals of Physics – Halliday, Resnick and Walker, John Wiley & Sons, 11th Edition, 2018.
3. Engineering Physics by Shatendra Sharma and Jyotsna Sharma, Pearson Publication,2019
4. B.K Pandey and Chaturvedi, Engineering Physics, Cengage Learning, 2nd Edition, 2022

PROGRAMMING FOR PROBLEM SOLVING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6CS02	ESC	3	-	-	3	40	60	100
Contact Classes: 64	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 64		

Course Objectives :

1) To familiarize with the syntax and semantics of C programming language.
2) To learn the usage of structured programming approach in solving problems.
3) To use arrays, pointers, strings and structures in solving problems.
4) To understand how to solve problems related to matrices, Searching and sorting.
5) To understand how to use files to perform read and write operations.

Course Outcomes :

1) Apply algorithmic thinking to understand, define and solve problems
2) Develop computer programs using programming constructs and control structures and to use arrays to develop C programs
3) Decompose a problem into functions to develop modular reusable code and to use pointers to solve complex problems.
4) Use Strings and structures to formulate algorithms and programs.
5) Use FILE to perform read and write operations.

UNIT-I	INTRODUCTION - PROBLEM SOLVING AND ALGORITHMIC THINKING & INTRODUCTION TO C LANGUAGE	Classes: 12

Algorithm -Definition, Characteristics of Algorithm.Constituents of algorithms**: -** Sequence, Selection and Repetition. Algorithm with Example: Roots Of a Quadratic Equations, Minimum And Maximum Numbers of a Given Set, Given number is prime number or not, given integer is palindrome or not, etc. Flowchart/Pseudo Code with examples.

Introduction To C Language: Structure of C Program, Data Types, data input and outputstatements, Operators, Precedenceand Associativity of operators , Evaluation of Expressions, Type Conversions In Expressions.

UNIT-II	CONTROL STRUCTURES AND ARRAYS	Classes: 15

Control structures: Decision statements; if and switch statement; **Loop control statements:** while, for and do while loops, Jump statements: break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi dimensional arrays

UNIT-III	FUNCTIONS AND POINTERS	Classes: 17

Functions: Function definition, Types of Functions: User defined and built-in Functions, Advantages of User Defined Functions. Parameter passing in functions**:** Call by value, Call by reference, Passing arrays to functions, Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Towers of Hanoi etc.. Storage classes.

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, Functions returning pointers, Dynamic memory allocation.

UNIT-IV	STRINGS AND USER DEFINED DATA TYPES	Classes: 10

Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, String Handling Functions, Arrays Of Strings
Structures and Unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, Structures and functions, Self-referential structures, unions, typedef, enumerations.

UNIT-V	FILE HANDLING , SEARCHING AND SORTING	Classes: 10

File Handling: Command Line Arguments, File Modes, Basic File Operations Read, Write And Append, Example Programs. Random Access Using fseek, ftell and rewind Functions.
Basic Searching And Sorting Algorithms: Linear and Binary Search, Bubble Sort ,Insertion Sort, Quick Sort.

Text Books:

1) B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)
2) Byron Gottfried, "Programming with C", Schaum's Outlines Series, McGraw Hill Education, 3rdedition, 2017.
3) Programming in C E. Balagurusamy Edition 3 Publisher Tata McGraw-Hill Publishing, 1990

Reference Books:

1) W. Kernighan Brian, Dennis M. Ritchie, "The C Programming Language", PHI Learning, 2nd Edition, 1988.
2) YashavantKanetkar, "Exploring C", BPB Publishers, 2nd Edition, 2003.
3) Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014.4. R. S. Bichkar, "Programming with C", Universities Press, 2nd Edition, 2012.
4) DeyPradeep, ManasGhosh, "Computer Fundamentals and Programming in C", Oxford University Press, 2nd Edition, 2006.
5) Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.

Web References:

1. https://en.wikipedia.org/wiki/Computational_thinking
2. https://nptel.ac.in/courses/106/104/106104128/
3. https://en.cppreference.com/w/c/language
4. https://www.learn-c.org/

E-Text Books:

1. https://slidelegend.com/queue/computational-thinking-for-the-modern-problem solver_59d6f01e1723ddb0c7a0df47.html
2. http://flowgorithm.altervista.org/#elf_l1_Lw
3. http://www.freebookcentre.net/Language/Free-C-Programming-Books-Download.htm

MOOC Course

1) https://www.coursera.org/learn/computational-thinking-problem-solving
2) https://onlinecourses.nptel.ac.in/noc18_cs33/preview
3) https://www.alison.com/courses/Introduction-to-Programming-in-c
4) http://www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s096-effective programming-in-c-and-c-january-iap-2014/index.html

ELECTRONIC DEVICES AND CIRCUITS

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC01	ESC	2	0	0	2	40	60	100
Contact Classes: 45	Tutorial Classes: 00	Practical Classes: Nil				Total Classes: 45		

Course Objectives:

The course should enable the students to:

1. To introduce components such as diodes, BJTs and FETs.
2. To know the applications of devices.
3. To know the switching characteristics of devices.

Course Outcomes:

At the end of the course students will be able to:

1. Acquire the knowledge of various electronic devices and their use on real life.
2. Understand the importance of application of diodes.
3. Know the applications of Bipolar Junction Transistor.
4. Analyze the concept on Junction Field Effect Transistor.
5. Acquire the knowledge about the role of special purpose devices and their applications.

UNIT-I	DIODES	Classes: 8

Diode-Static and Dynamic resistances, Equivalent circuit, Diffusion and Transition Capacitances,V-I Characteristics, Diode as a switch-switching times.

UNIT-II	DIODE APPLICATIONS	Classes: 8

Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifiers with Capacitive and Inductive Filters, Clippers-Clipping at two independent levels, Clamper-Clamping Circuit Theorem, Clamping Operation, Types of Clampers.

UNIT-III	BIPOLAR JUNCTION TRANSISTOR (BJT)	Classes: 8

Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch, switching times,

UNIT-IV	JUNCTION FIELD EFFECT TRANSISTOR (FET)	Classes: 10

Construction, Principle of Operation, Pinch-Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET, FET as Voltage Variable Resistor, MOSFET, MOSFET as a capacitor.

UNIT-V	SPECIAL PURPOSE DEVICES	Classes: 11

Zener Diode-Characteristics, Zener diode as Voltage Regulator, Principle of Operation-SCR, Tunnel diode, UJT, Varactor Diode, Photodiode, Solarcell, LED, Schottky diode.

TEXT BOOKS:

1. Jacob Millman-Electronic Devices and Circuits, McGrawHillEducation
2. RobertL.Boylestead,LouisNashelsky-ElectronicDevicesandCircuitstheory,11th Edition,2009,Pearson.

REFERENCE BOOKS:

1. Horowitz-ElectronicDevicesandCircuits, DavidA. Bell–5th Edition,Oxford.
2. ChinmoySaha,ArindamHalder,DebaatiGanguly-BasicElectronics-PrinciplesandApplications,Cambridge,2018.

ENGINEERING DRAWING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6ME02	ESC	1	-	3	2.5	40	60	100

COURSE OUTCOMES:

At the end of the course the student should be able to:

1. Understand various commands and create drawing in AutoCAD.
2. Construct various engineering curves and know their importance.
3. Prepare orthographic projections of objects by visualizing them in different positions.
4. Solve the problem of projections of planes and solids in different positions.
5. Construct the isometric view into orthographic views and vice versa.

UNIT-I	INTRODUCTION TO ENGINEERING DRAWING

Introduction to Engineering Drawing: Principles and their significance.
Introduction to Computer Aided Drafting: Initial Setup Commands, Draw Commands, modify commands, 2D Drawings-Simple Exercises.

UNIT-II	ENGINEERING CURVES

Engineering Curves: Ellipse, Parabola, and Hyperbola (General Method only), Involutes.

UNIT-III	ORTHOGRAPHIC PROJECTIONS OF POINTS AND LINES

Principles of Orthographic Projections –Projections of points.
Projection of lines inclined to both planes (First angle projection only).

UNIT-IV	PROJECTIONS OF PLANES AND SOLIDS

Projections of Planes: Projections of regular planes inclined to one plane.
Projection of Solids**:** Solids inclined to one plane (Regular solids).

UNIT-V	ISOMETRIC VIEW AND ORTHOGRAPHIC VIEWS - CONVERSION

Isometric view: Drawing Isometric circles, Dimensioning Isometric Objects.
Conversion of Isometric view to Orthographic views and Orthographic to isometric view.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing House.
2. Agrawal B. &Agrawal C. M., Engineering Graphics, TMH Publication.

Reference Books:

1. D.M. Kulkarni, A.P.Rastogi, A.K. Sarka “Engineering Graphics with AutoCAD” PHI publications.
2. Narayana, K.L. & P Kannaiah, Text book on Engineering Drawing, Scitech Publishers.
3. Shah, M.B. &Rana B.C., Engineering Drawing and Computer Graphics, Pearson Education.

APPLIED PHYSICS LAB

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6BS08	BSC	0	0	3	1.5	40	60	100

Course Objectives:

The course should enable the students to:

1. Understand the temperature and other dependent properties of semiconductor devices and their usages in different applications
2. To know the Laser and Fibre optic technologies and its applications in real time scenario
3. Understand the electromagnetic properties using experimental knowledge
4. Understand the method of least squares fitting

Course Outcomes:

By the end of the course students will be able to:

1. **Analyze** the electric properties of semiconductor materials by determining energy gap of semiconductors, charge carrier concentration in Semiconductors using Hall effect and threshold voltage of LEDs, photo current in Photo diodes, solar cell, and temperature effect on resistance using thermistor.
2. **Identify** the optical properties of light such as diffraction phenomenon using grating material for calculation of the wavelength of Laser and acceptance angle, NA of optical fiber using OFC and determine the value of Plank's constant using a light source and interference by using Newton's rings
3. **Analyze** the electromagnetic properties of a current carrying coil by using Stewart Gee's experiment
4. **Analyze** the least squares fitting method for data analysis using experimental data of Tensional pendulum

APPLIED PHYSICS LABORATORY

LIST OF EXPERIMENTS

Experiment-1	**ENERGY GAP OF P-N JUNCION DIODE:** To determine the energy gap of a given semiconductor diode
Experiment-2	**SOLAR CELL:** To study the V-I and V-P characteristics and determine the fill factor of solar cell
Experiment-3	**LIGHT EMITTING DIODE:** To study the characteristics of LED by plotting V-I graph and determine the threshold value of given LEDs
Experiment-4	**HALL EFFECT:** To determine Hall co-efficient and charge carrier concentration of a given semiconductor
Experiment-5	**PIN PHOTO DIODE:** To study the V-I Characteristics of Photo Diode with respect to intensity of light
Experiment-6	**OPTICAL FIBRE:** To determine the numerical aperture and acceptance angle of an optical fiber
Experiment-7	**LASER:** To determine the wavelength of a given laser source by using diffraction grating method
Experiment-8	**NEWTON'S RINGS:** To determine the radius of curvature of a given Plano convex lens by forming Newton's rings
Experiment-9	**THERMISTOR:** To study the variation of resistance with respect to temperature using thermistor
Experiment-10	Understanding the method of least squares - Torsional pendulum as an example

Experiment-11	**PLANCK'S CONSTANT:** To determine value of planck's constant by measuring radiation in fixed spectral range
Experiment-12	**STEWART GEE'S EXPERIMENT:** To study the variation of magnetic field along the axis of a circular coil and calculation of magnetic flux
Note: Students have to perform any 8 experiments	
Reference Books:	
1. "Applied Physics Lab Manual"- Dr. Radhika Devi, Mr. A V LaxmanRao, N. Noel 2. S. Balasubramanian, M.N Srinivasan "A Text book of practical Physics" – S Chand Publishers, 2017.	

ROGRAMMING FOR PROBLEM SOLVING LAB

I - II Semester: **Common to all branches**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6CS03		-	-	3	1.5	40	60	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes:36		

COURSE OBJECTIVES:

1) To be familiarize with flowgorithm to solve simple problems
2) To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
3) To develop modular, reusable and readable C Programs using the concepts like functions, arrays,strings, pointers and structures.

COURSE OUTCOMES:

At the end of the course, student will be able to

1) Solve simple mathematical problems using Flowgorithm.
2) Correct syntax errors as reported by the compilers and logical errors encountered at run time Develop programs by using decision making and looping constructs.
3) Implement real time applications using the concept of array, pointers, functions and structures.

Solve real world problems using matrices, searching and sorting.

LIST OF EXPERIMENTS

Week-1	INTRODUCTION TO FLOGORITHM

1. Installation and working of Flowgorithm Software.
2. Write and implement basic arithmetic operations using Flowgorithm – sum, average, product, difference, quotient and remainder of given numbers etc.
3. Draw a flowchart to calculate area of Shapes (Square, Rectangle, Circle and Triangle).
4. Draw a flowchart to find the sum of individual digits of a 3 digit number
5. Draw a flowchart to read input name, marks of 5 subjects of a student and display the name of the student, the total marks scored, percentage scored.
6. Draw a flowchart to find roots of a quadratic equation.
7. Draw a flowchart to find the largest and smallest among three entered numbers and also display whether the identified largest/smallest number is even or odd
8. Draw a flowchart to check whether the triangle is equilateral, isosceles or scalene triangle
9. Draw a flowchart to check whether a given number is palindrome or not.

Week-2	BASIC DATA TYPES

1) Write a C program to find division of 1 integer 1 float numbers.
2) Write a C program to find division of 2 integer numbers.
3) Write a C program to find average of (1int,1float) numbers.
4) Write a C Program to Swap Numbers without Using Temporary Variable
5) Write a C Program to Swap two Numbers Using Temporary Variable
6) Write a C Write a program to read the values of x, y and z and print the results of the following expressions in one line.
   a) (x+y+z) / (x-y-z)
   b) (x+y+z) / 3
   c) (x+y) * (x-y) * (y-z)

Week-3	OPERATORS

1) Write a C program to convert temperature from Fahrenheit to Celsius and vice versa (c=(fh-32)/1.8
2) Write a C program to find area and perimeter of a circle. (area=∏r2 perimeter=2∏r)
3) Write a C program to calculate area and perimeter of a right angled triangle.
   a. (Area=1/2*b*h perimeter=w+h+sqrt(w*w+h*h)
4) Find the sum of natural numbers 1 to n.(read n as input) (Use formula sum=n(n+1)/2
5) Write a C program to calculate Simple interest (SI=PTR/100)
6) Write a C program to calculate area and perimeter of a rectangle. Area=l*b Perimeter=2*(l+b)
7) Write a C program to calculate the value of the third angle of a triangle if two angles are given as input.(a+b+c=180)
8) Write a C program to read the consumer number and number of units consumed and the cost per unit and print the amount to be paid. (Amt=num of units*cost)
9) Write a C Program to calculate area and perimeter of a triangle.
   a. Perimeter=(a+b+c)
   b. s=(a+b+c)/2
   c. Area=sqrt(s*(s-a)(s-b)*(s-c))
10) Write a C program to read five Subject marks and find the average.
11) Write a C program to Calculate Compound interest (CI=p(1+r/100)n

Week-4	CONDITIONAL STATEMENTS

1. Write a C program to find largest and smallest of given numbers.
2. Write a C program which takes two integer operands and one operator form the user(+,-,*,/,% use switch)
3. Write a program to compute grade of students using if else adder. The grades are assigned as followed:
   marks<50 F
   50≤marks< 60 C
   60≤marks<70 B
   70≤marks B+
   80≤marks<90 A
   90≤mars≤ 100 A+
4. Write a C program to whether given year leap year or not.
5. Write a C program to find whether given triangle is scalene or isosceles or equilateral.

Week-5	LOOPING STATEMENTS

1) Write a C program to find Sum of individual digits of given integer
2) Write a C program to generate first n terms of Fibonacci series
3) Write a C Program to find the Sum of Series SUM=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!
4) Write a C program to print the Fibonacci sequence up to given value of n.
5) Write a C program to print the multiplication table to the given value of n.
6) Write a C program to check whether given number is palindrome or not
7) Write a C program to check whether given number is perfect or not

Week-6	NESTED LOOPING STATEMENTS

1) Write a C program to generate prime numbers between 1 and n
2) Write a C program to generate Pascal's triangle.
3) Write a C program to generate the following pyramid of numbers.

```
        1
      1   3   1
    1   3   5   3   1
```

4) Write a C program to generate the pattern

```
*****
****
***
**
*
```

Week-7	ARRAYS

1) Write a C Program to implement following searching methods
   i. Binary Search
   ii. Linear Search
2) Write a C program to find largest and smallest number in a list of integers
3) Write a C program
   i. To add two matrices
   ii. To multiply two matrices
4) Write a C program to find Transpose of a given matrix

Week-8	FUNCTIONS

1) Write a C program to find the factorial of a given integer using non recursive functions
2) Write a C program to find GCD of given integers using non recursive functions
3) Write a C Program to find the power of a given number using non recursive functions
4) Write a C program to find sum of natural numbers using non recursive function.
5) Write a C program to reverse a given integer number using non recursive functions
6) Write a C Program to find binary equivalent of a given decimal number using recursive functions.
7) Write a C Program to print Fibonacci sequence using recursive functions.
8) Write a C Program to find LCM of 3 given numbers using recursive functions
9) Write a C program to find the factorial of a given integer using recursive functions

10) Write a C program to print fibonocci series till n terms using recursion.

Week-9	STRINGS

1) Write a C program using to Insert a sub string into a given main string from a given position
2) Write a C program using to Delete n characters from a given position in a string
3) Write a C program to determine if given string is palindrome or not
4) Write C Programs to demonstrate the following string handling functions.
   a. strcat()
   b. strcmp()
   c. strrev()
   d. strcpy()
   e. strlen()
   f. strstr()
   g. strncpy()
   h. strncat()
   i. strncmp()

Week-10	POINTERS

1) Write a C program to read the elements of 1-d array using pointers and print them in reverse order using pointers.
2) Write a C Program to read two elements dynamically using malloc() function and interchange the two numbers using call by reference.
3) Write a C Program to read and print the elements of 1-D array using calloc() memory allocation function and reallocate memory for the array by increasing the size of the array, read and print the elements of reallocated array.
4) Write a C Program to print 2-D array using pointers.

Week-11	STRUCTURES

1) Write a C Program using functions to
   a) Reading a complex number
   b) Writing a complex number
   c) Add two complex numbers
   d) Multiply two complex numbers

Note: represent complex number using structure

2) Write a C program to read employee details employee number, employee name, basic salary, hra and da of n employees using structures and print employee number, employee name and gross salary of n employees.

Week-12	FILES

1) Write a C program to read and print the content of a file.
2) Write a C program copy the content of one file to another file
3) Write a C program to merge two file into third file.
4) Write a C Program to find the number of lines in a text file

Text Books:

1) Riley DD, Hunt K.A. Computational Thinking for the Modern Problem Solver. CRC press, 2014 Mar 27.
2) B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition) YashavantKanetkar, "Let Us C", BPB Publications, New Delhi, 13th Edition, 2012.

Reference Books:

1) Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018
2) King KN, "C Programming: A Modern Approach", Atlantic Publishers, 2nd Edition, 2015.
3) Kochan Stephen G, "Programming in C: A Complete Introduction to the C Programming Language", Sam's Publishers, 3rd Edition, 2004.
4) Linden Peter V, "Expert C Programming: Deep C Secrets", Pearson India, 1st Edition, 1994.

REFERENCE BOOKS:

1. Jacob Millman-Electronic Devices and Circuits, McGraw Hill Education
2. Robert L.Boylestead, Louis Nashelsky-Electronic Devices and Circuits theory,11thEdition, 2009,Pearson.
3. David A. Bell -Electronic Devices and Circuits,5thEdition,Oxford.

ELECTRONIC DEVICES AND CIRCUITS LABORATORY

Course Code:	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC02	ESC	0	0	3	1.5	40	60	100

Course Objectives:

1. To introduce components such as diodes, BJTs and FETs.
2. To know the applications of devices.
3. To know the switching characteristics of devices.

Course Outcomes:

By the end of the course students will be able to:

1. Acquiretheknowledgeofvarioussemiconductor devicesandtheir useinreallife.
2. Designaspectsofbiasingandkeeptheminactiveregionofthedeviceforfunctionalcircuits
3. Acquiretheknowledgeabouttheroleofspecialpurposedevicesandtheirapplications.

LIST OF EXPERIMENTS

Experiment-1	PN Junction diode characteristics. a) Forward bias, b) Reverse bias.
Experiment-2	Full Wave Rectifier with &without filters
Experiment-3	Types of Clippers at different reference voltages
Experiment-4	Types of Clampers at different reference voltages
Experiment-5	The steady state output waveform of clampers for a square wave input
Experiment-6	Input and output characteristics of BJT in CB Configuration
Experiment-7	Input and output characteristics of BJT in CE Configuration
Experiment-8	Input and output characteristics of BJT in CC Configuration
Experiment-9	Input and output characteristics of MOSFET in CS Configuration
Experiment-10	Input and output characteristics of MOSFET in CD Configuration
Experiment-11	Switching characteristics of a Transistor
Experiment-12	Zener diode characteristics and Zener as voltage Regulator
Experiment-13	Photodiode characteristics
Experiment-14	Solar cell characteristics
Experiment-15	LED Characteristics *Design a circuit to switch on and off LED using diode/BJT/FET as a switch.

II YEAR-
I SEMESTER

ANALOG CIRCUITS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC05	PCC	3	0	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To know about the various transistor amplifier circuits and their frequency responses at low, mid and high frequencies.
2. Know the design amplifier circuits using BJTs.
3. Know the concepts of both positive and negative feedback in electronic circuits.
4. Able to construct &analyze oscillator circuits.
5. Able to design the linear and non-linear applications of an op-amp and special application ICs.

COURSE OUTCOMES:

The course should enable the students to:

1. Analyze various transistor amplifier circuits and their frequency responses at low, mid and high frequencies.
2. Designing amplifier circuits using BJTs.
3. Analyze the concepts of both positive and negative feedback in electronic circuits.
4. Design, construct &analyze oscillator circuits to generate signals in various frequency ranges.
5. Elucidate and design the linear and non-linear applications of an op-amp and special application ICs

UNIT-I	SINGLE STAGE AMPLIFIER AND MULTISTAGE AMPLIFIER	Classes: 12

SINGLE STAGE AMPLIFIERS: Classification of Amplifiers, Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model, Analysis of CE amplifier with emitter resistance. Miller's theorem and its dual, Design of single stage RC coupled Amplifier using BJT.
MULTISTAGE AMPLIFIERS: Different Coupling Schemes used in Amplifiers. Analysis of Cascaded RC coupled amplifier, Cascode Amplifier and Darlington Pair.

UNIT-II	SMALL SIGNAL AND LARGE SIGNAL AMPLIFIER ANALYSIS	Classes: 12

BJT AMPLIFIERS: Frequency response, effect of coupling and bypass capacitors, hybrid-πmodel of CE amplifier, CE short circuit current gain, Gain-Bandwidth Product.
LARGE SIGNAL AMPLIFIERS: Classification, series fed and transformer coupled class A power amplifiers. Efficiency of Class A amplifiers. Push pull and complementary symmetry Class B power amplifiers, Efficiency of Class B amplifiers. Distortion in Power Amplifiers.

UNIT-III	CONCEPTS OF FEEDBACK AMPLIFIER AND OSCILLATORS	Classes: 10

NEGATIVE FEEDBACK AMPLIFIERS: General characteristics of negative feedback amplifiers. Effect of negative feedback on amplifier characteristics. Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations.
OSCILLATORS: Barkhausen criterion, RC Phase shift oscillators, Wien Bridge oscillators, Hartley oscillators, Colpitts oscillators, and crystal oscillators.

UNIT-IV	LINEAR AND NON LINEAR WAVE SHAPING	Classes: 14

LINEAR WAVE SHAPING: High pass and low pass RC circuits, their response for Step, Pulse and Square inputs. HPF as Differentiator and LPF as an integrator, basic concepts of attenuators.
NON-LINEAR WAVE SHAPING: Transistor clippers, Comparator and its applications.

UNIT-V	MULTIVIBRATORS AND SWEEP GENERATORS	Classes: 10

MULTIVIBRATORS: Analysis of Bistable, Monostableand Astable Multivibrators, Schmitt Trigger using Transistors.

SWEEEP GENERATORS: Operation and applications of bootstrap and Miller time base generators.

Text Books:

1. Jacob Milliman, Christos C. Halkias, Chetan D. Parikh (2015), Integrated Electronics-Analog and Digital Circuits and Systems, 2nd edition, Tata McGraw Hill Education Private Limited, NewDelhi.
2. G. K. Mithall (1998), Electronic Devices and Circuits, Khanna Publishers, New Delhi.
3. S.Anand Kumar, "Pulse and Digital circuits "Prentince hall of India, India 2005.

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky (2006), Electronic Devices and Circuits Theory, 9th edition, Pearson/Prentice Hall, India.
2. Jacob Millman, Arvin Grabel (2003), Microelectronics, 2nd edition, Tata McGraw Hill, New Delhi.Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4 th Edition, 2014.
3. Mothiki S. PrakashRao (2006), Pulse and Digital Circuits, Tata McGraw Hill, India

E-Text Books:

1. http://www.freebookcentre.net/Electronics/Analog-Circuits-Books.html
2. http://www.freebookcentre.net/Electronics/Operational-Amplifiers-Books.html

MOOCs Course

1. https://onlinecourses.nptel.ac.in/noc18_ee19/preview
2. http://www.nptelvideos.in/2012/12/circuits-for-analog-system-design.html

DATA STRUCTURES							
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**	
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
A6CS05	**PCC**	3	0	0	3	40	60	100

COURSE OBJECTIVES:

1. Impart the basic concepts of structures, pointers and data structures.
2. Understand concepts linked lists and their applications.
3. Understand basic concepts about stacks, queues and their applications.
4. Understand basic concepts of trees, graphs and their applications.
5. Enable them to write algorithms for sorting and searching

COURSE OUTCOMES:

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

1. Solve problems using data structures such as stacks and Queues.
2. Solve problems using singly linked lists and double linked list.
3. Compare various types of searching and sorting techniques in terms of implementation, operation and performance.
4. Implement Tree data structure and its variants.
5. Identify the importance and application of Graph data Structure with problem solving techniques

UNIT-I	**INTRODUCTION TO DATA STRUCTURES**	**Classes:09**

Introduction to Structures - Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self-referential structures, Pointer – Basics, Pointer to Structure.

Introduction to Data Structures- Definition, Linear Data Structures, Non-Linear Data Structures, Representation of single, two dimensional arrays, sparse matrices and their representation.

UNIT-II	**LINKED LIST**	**Classes:09**

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, Circularly linked lists- Operations-Insertion, Deletion, Doubly Linked Lists- Operations- Insertion, Deletion.

UNIT-III	**STACKS**	**Classes:09**

Stacks-Stack ADT, definition, operations, array and linked implementations in C,
Applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation

UNIT-IV	**QUEUES**	**Classes:09**

Queues-Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-array and linked implementations in C, Dequeue (Double ended queue)ADT, array and linked implementations in C.

UNIT-V	**SEARCHING & SORTING AND NON-LINEAR DATA STRUCTURES**	**Classes:09**

Searching- Linear Search, Binary Search, **Sorting**- Bubble Sort, Insertion Sort, Selection Sort, Quick sort, Merge Sort, Comparison of Sorting methods.

Non-Linear Data Structures-Trees – Introduction, Definition, Terminology, Applications, Tree Representations- List Representation, Left Child – Right Sibling Representation. **Graphs -** Introduction, Definition, Terminology, Applications, Graph Representations- Adjacency matrix, Adjacency lists

Text Books:

1. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education, 6th Edition, 2012.
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.
3. Data Structures using C, R.Thareja 2nd Edition, Oxford Pres0073

Reference Books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education

WEB REFERENCES:

1. https://hackr.io/tutorials/learn-data-structures-algorithms
2. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
3. https://www.udemy.com/introduction-to-algorithms-and-data-structures-in-c/
4. https://leetcode.com

E-TEXT BOOKS:

1. http://www.freetechbooks.com/algorithm-analysis-and-design-t1030.html
2. http://www.freetechbooks.com/algorithmic-problem-solving-t373.html
3. http://www.freetechbooks.com/algorithms-and-data-structures-the-basic-toolbox-t871.html

MOOCS COURSE

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://onlinecourses.nptel.ac.in/noc16_cs06/preview

SIGNALS AND SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC06	PCC	3	1	-	4	40	60	100

COURSE OVERVIEW:

This course is an introductory course to study about the signals and systems. This course explain about the Fourier series and its importance to analyse the signals in both time and frequency domain. This course presents the both continuous-time and discrete time transforms to explore the signals in time domain to frequency domain. This course presents the fundamental difference of continuous-time and discrete time signals with the help of sampling theorem. This course describes how both the Signal and system are linked by Signal Transmission through Linear Systems. This course presents the importance of convolution and correlation concepts

COURSE OBJECTIVES:

1. Learn the different types of signals and systems
2. Know the continuous and discrete systems in time and frequency domain using different transforms
3. Check the properties of continuous and discrete systems
4. Understand the properties to analyze the CT and DT signals and systems
5. Represent the LTI systems in the Time domain and various Transform domains

COURSE OUTCOMES:

After going through this course the student will be able to

1. Analyze the different types of signals and systems
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate the stability and causality of systems
4. Apply various transforms and its properties to analyze the CT and DT signals and systems
5. Characterize LTI systems in the Time domain and various Transform domains

SYLLABUS

UNIT-I	SIGNAL ANALYSIS	Classes:09

Signals: Introduction of signals, Elementary signals: unit step, unit ramp-unit impulse, sinusoidal, signum, exponential and sinc signals- Basic operations on signals: Time shifting, time reversal, time scaling, amplitude scaling, signal addition and signal multiplication with examples- Classifications of Signals: Energy and power signals, Even and Odd, Periodic and non-periodic, Causal Non causal, Deterministic and non-deterministic.

UNIT-II	FOURIER SERIES AND TRANSFORMS	Classes:10

Fourier Series: Representation of Fourier series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Properties of Fourier Series (statement only).

Fourier Transforms: Deriving Fourier Transform from Fourier Series, Fourier Transform of standard signals: Impulse function, single sided exponential, double sided exponential, constant amplitude, complex exponential function, sine wave, cosine wave and triangular functions- Properties of Fourier Transform: linearity, time shifting, frequency shifting, time scaling and time convolution with proof.

UNIT-III	SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS	Classes:09

Sampling: Sampling theorem – Graphical and analytical proof for Band Limited Signals, Types of Sampling: Impulse Sampling, Natural and Flat top Sampling- Effect of under sampling.

Systems: Continuous time Systems - representations of continuous time systems- Classifications of Systems based on properties: linearity, shift-invariance, causality, stability, static and dynamic.

Transfer function of a LTI system- Signal bandwidth- System bandwidth- Ideal LPF, HPF, BPF&BSF characteristics.

UNIT-IV	CONVOLUTION AND LAPLACE TRANSFORMS	Classes:09

Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution, **Laplace Transforms:** Laplace transform, Concept of Region of Convergence (ROC) in Laplace transform, Properties of Laplace Transform: linearity, Time shifting, Time Reversal, frequency shifting, Initial value and Final value theorem-Inverse Laplace Transform- problem solving - Relation between Laplace and Fourier Transform of a signal

UNIT-V	Z-TRANSFORMS	Classes:09

Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform-, properties of Z transform: linearity, Time shifting, Time Reversal, Correlation, Initial value and Final value theorem, Inverse Z-transform and problem solving.

Text Books:

1. Oppenheim A. V, Willisky (2009), *Signals and Systems*, 2nd edition, Prentice Hall of India, India.
2. A.Anand Kumar,*Signals and Systems*, 3rd edition, Prentice Hall of India, India.
3. P. Lathi (2001), *Signals, Systems & Communications*, BS Publications, New Delhi.

Reference Books:

1. Simon Haykin, Van Veen (2007), *Signals & Systems*, 2nd edition, Wiley publications, India.
2. HweiPiao Hsu, Schaums (2003), *Outline of Theory Problems of Signals and Systems*, McGraw Hill, India.
3. Charles L. Phillips, John M. Parr, Eve A. Riskin (2007), *Signals, Systems and Transforms*, Prentice Hall of India, New Delhi

Web References:

1. https://www.khanacademy.org/science/electrical-engineering/ee -signals/ee-fourier-series/v/ee-fourier series-intro
2. https://www.khanacademy.org/science/electrical-engineering/ee-signals
3. https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-3
4. https://www.edx.org/course/signals-and-systems-part-1-1

E-Text Books:

1. http://www.freebookcentre.net/Mathematics/Fourier-Analysis-Books.html
2. http://www.freebookcentre.net/Mathematics/Differential-Equations-Books_1.html

MOOCS Course

1. http://nptel.ac.in/courses/117101055/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
A6EC07	**ESC**	3	0	0	3	40	60	100

COURSE OBJECTIVES:

After going through this course the student will be able to

1. Apply knowledge of electronic instruments for measurement of electrical quantities.
2. Know the principles and operations of instruments.
3. Select and use latest hardware for measurements.
4. Identify the various instruments for various measurements
5. Use the instruments in laboratory and real life

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Apply knowledge of electronic instruments for measurement of electrical quantities.
2. Understand the concepts of digital instruments.
3. Understand the working principles of various oscilloscopes.
4. Identify the various instruments for various measurements
5. Analyze the applications of transducer and data acquisition systems.

UNIT-I	MEASUREMENT CONCEPTS	*Classes:10*

Measurement concepts : Quantities of Measurement- Performance Characteristics – Static and dynamic characteristics – units and standards of measurements – errors in measurements-accuracy and precision, statistical analysis – moving coil, moving iron types Instruments –DC Voltmeter multi-meter & Calibrations

UNIT-II	DIGITAL INSTRUMENTS AND SIGNAL GENERATORS	Classes:08

Digital instruments: Digital multi-meters – Digital frequency meter-digital tacho meter-digital PH meter-digital phase meter-digital capacitance meter-Microprocessor based instruments-IEEE 488 bus

Signal generators: Function generators – pulse and square wave generators, RF signal generators –Sweep generators– Frequency synthesizer

UNIT-III	CATHODE RAY OSCILLOSCOPES	Classes:09

Cathode ray oscilloscopes: Basic block diagram of CRO, features of CRT, triggered sweep CRO, dual beam CRO, dual trace CRO,

Special Oscilloscopes: delayed time base oscilloscopes, sampling oscilloscope, storage oscilloscope, digital storage oscilloscope, lissagious patterns.

UNIT-IV	MEASUREING INSTRUMENTS AND BRIDGES	Classes:09

Measuring instruments: Introduction-field strength meter –Q- meter- LCR Bridge-Transistor tester

Bridge: Wheatstone's bridges for resistance measurements-Maxwell's bridge for inductance measurements- Schering's bridge for capacitance measurements measurement

UNIT-V	TRANSDUCERS &DATA ACQUISITION SYSTEMS	Classes:10

Transducer: Introduction-electrical transducers-selecting a transducers-active and passive transducers with examples

Data acquisition systems: Elements of a digital data acquisition system – interfacing of transducers – multiplexing–data loggers –computer controlled instrumentation

Text Books:

1. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and MeasurementTechniques, Pearson / Prentice Hall of India, 2007.
2. Ernest O. Doebelin, Measurement Systems- Application and Design, TMH, 2007.

Reference Books:

1. Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, Pearson Education,2003.
2. Alan.S.Morris,PrinciplesofMeasurementsandInstrumentation,2ndEdition,Prentice HallofIndia,2003.
3. David A. Bell, Electronic Instrumentation and measurements, Prentice Hall of India Pvt Ltd, 2003.
4. B.C. Nakra and K.K. Choudhry, Instrumentation, Measurement and Analysis, 2nd Edition, TMH, 2004.
5. James W. Dally, William F. Riley, Kenneth G. McConnell, Instrumentation for EngineeringMeasurements,2nd Edition, John Wiley, 2003

WEB REFERENCES:

1. https://www.sciencedirect.com/science/book/9780123819604
2. https://www.schneider-electric.com/en/.../86485-measurement-and-instrumentation/

E-TEXT BOOKS:

1. https://books.google.co.in/books/about/Electronics_Measurements_And_Instrumenta.html?id=mxVRJRYCi-QC
2. https://sway.com/V1Uclj1JCiLhqcCb

MOOCS COURSE

1. https://www.schneider-electric.com/en/.../86485-measurement-and-instrumentation/
2. https://www.schneider-electric.com/en/.../86485-measurement-and-instrumentation/
3. https://www.coursera.org/courses?query=measurements%20and%20instrumentat

PROBABILITY THEORY AND STOCHASTIC PROCESSES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC08	ESC	3	1	0	4	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To know the various probability function.
2. Understand the concepts of random variable.
3. Know the operation of single random variable.
4. Understand the temporal characteristics in stochastic process.
5. Understand the spectral characteristics in stochastic process.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand the various probability function and theorem.
2. Analyze the application of random variable.
3. Understand the operations on single random variable.
4. Analyze the temporal characteristics in stochastic process.
5. Analyze the spectral characteristics in stochastic process.

UNIT-I	INTRODUCTION TO PROBABILITY	Classes: 9

The relative frequency and Axioms of probability: Probability introduced through relative frequency, Probability introduced through Axioms, Classical definition of probability- joint Probability and Conditional Probability, Total Probability theorem, Bayes Theorem and Independent events. With relative problems.

UNIT-II	INTRODUCTION OF RANDOM VARIABLE	Classes: 9

RANDOM VARIABLE: Definition of Random variable-Conditions for a function to be a Random Variable- Types of Random variables: Discrete, continuous and Mixed Random Variable- Distribution function, density function and its properties- Examples of Distribution and Density function : Binomial, Poisson, uniform, Gaussian, Exponential and Rayleigh. With relative problems

UNIT-III	OPERATIONS ON SINGLE RANDOM VARIABLES	Classes: 10

Mathematical Expectation: Expected value of a Random Variable, expected value of Function of a Random variable, properties of Expectation-Moments: moments about the origin, central moments, variance and skew, properties of Variance- Functions of moments: characteristic function, moment generating function and its properties. With relative problems.

UNIT-IV	STOCHASTIC PROCESSES –TEMPORAL CHARACTERISTICS	Classes: 10

Definition of Random Process-Classification of Random Processes-Joint Distribution and Density Functions of Random processes-Statistical Independent random processes-concept of Stationary process: First order stationary processes, Second order, Wide-Sense Stationary, Strict Sense Stationary(N-Order)-Time Averages and Ergodicity: Mean, Correlation ergodic-Autocorrelation Function and its Properties, Cross Correlation function and its Properties. With relative problems.

UNIT-V	STOCHASTIC PROCESSES –SPECTRAL CHARACTERISTICS	Classes: 09

The Power Spectrum: Properties: Relationship between power Spectrum and Autocorrelation Function, The Cross–Power Density Spectrum, Properties: Relationship between Cross–Power Spectrum and Cross – Correlation Function. With relative problems.

Text Books:

1. Probability, Random Variables &Random Signal Principles - Peyton Z. Peebles, TMH,4th Edition,2001.
2. Probability theory and stochastic processes –Y. mallikarjuna reddy , Universities press, 4th edition
3. A.Papoulis and S.Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.

Reference Books:

1. Probability and random process- Scott Miler, Donald Childers, 2ed, Elsevier,2012.
2. H. Starkand J.Woods, "Probability and Random Processes with Applications to Signal Processing", Third Edition, Pearson Education
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers
5. P. G. Hoel, S. C. Port and C.J.Stone, Introduction to Stochastic Processes, UBS Publishers.

Web References:

1. https:// www.khanacademy.org/ math/ probability/ probability - geometry/ probability-
2. basics/ a/ probability -the- basics https:// www.khanacademy.org/ math/ statistics- probability/ random -variables-stats- library/ random - variables- discrete/v/discrete-and-continuous-random-variables
3. https:// www .khanacadem y.org/ math/ statistics - probability/ random -variables-stats-library/ random - variables-discrete/v/random-variables
4. https://www.edx.org/course/probability-basic-concepts-discrete-random-variables.

E-Text Books:

1. http://www.freebookcentre.net/maths-books-download/Lecture-Notes-Probability-Theory.html
2. http://www.freebookcentre.net/maths-books-download/Probability-and-Stochastic-Processes.html
3. htt p:// www .freebookcentre.net/ electronics -ebooks-download/ Introduction-to - Communication- Systems.html
4. http://www.freebookcentre.net/electronics -ebooks-download/Communication-Systems-by-Dr.-Cong- Ling.html

ANALOG CIRCUITS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC09	PCC	-	-	2	1	40	60	100

COURSE OUTCOMES:

Upon successful completion of the course, student is able to

1. Design BJT and FET amplifiers.
2. Analyze various BJT Feedback amplifiers.
3. Design various BJT Oscillators and multivibrators.
4. Simulate various power amplifiers and tuned amplifiers.
5. Implement Linear and Non-Linear wave shaping circuits

LIST OF EXPERIMENTS (Minimum of 6 experiments from each cycle)

Cycle-I

1. Design and testing of Common Emitter Amplifier
2. Design and testing of Two Stage RC Coupled Amplifier
3. Design and testing of Common Collector Amplifier
4. Class A Power Amplifier (Transformer less).
5. Construct and testing of Class B Power Amplifier
6. Design and testing of Common Source Amplifier
7. Darlington Pair Configuration
8. Voltage and Current Shunt Feedback Amplifiers

Cycle-II

1. Design and testing of RC Phase Shift Oscillator
2. Design and testing of Hartley and Colpitts's Oscillator
3. Linear Wave Shaping.
   a. RC Low Pass Circuit for different time constants.
   b. RC High Pass Circuit for different time constants.
4. Design a Bi-stable Multi-vibrator and draw its waveforms
5. Design a Mono-stable Multi-vibrator and draw its waveforms
6. Design an Astable Multi-vibrator and draw its waveforms
7. Response of Schmitt Trigger circuit for loop gain less than and greater than one
8. UJT relaxation Oscillator.

DATA STRUCTURES LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6CS06	ESC	-	-	2	1	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Ability to identify the appropriate data structure for given problem.
2. Effectively use compilers include library functions, debuggers and troubleshooting.
3. Write and execute programs using data structures such as arrays, linked lists to implement stacks, queues.
4. Write and execute programs in C to implement various sorting and searching.

COURSE OUTCOMES:

The course should enable the students to:

1. Students will implement Stacks, solve delimiter and postfix expression problems, implement Queues, and understand Priority Queues.
2. Students will implement linked lists and use them to create effective Stack and Queue data structures.
3. Students will apply search and sorting algorithms and make informed choices for specific problems.
4. Students will create, manipulate, and choose appropriate tree structures for different scenarios.
5. Students will work with graphs, perform traversals, apply graph algorithms, and implement text processing techniques.

LIST OF EXPERIMENTS

WEEK-1 STRUTCURES

Write a C Program using functions to

a. Reading a complex number
b. Writing a complex number
c. Add two complex numbers
d. Multiply two complex numbers

Note: represent complex number using structure

WEEK-2 ARRAYS

1. Write a C program
   I. To add two matrices
   II. To multiply two matrices
2. Write a C program to implement Sparse Matrices.

WEEK-3 SINGLE LINKED LIST

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

a. Create a singly linked list of integers.
b. Delete a given integer from the above linked list.
c. Display the contents of the above list after deletion.

WEEK-4 SINGLE LINKED LIST

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

a. Create TWO singly linked list of integers.
b. Concatenate TWO Singly Linked Lists.
c. Display the contents of the above list after concatenation

WEEK-5 DOUBLE LINKED LIST

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

a. Create a doubly linked list of integers.
b. Delete a given integer from the above doubly linked list.
c. Display the contents of the above list after deletion

WEEK-6	STACK
Write C programs to implement a Queue ADT using i) array ii) linked list	
WEEK-7	**STACK APPLICATION**
a. Write a C program that uses stack operations to convert a given infix expression into its postfix Equivalent, Implement the stack using an array. **b.** Write a C program that uses Stack to evaluate Postfix Expression.	
WEEK-8	**QUEUE**
Write C programs to implement a Queue ADT using i) array ii) linked list	
WEEK-9	**DOUBLE ENDED QUEUE**
Write C programs to implement a double ended queue ADT using i) array **ii)** doubly linked list	
WEEK-10	**SEARCHING**
Write C programs for implementing the following searching methods: a) Linear Search b) Binary Search	
WEEK-11	**SORTING**
Write C programs for implementing the following sorting methods to arrange a list of integers in Ascending order : a) Insertion sort b) Merge sort	
Week-12	**SORTING**
Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Quick sort b) Selection sort	

TEXT BOOKS

1. C and Data Structures, Prof. P.S. Deshpande and Prof. O.G. Kakde, Dreamtech Press.
2. Data structures using C, A.K.Sharma, 2nd edition, Pearson.
3. Data Structures using C, R.Thareja, Oxford UniversityPress

WEB REFERENCES

1. http://www.sanfoundry.com/data structures-examples
2. http://www.geeksforgeeks.org/c
3. http://www.cs.princeton.edu

BASIC SIMULATION LAB								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
A6EC10	ESC	L	T	P	C	CIA	SEE	Total
		0	0	2	1	40	60	100

COURSE OUTCOMES:

After going through this course the student will be able to

1. Perform various operations on the signals including Time shifting, Scaling, Reversal, Amplitude Scaling To generate various signals and systems.
2. Determine the correlation & Convolution between Signals and sequences.
3. Verification of Weiner-Khinchine Relations i.e., Auto Correlation and Power Spectral Density forms Fourier transform pair.
4. Determine the Fourier and Laplace transform of a signal

(Minimum 6 experiments from each Cycle using Lab view or MAT Lab or open source software).

LIST OF EXPERIMENTNS

CYCLE –I:

1. Basic Operations on Matrices.
2. Generations of Various Signals and sequences (periodic and Aperiodic),such as UNIT Impulses, UNIT step, square, saw tooth, triangular, sinusoidal, ramp, sinc.
3. Operation on Signals and sequences such as addition, Multiplication, Scaling, Shifting, Folding, Computation of energy and average power
4. Finding the even and odd parts of signal/sequence and real and imaginary parts of signal
5. Convolution between Signals and Sequences
6. Auto correlation and cross correlation between signals and sequences.
7. Verification of linearity and time invariance properties of a given continuous/discrete systems
8. Computation of UNIT samples, UNIT step and sinusoidal response of the Given LTI system and verifying its physical realiazability and stability properties.
9. Gibbs phenomenon

CYCLE –II:

1. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
2. Wave form synthesis using Laplace Transforms.
3. Locating the zeros and poles and plotting the pole-zero maps in S-plane and Z-plane for the transfer function.
4. Generation of Gaussion noise (Real and Complex), computation of its mean, M.S. value and its S kurtosis, and PSD, probability distribution function.
5. Sampling theorem verification.
6. Removal of noise by auto correlation/cross correlation.
7. Extraction of periodic signal masked by noise using correlation.
8. Verification of wiener – Khinchine relations.
9. Checking a random process for stationary in widesense

CONSTITUTION OF INDIA

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6HS06	MC	2	-	-	-	50	-	50

Course Objectives:

Students will be able to:

1. Understand the need for constitution
2. Appreciate the fundamental duties and rights of the citizens of India.
3. Explain the role and amendments of constitution in a democratic society.
4. Describe the directive principles of state policy and their significance.
5. List the key features of the constitution, union government and state government.

Course Outcomes:

Students will be able to:

1. Create awareness about the constitutional values and objectives written in the Indian constitution.
2. List fundamental rights and fundamental duties of Indian citizens.
3. Identify the division of legislative, executive and financial powers between the union and state governments.
4. Understand the working of Indian democracy, its institutions and processes at the local, state and union levels.
5. Explain the functions and responsibilities of election commission of India and union public service commission.

UNIT-I	HISTORY OF MAKING OF THE INDIAN CONSTITUTION	Classes:

Introduction to the constitution of India, the making of the constitution and salient features of the constitution.

UNIT-II	PHILOSOPHY OF THE INDIAN CONSTITUTION	Classes:

Preamble Salient Features, Contours of Constitutional Rights &Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties, Amendment of the constitutional powers and procedures.

UNIT-III	UNION GOVERNMENT	Classes:

Union Government, Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with powers and functions), president of India (with powers and functions), Prime minister of India (With powers and functions), Union judiciary (Supreme court), Jurisdiction of the supreme court.

UNIT-IV	STATE GOVERNMENT	Classes:

State Government, State legislature (Legislative Assembly/ Vidhan Sabha, Legislative council/ Vidhan parishad), powers and functions of the state legislature, State executive, Governor of the state (with powers and functions), The chief Minister of the state (with powers and functions), State Judiciary (High courts)

UNIT-V	ELECTIONCOMMISSION	Classes:

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd. New Delhi
2. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012
3. The constitution of India, P.M.Bakshi, Universal Law Publishing Co.,
4. The Constitution of India, 1950 (Bare Act), GovernmentPublication.
5. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015.

Reference Books:

1. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.
3. Indian constitution at work, NCERT
4. SubashKashyap, Indian Constitution, National Book Trust
5. J.A. Siwach, Dynamics of Indian Government & Politics
6. D.C. Gupta, Indian Government and Politics

1.

E-Resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

II YEAR-
II SEMESTER

INTERNET OF THINGS AND APPLICATIONS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC11	PEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

1. To understand the fundamentals of Internet of Things.
2. To learn about the basics of IOT protocols.
3. To build a small low cost embedded system using Raspberry Pi and Arduino board.
4. To apply the concept of Internet of Things in the real world scenario.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
2. Develop web services to access/control IoT devices.
3. Analyze various protocols for IoT
4. Deploy an IoT application.
5. Analyze the applications of IoT in real time scenario

UNIT-I	INTRODUCTION TO IoT	Classes:10

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, IoT Enabling Technologies, Applications of IoT, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT-II	BUILDING BLOCKS OF IOT ARCHITECTURE	Classes:12

Introduction to four layers Architecture of IoT, Arduino Programming, Integration of Sensors and Actuators with Arduino. Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi.

UNIT-III	M2M COMMUNICATIONS	Classes: 10

Introduction to Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Software Defined Network (SDN) for IoT and Network function virtualization (NFV) for IoT.

UNIT-IV	IoT PROTOCOLS	Classes:12

Introduction to IoT protocols, IoT Access Technologies: Physical layer, MAC layer, topology and security, IEEE 802.15.4, 802.11ah and Lora WAN.

Network Layer: IP versions, Constrained Nodes and Constrained Networks, IPv6 over Low-Power Wireless Personal Area Networks (6LoWPAN), Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT-V	REAL – TIME APPLICATIONS OF IoT	Classes: 10

Applications of Smart Cities, Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Healthcare and Industrial IoT.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, ―Internet of things(A-Hand-on-Approach)‖ 1st Edition, Universal Press

Reference Books:

1. Rajkamal,‖Internet of Things‖, Tata McGraw Hill publication
2. Hakima Chaouchi ―The Internet of Things: Connecting Objects‖, Wiley publication.
3. Charless Bell ―MySQL for the Internet of Things‖, Apress publications.
4. Francis dacosta ―Rethinking the Internet of Things:A scalable Approach to
5. Connecting everything‖, 1st edition, Apress publications 2013.
6. Donald Norris―The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black‖, McGraw Hill publication.

DIGITAL SYSTEM DESIGN

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC12	PCC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Learn basic techniques for the design of digital circuits.
2. Understand number representation in digital electronic circuits and to be able to convert between different representations.
3. Implement simple logical operations using logic gates, design of combinational and sequential logic circuits.
4. Analyze sequential systems in terms of state machines and implement synchronous state machines using flip-flops.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand the various numeric information in different forms
2. Minimize simple Boolean expressions using the theorems and postulates of Boolean algebra
3. Design and analyze combinational circuits and to use standard combinational functions to build more complex circuits.
4. Design and analyze sequential circuits and to use standard sequential functions to build more complex circuits
5. Understand the concept of finite state machine.

UNIT-I	REVIEW OF NUMBER SYSTEMS	Classes:09

Representation of numbers of different radix, conversion of numbers from one radix to another radix, Complements of Numbers, problem solving for addition and subtraction. 4-bit codes: BCD, EXCESS 3, etc, Error Detecting and Correcting Codes, Parity checking and Hamming Code.

UNIT-II	BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS	Classes:09

Boolean algebra: Boolean theorems and properties, Minimization of logic functions using theorems, Complement and dual of logical expressions, Canonical and Standard Forms, Digital Logic Gates, Universal Logic Gates, Multilevel NAND/ NOR realizations, Minimization of logic functions using K-maps.

Combinational Circuits: Combinational Design, Arithmetic Circuits, Comparator, Decoder, Encoder, Multiplexers, De-Multiplexers, Implementation of Higher Order Multiplexers/ Decoder Using Lower Order Multiplexers/ Decoder

UNIT-III	SEQUENTIAL MACHINES FUNDAMENTALS	Classes:09

Introduction, Basic Architectural Distinctions between Combinational and Sequential circuits, Classification of sequential circuits, The binary cell, The S-R-Latch and Flip-Flop The D-Latch and Flip-Flop, The "Clocked T" Flip-Flop, The " Clocked J-K" Flip-Flop, Conversion from one type of Flip-Flop to another, Timing and Triggering Consideration, Clock Skew

UNIT-IV	SEQUENTIAL CIRCUIT DESIGN AND ANALYSIS	Classes:09

Sequential Circuit Design and Analysis: Introduction, State Diagram, Analysis of Synchronous Sequential Circuits, Approaches to the Design of Synchronous Sequential Finite State Machines, Design Aspects, State Reduction, Design Steps, Realization using Flip-Flops Counters - Design of Ripple Counter, Synchronous counter, Ring Counter, Registers, Shift Register.

UNIT-V	FINITE STATE MACHINE AND ALGORITHMIC STATE MACHINES	Classes:09

Sequential Circuits: Finite state machine- capabilities and limitations, Mealy and Moore models, minimization of completely specified and incompletely specified sequential machines, Partition techniques and Merger chart methods-concept of minimal cover table.
Algorithmic State Machines: Salient features of the ASM chart-Simple examples- Weighing machine and binary multiplier.

Text Books:

1. Digital Design- Morris Mano, PHI, 3rd Edition.
2. Switching Theory and Logic Design-A. Anand Kumar, PHI, 2nd Edition.
3. Switching and Finite Automata Theory- ZviKohavi&Niraj K. Jha, 3rd Edition, Cambridge.

Reference Books:

1. Introduction to Switching Theory and Logic Design – Fredriac J. Hill, Gerald R. Peterson, 3rd Ed,John Wiley & Sons Inc.
2. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson, 2013.
3. Switching Theory and Logic Design – Bhanu Bhaskara –Tata McGraw Hill Publication, 2012
4. Fundamentals of Logic Design- Charles H. Roth, Cengage Leanring, 5th, Edition, 2004.
5. Digital Logic Applications and Design- John M. Yarbrough, Thomson Publications, 2006.

igital Logic and State Machine Design – Comer, 3rd, Oxford, 2013

E-Text Books:

1. http://www.site.uottawa.ca/~petriu/Digital-Logic.pdf
2. http://uav.ece.nus.edu.sg/~bmchen/courses/EG1108_Digital.pdf
3. http://info.iet.unipi.it/~luigi/biomedica/sito/cosc205.pdf

ANALOG AND DIGITAL COMMUNICATIONS							
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**	
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
A6EC13	**PCC**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

COURSE OBJECTIVES:

1. To introduce the communication system and need of modulation and explain the concepts of Amplitude Modulation and its types (DSB-SC & SSB).
2. Classify the concepts of Angular Modulation, FM and types of FM and Noise in AM & FM Systems
3. To acquire the fundamentals of modern digital communication system design and to evaluate the performance of digital signaling schemes for digital communication channels.
4. To review the key characteristics and salient features of various digital carrier modulation and schemes for various receiver and transmitter requirements used in different applications.
5. To understand the concepts of minimizing the effects of errors due to channel noise, with various channel coding techniques.

COURSE OUTCOMES:

The course should enable the students to:

1. Understand the need of modulation and the types of Amplitude Modulation.
2. Apply the concepts of Frequency Modulation in real time applications.
3. Evaluate the performance of digital signaling schemes for digital communication channels.
4. Review the key characteristics of various digital carrier modulation,
5. Know the concepts of minimizing the effects of errors due to channel noise.

UNIT-I	**AMPLITUDE MODULATION**	**Classes: 10**

Amplitude Modulation: Amplitude modulation theory, single tone modulation, power relations in AM waves, Envelop detector. Linear modulation schemes: DSB modulation, SSB modulation: Frequency discrimination method, Phase discrimination method, Coherent detection of DSB/SSB.

UNIT-II	**ANGLE MODULATION AND NOISE ANALYSIS**	**Classes: 10**

Frequency modulation, Phase modulation, Relationship between PM and FM Spectral characteristics of angle modulated signals, Generation of FM waves: Narrow band FM (Indirect method), Wide band FM, Power and bandwidth of FM, Balanced Frequency Slope discriminator, Noise in Amplitude modulation systems (DSB & SSB), Noise in Angle Modulation systems(FM). Pre-emphasis and De-emphasis.

UNIT-III	**PULSE MODULATION TECHNIQUES**	**Classes: 09**

Pulse Code Modulation (PCM): Sampling, quantization and coding, quantization error, Companding in PCM systems. Differential PCM and Delta Modulation. Time Division Multiplexing, Noise in PCM. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion

UNIT-IV	**OPTIMUM DETECTION AND KEYING TECHNIQUES**	**Classes: 08**

Optimum receiver and error probability, Matched filter, Correlator, Pass band Digital Modulation schemes- Phase Shift Keying, Amplitude Shift Keying, Frequency Shift Keying.

UNIT-V	**ERROR CONTROL CODES**	**Classes: 10**

Error Control Codes: Linear Block Codes: Matrix description of Linear Block Codes, Error detection and error Correction capabilities of linear block codes.
Cyclic Codes: Algebraic structure, encoding, syndrome calculation, Decoding.

Text Books:

1. Haskin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,2002

Reference Books:

1. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.
2. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley,1965.
3. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers,2004.
4. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill,2000.

VECTOR CACULUS AND COMPLEX ANALYSIS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6BS04	BSC	3	0	0	3	40	60	100

COURSE OUTCOMES:

To learn

1. The concepts of finite differences, operators and relations between them.
2. Evaluation of integrals by using numerical methods.
3. Evaluation of the line integrals along piece wise smooth paths.
4. Concepts of Taylors and Maclaurin's series.
5. Finding Residues using Laurent series.
6. Concept of bilinear transformation and mapping it to the given points.

COURSE OBJECTIVES:

Upon successful completion of the course, the student is able to

1. Find Interpolating polynomial for the given tabular data.
2. Solve the first order ordinary differential equations using numerical techniques.
3. Calculate line integrals along piece wise smooth paths.
4. Express the given complex function as a power series using Taylor's series and Maclaurin's series.
5. Evaluate Residues by Laurent series
6. Find the bilinear transformation mapping to three given points

UNIT-I	INTERPOLATION AND CURVE FITTING	Classes: 10

INTERPOLATION: Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Difference of a polynomial – Missing terms - Newton's forward interpolation, Newton's backward interpolation, Gauss's forward and backward interpolation formulae . Interpolation with unequal intervals – Lagrange's interpolation.

CURVE FITTING: Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of the form $y= a e^{bx}$, $y= a x^{b}$, $y = a b^{x}$ by the method of least squares.

UNIT-II	NUMERICAL TECHNIQUES	Classes: 08

ROOT FINDING TECHNIQUES: Bisection method-RegulaFalsi method and Newton Raphson method.

NUMERICAL INTEGRATION : Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Taylor's series method –- Euler's - Modified Euler's Method – Runge -Kutta method

UNIT-III	FUNCTIONS OF COMPLEX VARIABLES AND COMPLEX INTEGRATION	Classes: 08

Complex functions and its representation on Argand plane, Concepts of limit &Continuity, Differentiability, Analyticity and Cauchy-Riemann conditions, Harmonic functions- Milne-Thompson method.

Line integral-Evaluation along a path and by indefinite integration-Cauchy's integral theorem- Cauchy's integral formula -Generalized integral formula.

UNIT-IV	COMPLEX POWER SERIES AND CONTOUR INTEGRATION	Classes: 08

Radius of convergence-expansion in Taylor's series - Maclaurin's series and Laurent series - Singular point - Isolated singular point-pole of order m - essential singularity.

Residue- Evaluation of residue by formula and by Laurent's Series- Residue Theorem. Evaluation of integrals of the type

(a) Improper real integral $\int_{-\infty}^{+\infty} f(x)dx$ (b) $\int_{c}^{c+2\pi} f(\cos\theta,\sin\theta)d\theta$

UNIT-V	CONFORMAL MAPPING	Classes: 08

Transformation by e^z, $\log z, z^2, z^n$ (n is a positive integer), $\sin z, \cos z, \frac{z+a}{z}$, Translation, rotation, inversion and bilinear transformation – fixed point – cross ratio properties – invariance of circles and cross ratio – determination of bilinear transformation mapping three given points.

Text Books:

1. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 36th Edition, 2010.

Reference Books:

1. G.B.Thomas, calculus and analytical geometry, 9th Edition, Pearson Reprint 2006.
2. N.P Bali and Manish Goyal, A Text of Engineering Mathematics, Laxmi publications, 2008.
3. E.L.Ince, Ordinary differential Equations, Dover publications, 1958

Web References:

1. https://www.efunda.com/math/math_home/math.cfm
2. https://www.ocw.mit.edu/resources/#Mathematics
3. https://www.sosmath.com/
4. https://www.mathworld.wolfram.com/

E-Text Books:

1. https://www.e-booksdirectory.com/details.php?ebook=10166
2. https://www.e-booksdirectory.com/details.php?ebook=10166

ELECTROMAGNETIC AND TRANSMISSION LINES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC14	PCC	3	0	0	3	40	60	100

COURSE OBJECTIVES:

1. To impart the knowledge of electric and magnetic fields.
2. To introduce the fundamental theory of electromagnetic waves in transmission lines.
3. To study the propagation characteristics of electromagnetic wave in bounded and Un bounded media.
4. To know the various line parameters by conventional and graphical methods

COURSE OUTCOMES:

The course should enable the students to:

1. Understand the concepts of electric and magnetic fields.
2. Apply the knowledge on Magneto statics
3. Analyze the fundamental theory of electromagnetic waves in transmission lines.
4. Apply the propagation characteristics of electromagnetic wave in bounded and unbounded media.
5. Justify the various line parameters by conventional and graphical methods.

UNIT-I	ELECTROSTATICS	Classes: 11

Basics of Vectors, ,Coulomb's law, Electric field Intensity, Fields due to different charge distributions, Electric Flux Density, Gauss law and its Applications, Electric Potential, Relation Between E and V, Maxwell's Two equations for Electrostatic Fields, energy Density, illustrative problems. Convection and Conduction Currents, Dielectric Constant, Poisson's and Laplace's Equations, Capacitance- Parallel plate, Co-axial and Spherical capacitors, Illustrative Problems.

UNIT-II	MAGNETO STATICS	Classes: 11

Magnetic field intensity and Magnetic flux density, Biot - Savart Law, Ampere's circuital Law and Applications. Maxwell's Two Equations for Magneto static fields, Magnetic Scalar and Vector Potentials, Ampere's force Law, Inductances and Magnetic Energy, Illustrative Problems. Faraday's Law and Transformer EMF, Inconsistence of Ampere's Law and Displacement Current density,Maxwell's Equations in different Final Forms and Word Statements for stationary and time varying fields, Conditions at a boundary Surface: Dielectric-dielectric, dielectric- conductor Interfaces.

UNIT-III	EM WAVE CHARACTERISTICS	Classes: 11

EM Wave Characteristics: Wave Equations for conducting and Perfect Dielectric Media, Uniform Plane Waves- Definition, Relations between E and H, Sinusoidal Variations, Wave Propagation in various media, Polarization, Illustrative Problems. EM Wave Characteristics: Reflection and Refraction of Plane waves- Normal and Oblique Incidences for Perfect Dielectric Brewster angle, Critical Angle, Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem Power Loss in Plane Conductor, Illustrative Problems.

UNIT-IV	TRANSMISSION LINES-I	Classes:11

Transmission line types, Transmission line Parameters, Transmission line Equations, Primary and Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities. Infinite Line Concepts, Lossless/Lossy Characterization, Distortion, Conditions for distortion-less transmission lines and condition for minimum attenuation Loading- Types of loading, Illustrative Problems.

UNIT-V	TRANSMISSION LINES-II	Classes: 11

Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR, UHF Lines as Circuit Elements, $\lambda/4$, $\lambda/2$ and $\lambda/8$ Lines- Impedance Transformations, Significance of Z_{min} and Zmax, Smith Chart- Configuration and Applications. Single Stub Matching and Double Stub Matching, Illustrative Problems.

Text Books:

1. Elements of Electromagnetic – Matthew N.O. Sadiku, Oxford Univ. Press, 3rd ed., 2001.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.
3. Transmission Lines and Networks – UmeshSinha, SatyaPrakashan (Tech. India Publications),New Delhi

Reference Books:

2. Engineering Electromagnetics – Nathan Ida, Springer (India) Pvt. Ltd., New Delhi, 2nd ed., 2005.
3. Networks, Lines and Fields – John D. Ryder, PHI, 2nd ed.,1999.
4. Engineering Electromagnetics – William H. Hayt Jr. and John A. Buck, TMH, 7th ed., 2006

Web References:

1. web.media.mit.edu/~aggelos/papers/EM_Hayt_6th.pdf
2. https://books.google.co.in/books/.../Electromagnetic_Waves_Transmission_Lines.html..

E-Text Books:

1. web.media.mit.edu/~aggelos/papers/EM_Hayt_6th.pdf
2. https://books.google.co.in/books/.../Electromagnetic_Waves_Transmission_Lines.html..

MOOCS Course

1. https://onlinecourses.nptel.ac.in/noc18_ee22/preview
2. https://onlinecourses.nptel.ac.in/noc18_ee23
3. https://onlinecourses.nptel.ac.in/noc18_ee24

IoT ARCHITECTURE LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC15	PCC	-	-	2	1	40	60	100

COURSE OBJECTIVES:

1. To develop basic programming skills through graphical programming
2. Learn the working of **Arduino/ESP8266/ESP32/Raspberry Pi** processor
3. Understand the Building Blocks of iot
4. To learn hardware interfacing and debugging techniques
5. To design and develop android apps

COURSE OUTCOMES:

At the end of the course, student will be able to the algorithms for simple problems

1. Configure the Arduino development environment and implement basic digital input–output interfacing using simple control programs.
2. Design and implement an IoT-based sensor data acquisition and cloud communication system using NodeMCU.
3. Implement embedded control and short-range wireless communication systems using the ESP32 platform.
4. Develop Raspberry Pi–based embedded applications involving device interfacing, sensor integration, and cloud data access.
5. Design and implement network-based data communication systems using MQTT and TCP/IP protocols.

LIST OF EXPERIMENTS

WEEK - 1	Familiarization with Arduino performs necessary software installation.
WEEK - 2	To interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds. And Different task.
WEEK - 3	To interface Push button/Digital sensor (IR/LDR) with Arduino write a program to turn ON LED when push button is pressed or at sensor detection
WEEK - 4	To interface LCD with NODEMCU ESP8266 and write a program to print temperature using LM35.
WEEK - 5	To interface DHT11 sensor with NODEMCU ESP8266 and write a program to print temperature and humidity readings.
WEEK - 6	Write a program on NODEMCU ESP8266 to upload temperature and humidity data to thingspeak cloud.
WEEK - 7	To interface motor using relay with ESP32 and write a program to turn ON motor when push button is pressed using micro-python.
WEEK - 8	To interface Bluetooth with ESP32 and write a program to send sensor data to smartphone using Bluetooth.
WEEK - 9	Familiarization with Raspberry Pi performs necessary software installation
WEEK -10	To interface LED/Buzzer with Raspberry Pi write a program to turn ON LED for 1 sec after every 2 seconds.
WEEK -11	To interface ultrasonic with Raspberry Pi and write a program to turn LED ON/OFF when ultrasonic sensor is detected.
WEEK -12	Write a program on Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
WEEK -13	Write a program on Raspberry Pi to publish temperature data to MQTT broker.
WEEK -14	Write a program to create TCP server on ESP32 and respond with humidity data to TCP client when requested.

REFERENCES

1. Sylvia Libow Martinez, Gary S Stager, Invent To Learn: Making, Tinkering, and Engineering in the Classroom, Constructing Modern Knowledge Press,2016
2. Michael Margolis, Arduino Cookbook, Oreilly,2011

DIGITAL SYSTEM DESIGN LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC16	PCC	-	-	2	1	40	60	100

COURSE OBJECTIVES:

The course should enable the students to

1. To get familiarity with functionalities of IC's.
2. To learn how to design a Boolean expression using ICs.
3. To learn designing of combinational and sequential logic circuits
4. To learn complex circuits like counter using the combination of ICs.

COURSE OUTCOMES:

After going through this course the student will be able to

1. Verify the functionality of various Digital ICs.
2. Design any digital logic circuits using ICs
3. Design and verify the functionality of combinational circuits
4. Design and verify the functionality of sequential circuits.

To Verify the Functionality of the following using ICs

1. Study of logic gates and verify their truth tables
2. Implement boolean function using AOI logic
3. Adder and subtractors
4. BCD to EXCESS-3 converter
5. Binary to gray /gray to binary code converter
6. Verification of truth tables of R-S flip-flop , J-K flip-flop , T flip-flop and D flip-flop
7. Verification of 4-bit Comparator
8. Implementation and verification of decoder.
9. Implementation and verification of encoder.
10. Implementation of 8x1 multiplexer.
11. Verification of Universal shift register.
12. Design and verify the 4-bit synchronous counter.
13. To design and verify 4 bit ripple (asynchronous counter).

Reference Books:

1. Digital Design- Morris Mano, PHI, 3rd Edition.
2. Switching Theory and Logic Design-A. Anand Kumar, PHI, 2nd Edition.
3. Switching and Finite Automata Theory- ZviKohavi&Niraj K. Jha, 3rd Edition, Cambridge.

ANALOG AND DIGITAL COMMUNICATIONS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC17	PCC	-	-	2	1	40	60	100

COURSE OBJECTIVES:

The course should enable the students to

1. To get familiarity with modulation techniques.
2. To learn how to perform sampling.
3. To learn various pulse modulation techniques
4. To learn various multiplexing techniques.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Perform Analog and Digital modulation techniques.
2. Analyse the modulated wave forms.
3. Observe receiver characteristics.
4. Design Time and Frequency division multiplexing Techniques.

LIST OF EXPERIMENTS (Minimum of 6 experiments from each cycle)

Cycle – 1

1. Amplitude Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. SSB-SC Modulation and Demodulation (PHASE SHIFTMETHOD)
4. Frequency Modulation and Demodulation
5. Pre-Emphasis and De-Emphasis
6. Time division &De-Multiplexing
7. Verification of Sampling Theorem
8. Phase Locked Loop

Cycle - 2

1. Pulse Amplitude Modulation and Demodulation
2. Pulse Width and Position Modulation and Demodulation
3. Delta Modulation
4. Phase Shift Keying Modulation
5. Differential Phase Shift Keying Modulation
6. Amplitude Shift Keying Modulation
7. Frequency Shift Keying Modulation
8. Frequency Division Multiplexing and De-Multiplexing

Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons,2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,2002.
3. TaubH.and SchillingD.L.,"PrinciplesofCommunicationSystems", TataMcGrawHill,2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering", John Wiley,1965

REAL TIME PROJECTS/FIELD BASED PROJECTS								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC18	PWC			4	2	50	-	50

COURSE OUTCOMES:

Upon successful completion of the project, the student is able to

1. **Research** independently in collecting the required information through various resources during the course of internship.
2. **Apply** knowledge of basic sciences, mathematics and engineering for real life applications.
3. **Present** the skills acquired during the internship in an effective manner**.**
4. **Demonstrate** the writing skills in the preparation of report.
5. **Exhibit** critical and analytical thinking skills acquired during the internship.

Real-Time (or) Field-based Research Project course: The internalevaluation is for 50 marks and it shall take place during I Mid-Term examination andII Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks fromaverage of the two examinations. There shall be NO external evaluation. The studentis deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the internal committee as per schedule, or (ii) secures less than 40% marks in this course.

GENDER SENSITIZATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6HS05	MC	2	--	-	--	50	--	50

COURSE OUTCOMES:

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
3. Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
4. Students will acquire insight into the gendered division of labour and its relation to politics and economics.
5. Men and women students and professionals will be better equipped to work and live together as equals.
6. Students will develop a sense of appreciation of women in all walks of life. Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT-I UNDERSTANDING GENDER

Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1) **Socialization:** Making Women, Making Men (*Towards a World of Equals*: Unit -2) Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT-II GENDER AND BIOLOGY

Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4) Declining Sex Ratio. Demographic Consequences. **Gender Spectrum:** Beyond the Binary (*Towards a World of Equals*: Unit -10) Two or Many? Struggles with Discrimination

UNIT-III GENDER AND LABOUR

Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV ISSUES OF VIOLENCE

Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading:"*Chupulu"*.
Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:
New Forums for Justice.
Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Violence.

UNIT-V GENDER: CO – EXISTENCE

Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and FathersAdditional Reading: Rosa Parks- The Brave Heart

TEXT BOOKS:

1. All the five Units in the Textbook, ***"Towards a World of Equals: A Bilingual Textbook onGender"*** written by A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu and published by **Telugu Akademi, Hyderabad**,Telangana State in the year **2015**.

REFERENCE BOOKS:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. AbdulaliSohaila. "*I Fought For My Life…and Won*."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

III YEAR-
I SEMESTER

LINEAR AND DIGITAL INTEGRATED CIRCUIT APPLICATIONS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC19	PCC	3	0	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students:

1. To introduce the basic building blocks of linear integrated circuits.
2. To teach the linear and non-linear applications of operational amplifiers.
3. To introduce the concepts of waveform generation and introduce some special function ICs...
4. To introduce the concepts of active filters.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Design a basic circuit using Op-amp.
2. Design linear, non-linear applications using Op-amp.
3. Develop skills to design the active filters circuits and application mode of IC555 timer.
4. Learn about various techniques to develop A/D and D/A converters
5. Acquired the knowledge about the combinational and sequential circuits.

UNIT-I OP-AMP AND ITS APPLICATIONS — Classes: 09

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 LINEAR & NON-LINEAR APPLICATIONS OF OP-AMP — Classes: 09

LINEAR APPLICATIONS OF OP-AMP: Inverting and non-inverting amplifiers, adders, subtractors, Instrumentation amplifier, V to I and I to V converters, Integrator and differentiator.
NON-LINEAR APPLICATIONS OF OP-AMP: Log and Antilog amplifier, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators, Oscillators

UNIT-III ACTIVE FILTERS & IC 555 TIMER — Classes: 09

ACTIVE FILTERS: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters, band pass, band reject and allpass filters.
Introduction to IC 555 timer: Description of functional diagram, operations and applications of Astable, Monostable, Schmitt trigger.

UNIT-IV VOLTAGE REGULATORS & CONVERTERS — Classes: 09

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, 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 CIRCUITS USING TTL 74XXICS — Classes: 09

COMBINATIONAL CIRCUITS USING TTL *74XX* ICS: Study of logic gates using *74XX* ICs, Four-bit parallel adder(IC 7483), Comparator(IC 7485), Decoder(IC 74138, IC 74154), BCD-to-7-segment decoder(IC 7447), Encoder(IC 74147), Multiplexer(IC74151), Demultiplexer (IC 74154).
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).

Text Books:

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

Reference Books:

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

Web References:

1. https://www.electronics-tutorials.ws/opamp/opamp_1.htm
2. https://circuitdigest.com/article/555-timer-ic

E-Text Books:

1. http://dea.unsj.edu.ar/sredes/Biblioauxi/130107134-106147696-S-Franco-Design-With-Operational-Amplifiers-and-Analog-Integrated-Circuits-1-pdf.pdf2.
2. https://www.u-cursos.cl/usuario/9553d43f5ccbf1cca06cc02562b4005e/mi_blog/r/%5Bgray Meyer%5D_Analysis_and_Design_of_Analog_Integrated_Circuits_5th_cropped.pdf

MOOC Course

1.http://nptel.ac.in/courses/117107094/30 2.http://nptel.ac.in/courses/117108107/Lecture%2035.pdf

CONTROL SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC20	PCC	3	1	0	4	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the different ways of system representations such as Transfer function representation and state space representations
and to assess the system dynamic response
2. Assess the system performance using time domain analysis and methods for improving it
3. Assess the system performance using frequency domain analysis and techniques for improving the performance
4. Design various controllers and compensators to improve system performance
5. Compare the linear time variant and time invariant systems
6. Design and implement any system using state space analysis

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand the different ways of system representations such as Transfer function representation and state space representations
and to assess the system dynamic response
2. Assess the system performance using time domain analysis and methods for improving it
3. Assess the system performance using frequency domain analysis and techniques for improving the performance
4. Design various controllers and compensators to improve system performance
5. Compare the linear time variant and time invariant systems
6. Design and implement any system using state space analysis

UNIT-I	Introduction to control problem	Classes:11

Transfer function, System with dead-time, System response, open loop and closed loop control systems and their differences. Feedback control systems - Stability, accuracy, disturbance rejection, insensitivity and robustness. Industrial Control examples. Mathematical models-differential equations, impulse response. Electrical systems-examples, Block diagram and signal flow graph with Mason's gain formula analysis.

UNIT-II	Time Response Analysis	Classes:8

Standard test signals-time response of first order systems-characteristic equation of feedback control systems, transient response of second order systems-time domain specifications-steady state response-steady state errors and error constants-effects of proportional derivative, proportional integral systems.

UNIT-III	Stability Analysis In S-Domain	Classes: 8

The concept of stability-routh's stability criterion -qualitative stability and conditional stability-limitations of routh's stability. Root Locus Technique: The root locus concept –construction of root loci, lead and lag compensation on root locus technique.

UNIT-IV	Frequency-response analysis	Classes:8

Introduction, frequency domain specifications, Bode plot, Polar plot, stability in frequency domain. Nyquist plots, Nyquist stability criterion. Compensation techniques- Lead, Lag and lag-lead compensation & their realization in frequency domain.

UNIT-V	State variable Analysis for linear and Continuous Systems	Classes: 8

Concepts of state, state variable, state models, derivation of state models from block diagrams and signal flow graph, Eigen values and vectors, diagonalization-solving the time invariant state equations-state transition matrix and its properties, concept of controllability & observability

Text Books:
1. "I. J. Nagrath and M. Gopal", "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th edition, 2009 2. "B. C. Kuo", "Automatic Control Systems", John wiley and sons, 8th edition, 2003.
Reference Books:
1. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991. 2. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi
E-Resources: 1.https://library.iitd.ac.in/index.php/node/81807

MICROPROCESSORS AND MICROCONTROLLERS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC21	PCC	3	0	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the basic of 8, 16-bit microprocessor architectures and its functionalities.
2. Write an assembly language programming skills of various processors.
3. Interface different peripheral devices with microprocessors and microcontrollers.
4. Develop systems using different microprocessors and microcontrollers.
5. Analyze RISC and ARM microprocessor-based systems.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand the architecture of microprocessors and microcontroller
2. Develop the programming model of microprocessors and micro controllers
3. Interface different external peripheral devices with microprocessors and micro controllers
4. Analyze a problem and formulate appropriate computing solution for processor or controller based application.
5. Develop an assembly language program for specified application

UNIT-I	MICROPROCESSORS ARCHITECTURE	Classes:9

Overview of 8085, 8086 architecture- functional diagram, Register organization, memory segmentation, Memory addresses, physical memory organization, Signal descriptions of 8086, timing diagrams, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine.

UNIT-II	INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING OF 8086	Classes:9

Programming model, addressing modes, Instruction set, Assembler directives, Programs involving logical, branch and call instructions, Sorting, evaluating arithmetic expressions, and string manipulations.

UNIT-III	INTERFACING WITH 8086	Classes: 9

8255 PPI, various modes of operation and interfacing to 8086, Stepper motor interfacing, D/A &A/D converter, Memory interfacing to 8086, DMA controller (8257) , 8251 USART architecture and Interfacing.

Interfacing With advanced devices: Serial communication standards, serial data transfer schemes

UNIT-IV	INTRODUCTION TO MICROCONTROLLERS	Classes:9

Overview of 8051 microcontroller, Architecture, I/O ports, Memory organization, addressing modes and instruction set of 8051, Simple programs, Programming 8051 timers/ counters, Programming 8051 interrupts.

UNIT-V	8051 REAL TIME CONTROL	Classes: 9

Programming Timer Interrupts, Programming External Hardware Interrupts, Interrupts, Programming serial communication interrupts, Programming 8051 timers and counters, Introduction to ARM Architecture.

Text Books:

1.D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition 2006.
2. Kenneth.J.Ayala. The 8051 microcontroller, 3rd edition, Cengage learning,2010
3. Advanced microprocessors and peripherals-A.K ray and K.M.Bhurchandani, TMH, 2nd edition2006.
4. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996.

Reference Books:

1. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
2. Micro computer system 8086/8088 family architecture, programming and design- By Liu and GA Gibson, PHI, 2nd Ed.,
3. Microcontrollers and application, Ajay.V.Deshmukh, TMGH, 2005.
4. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, Janice Gillispie Mazidi, Second Edition.

E-Resources:

1.http://gen.lib.rus.ec/book/index.php?md5=67C5AC79DC8180A7F0641609D0C7800C
2.http://www.faadooengineers.com/threads/9039-8085-microprocessor-by-RAMESH-GANOKAR ebook-pdf-download
3.https://e.edim.co/123389964/The_8051_Microcontroller_Architecture_Programming_And_Applications.pdf
4.https://e.edim.co/123389964/A.K._Ray_and_K.M._Bhurchandi Advanced_Microprocessors_and_Peripherals_3e-Tata_Mcgraw_Hill.pdf

MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC22	PCC	0	0	2	1	40	60	100

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Formulate problems and implement algorithms using Assembly language.
2. Develop programs for different applications.
3. Interface peripheral devices with 8086 and 8051.
4. 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)**

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 choosing variable step-size.
b. Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise by choosing 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/ Step signal.

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, Multiplication and Division.
b. Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR.
c. 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 port 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 edition 2006. 3. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, Janice GillispieMazidi, Second Edition.

ANALOG & DIGITAL IC APPLICATIONS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CI	SEE	Total
A6EC23	PCC	-	-	2	1	40	60	100

COURSE OBJECTIVES:

The course should enable the students to

1. Demonstrate the characteristics and applications of Op-Amps
2. Verify the functionality of specific ICs like 555 timer, and voltage regulators.
3. Verify the various digital functions using Verilog HDL.
4. Verify the combinational and sequential functions using Verilog HDL.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Design various applications using op-amp
2. Design various applications with 555 timer IC
3. Deign various sequential and combinational circuits using Verilog HDL.

LIST OF EXPERIMENTS

The following experiments from 1 to 8 are using ICs and the remaining experiments are using EDA simulation tools

1. Basic applications of IC741 op-amp.
2. Integrator and differentiator using IC741 op-amp.
3. Adder, Subtractor, Comparator using IC 741 Op-Amp.
4. Active Low Pass & High Pass Butterworth filters (1st &2nd Order).
5. RC Phase Shift and Wien Bridge Oscillators using IC 741 Op-Amp
6. IC 555 timer in Astable and Monostable operation.
7. Schmitt trigger circuits using IC 741 op-amp & IC 555 timer.
8. Voltage regulator IC 723, three terminal voltage regulators- 7805, 7809, 7912.
9. Design and simulate all logic gates.
10. Implement a Verilog code for AOI logic
11. Design and check the truth tables of adders and subtractors.
12. Implementation of binary to gray and gray to binary code convertor using Verilog.
13. Design and simulate Multiplexer and De-multiplexer.
14. Design and simulate Encoder and Decoder.
15. Design and simulate 8*1 multiplexer using lower order multiplexers.

Reference Books:

1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd., NewDelhi, India.
2. Thomas L. Floyd (2013), Digital Fundamentals – A Systems Approach –Pearson

OBJECT ORIENTED PROGRAMMING LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6IT41	PCC	0	0	2	1	40	60	100

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand and apply object oriented features and C++ concepts
2. Apply the concept of polymorphism and inheritance
3. Implement exception handling and templates
4. Develop applications using console I/O and file I/O GUI applications with JDBC connectivity
5. Demonstrate java compiler and eclipse platform and learn how to use net beans IDE to create java application

LIST OF EXPERIMENTS

1. a) Write a Java program that prints all real solutions to the quadratic equation ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula. If the discriminate b2-4ac is negative, display a message stating that there are no real solutions.
b) The Fibonacci sequence is defined by the following rule:
c) The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence.

2.a) Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer. (use Scanner class to read input)
b) Write a Java program to multiply two given matrices.
c) Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util)

3.a) Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome.
b) Write a Java program for sorting list of names. Read input from command line.
c) Write a Java program to make frequency count of words in a given text.

4.a) Write a Java program to create a Student class with following fields
i. Hall ticket number
ii. Student Name
iii. Department

5. a) Write a java program to create an abstract class named Shape that contains an empty method named number Of Sides ( ).Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number Of Sides ( ) that shows the number of sides in the given geometrical figures.
b) Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are separated by commas. Write a java program to display the table using JTable component.

6.a) Write a Java program to read copy content of one file to other by handling all file related exceptions.

7. a) Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
b) Write a Java program that reads a file and displays the file on the screen, with a line number before each line.

8. a) Write a Java program that creates three threads. First thread displays —Good Morning‖ every one second, the second thread displays —Hello‖ every two seconds and the third thread displays —Welcome‖

9. a) Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.
10.a. Write a Java program for handling mouse events. b. Write a Java program for handling key events using Adapter classes
11. a) Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time No light is on when the program starts. b) Write a Java program that allows the user to draw lines, rectangles and ovals.
12. a. Develop simple calculator using Swings. b. Develop an applet that displays a simple message in center of the screen
REFERENCE BOOKS: 1. Java for Programmers, P.J. Deitel and H.M. Deitel, Pearson education (OR) Java: How to Program P.J.Deitel and H.M. Deitel, PHI. 2.Object Oriented Programming through Java, P. Radha Krishna, Universities Press. 3.Thinking in Java, Bruce Eckel, Peason Education 4.Programming in Java, S. Malhotra and S. Choudary, Oxford Univ. Press.

INDEPENDENT STUDY/ MOOC'S								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC24	PWC	-	-	2	1	-	100	100

Independent Study:

There shall be a independent study in III-B.Tech II-Semester and will be conducted SEE by through a test or a committee consisting of One External Examiner, Head of the Department and two Senior faculty members of the Department. The independent study is intended to assess the student's understanding of the subjects he/she studied during the B.Tech course of study and evaluated for 100 marks. There shall be no CIE for independent study.

MOOC/SWAYAM

MOOC/SWAYAM: College intends to encourage the students to do a minimum of one MOOC in discipline and open elective during third year. The respective departments shall give a list of standard MOOCs providers including SWAYAM whose credentials are endorsed by the BoS chairperson. In general, MOOCs providers provide the result in percentage. In such case, the college shall follow the grade table mentioned in 14.2. The Credits for MOOC(s) shall be transferred same as given for the respective discipline or open electives. In case a student fails to complete the MOOCs he/she shall re-register for the same with any of the providers from the list provided by the department. Still if a student fails to clear the course/s, or in case a provider fails to offer a MOOC in any semester, then in all such cases the college shall conduct the end semester examinations for the same as per the college end semester examination pattern. The syllabi for the supplementary examinations shall be same as that of MOOCs. There shall be no internal assessment however the marks obtained out of 70 shall be scaled up to 100 marks and the respective letter grade shall be allotted. The details of MOOC(s) shall be displayed in Memorandum of Grades of a student, provided he/she submits the proof of completion of it or them to the examination branch through the Coordinator/Mentor, before the end semester examination of the particular semester.

Mandatory Course (Non-Credit)

HUMAN VALUES AND PROFESSIONAL ETHICS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6HS10	MC	2	0	0	-	50	--	50

COURSE OBJECTIVES:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective
forms the basis of Value based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with Nature.

COURSE OUTCOMES:

1. It ensures students sustained happiness through identifying the essentials of human values and skills.
2. It facilitates a correct understanding between profession and happiness
3. It helps students understand practically the importance of trust, mutually satisfying human behavior and enriching interaction with nature.
4. Ability to develop appropriate technologies and management patterns to create harmony in professional and personal life.

UNIT-I		Classes: 3

Course Introduction - Need, basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education. Self Exploration - what is it? - its content and process; 'Natural Acceptance' and Experiential Validation - as the mechanism for self-exploration. Continuous Happiness and Prosperity - A look at basic Human Aspirations. Right understanding, Relationship and Physical Facilities - the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT-II		Classes:3

Understanding Harmony in the Human Being - Harmony in Myself: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

UNIT-III		Classes: 3

Understanding Harmony in the Family and Society - Harmony in Human - Human Relationship: Understanding harmony in the Family the basic unit of human interaction. Understanding values in human - human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; **Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.** Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astiva as comprehensive Human Goals. Visualizing a universal harmonious order in society - Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) - from family to world family.

UNIT-IV		Classes:3

Understanding Harmony in the nature and Existence - Whole existence as Co-existence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astiva) of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.

UNIT-V		Classes: 3

implications of the above Holistic Understanding of Harmony on Professional Ethics:
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basic 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 techologies 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.

Text Books:

1. R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Prof. K. V. Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications, 3rd Edition.

Reference Books:

1. Ivan IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
2. E. F. Schumancher, 1973, Small is Beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.
3. A Nagraj, 1998 Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986, 1991.
5. P. L. Dhar, R. R. Gaur, 1990, Science and Humanism, Commonwealth Publishers.
6. A. N. Tripathy, 2003, Human Values, New Age International Publishers.
7. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth - Club of Rome's report, Universe Books.
9. E G Seebauer & Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
10. M Govindrajan, S Natrajan & V. S Senthil kumar, Engineering Ethics (including Humna Values), Eastern Economy Edition, Prentice Hall of India Ltd.

E-Resources:

1.value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. AI Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charle Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology - the Untold Story

III YEAR -
II SEMESTER

DIGITAL SIGNAL PROCESSING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC25	PCC	3	0	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Learn various DFT and FFT algorithms
2. Realize the various digital filters
3. Know the various digital filter design techniques
4. Understand the concepts of multi-rate signal processing and its applications
5. Introduce the concepts of DSP processor and its architectures.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Solve DFT using various FFT algorithms.
2. Construct the various digital filters.
3. Design a digital filter using various techniques.
4. Apply the knowledge of multi-rate signal processing in the real time applications.
5. Use of DSP Processors in real time environment.

UNIT-I	Discrete Fourier Transforms	Classes:12

Introduction, Computation of DFT, Properties of DFT, Inverse DFT. Linear and Circular convolutions, Overlap add method and overlap save method. Relationship of DFT to other transforms. Radix-2 FFT algorithms, Inverse FFT.

UNIT-II	IIR Digital Filters	Classes:12

Basic structures of IIR systems - Direct form-I, Direct form-II, Cascade form, Parallel form. Analog filter approximations – Butterworth and Chebyshev: Low pass, Band pass, Band stop and High pass filters. Design of IIR digital filters from analog filters by impulse invariant method & Bilinear transformation method.

UNIT-III	FIR Digital Filters	Classes: 12

Basic structures of FIR systems -Direct form, Cascade form, Linear Phase method. Characteristics of FIR digital filters, Design of linear phase FIR Digital Filters using Windows and Design of FIR digital filters using Fourier Series method, Comparison of IIR and FIR filters

UNIT-IV	Multirate Digital Signal Processing	Classes:10

Introduction, Decimation by a factor D, interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter Design & Implementation for sampling rate conversion, Multi stage Implementation of sampling rate conversion, and Applications of multirate DSP.

UNIT-V	Introduction to DSP Processors	Classes: 10

Introduction to commercial Digital signal processors, Basic Architectural features, DSP computational Building Blocks, Bus Architecture and Memory, TMS320C54XX DSP‘s: Architecture, Data Addressing modes, Instruction set, On-Chip Peripherals, Interrupts, and Concept of pipelining.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications – John G. Proakis, Dimitris G.Manolakis, Pearson Education/PHI, 2007.
2. Digital Signal Processors: Architecture, Programming and Applications, B. Venkataramani, M. Bhaskar, TMH Edition, 2002.
3. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH

Reference Books:

1. Digital Signal Processing – Andreas Antoniou, Tata McGraw Hill, 2006.
2. Digital Signal Processing – MH Hayes, Schaum ‘s Outlines, Tata Mc-Graw Hill, 2007.
3. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI .

E-Resources:

1. https://www.textbooks.com/Digital-Signal-Processing-4th Edition/9780131873742/John-Proakis-and-Dimitris-Manolakis.php
2. https://www.textbooks.com/Digital-Signal-Processing-2nd Edition/9780124158931/Li-Tan-and-Jean-Jiang.php
3. https://www.textbooks.com/Digital-Signal-Processing-using-MATLAB-3rd Edition/9781305635197/Robert-Schilling.php
4. https://www.textbooks.com/Fundamentals-of-Digital-Signal-Processing-86 Edition/9780471603634/Lonnie-C-Ludeman.php

ANTENNAS AND WAVE PROPAGATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC26	PCC	3	0	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the basic terminology and concepts of Antennas.
2. Attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
3. Analyze the electric and magnetic field emission from various basic antennas and their mathematical analysis
4. Analyze the wave spectrum and respective band-based antenna usage and also to know the propagation of the waves at different frequencies through different layers in the existing layered free space environment structure.
5. To impart the key skill of Design methodology of transmission lines and wave propagation techniques.

CORSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Apply knowledge on basic antennas to derive antenna parameters like radiation power and radiation resistance.
2. Analyse use of a various antennas with respect to their design and the analysis their performance parameters.
3. Analyze the performance modern antennas like MPA‘s and evaluate the performance and beam formation of antenna arrays.
4. Apply knowledge various atmospheric layers to understand EM wave propagation through various media.
5. Evaluate various antenna parameters like Gain, directivity using antenna theorems and other methods.

UNIT-I	Antenna Basics	Classes:10

Introduction, Basic Antenna Parameters - Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Related Problems.

Thin Linear Wire Antennas: Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance

UNIT-II	VHF, UHF AND Microwave Antennas - I:	Classes:10

Arrays with Parasitic Elements, Yagi - Uda Arrays, Folded Dipoles & their characteristics, Helical Antennas - Helical geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes. Horn Antennas - Types, Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.

UNIT-III	VHF, UHF AND Microwave Antennas - II:	Classes: 12

Microstrip Antennas - Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas - Geometry and Parameters, Characteristics of Micro strip Antennas. Impact of Different Parameters on Characteristics, Reflector Antennas.

Antenna Arrays: Point Sources - Definition, Pattern, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays - Broadside Arrays, End fire Arrays, Binomial Array Antenna, EFA with Increased Directivity.

UNIT-IV	Wave Propagation - I:	Classes: 10

Introduction, Definitions, Categorizations and General Classifications Different Modes of Wave Propagation, Ray/Mode Concepts, Ground Wave Propagation (Qualitative Treatment)- Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections, Space Wave Propagation- Introduction, Field Strength Variation with Distance and Height, Effect of Earth‘s Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation, Fading and Path Loss Calculations

UNIT-V	Wave Propagation – II & Antenna Measurements	Classes:
Sky Wave Propagation- Introduction, Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation **Antenna Measurements:** Introduction, Concepts –Reciprocity Near and Far Fields, Coordinate System, Sources of Errors Patterns to be Measured, Pattern Measurement Arrangement Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods)		
Text Books:		
1. Antennas for All Applications – John D. Kraus and R. J. Marhefka, and Ahmad S. Khan TMH, New Delhi, 4th ed., (Special Indian Edition) 2010. 2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition 2000.		
Reference Books:		
1.Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd ed., 2005. 2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.		
E-Resources: 1. wireless.ictp.it/school_2007/lectures/Struzak/5Anten_theor_basics.pdf 2.http://www.bing.com/videos/search?q=WEB+REFERENCE+FOR+ANTENNAS&&view=detail&mid=72ED51D8D7981620B0CE72ED51D8D7981620B0CE&&FORM=VRDGAR		

DIGITAL SIGNAL PROCESSING LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC27	PCC	0	0	2	1	40	60	100

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to
1. Learn DFT/IDFT of a sequence using FFT
2. Understand recursive and filtering methods
3. Plot Magnitude and phase characteristics of digital filters.
4. Know the multirate digital signal Processing using I/D factors
5. Write a C code and Implement it on DSP TMS320C6713 Processor.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to
1. Find DFT/IDFT of a sequence using FFT
2. Use of recursive and filtering methods generate sinusoidal signal
3. Analyze and Observe Magnitude and phase characteristics of digital filters.
4. Implement the multirate digital signal Processing using I/D factors
5. Develop a C code and Implement it on DSP TMS320C6713 Processor.

LIST OF EXPERIMENTS

1. Generation of Sinusoidal waveform / signal based on recursive difference equations
2. Find DFT / IDFT of given DT signal
3. Find frequency response of a given system given in (Transfer Function/ Differential equation form)
4. Implementation of FFT of given sequence
5. Determination of Power Spectrum of a given signal(s).
6. Implementation of LP,HP,BP and BS IIR filter for a given sequence
7. Implementation of LP,HP,BP and BS FIR filter for a given sequence
8. Generation of Sinusoidal signal through filtering
9. Implementation of Decimation and Interpolation Process
10. Impulse response of first order and second order systems
11. Find Linear and Circular Convolution between the sequences using a computer language such as C with TMS320C6713 Processor.
12. Find FFT of a sequence using a computer language such as C with TMS320C6713 Processor.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications – John G. Proakis, Dimitris G.Manolakis, Pearson Education/PHI, 2007.
2. Digital Signal Processors: Architecture, Programming and Applications, B. Venkataramani, M. Bhaskar, TMH Edition, 2002.
3. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH

Reference Books:

1. Digital Signal Processing – Andreas Antoniou, Tata McGraw Hill , 2006.
2. Digital Signal Processing – MH Hayes, Schaum's Outlines, Tata Mc-Graw Hill, 2007.
3. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI .

ANTENNAS AND WAVE PROPAGATION LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC28	PCC	0	0	2	1	40	60	100

Course Outcomes:

Upon Successful Completion of the Course, the Student is Able To

1. Analyze the performance Characteristics of various antennas.
2. Applying the basic antenna theorems/theories for the designed antennas.
3. Design and analyze wire & aperture antennas and antenna Arrays
5. Analyze radiation mechanism of various antennas.

PART-A

The following experiments will be conducted using simulation software (HFSS)

1. Introduction on simulation software to Design various antennas.
2. Investigation on effects of Dipole Antenna‘s Lengths on Radiation Pattern and Gain Characteristics.
3. Investigate the various characteristics of a Monopole Antenna.
4. Investigate the various characteristics of a Dipole Antenna.
5. Design and investigate the radiation characteristics of dish antenna.
6. To analyze the characteristics and radiation Pattern of End Fire Arrays
7. Simulation of patch antenna and to understand the radiation characteristics.
8. To design and analyze 3- Elements and 5-Element Yagi-Uda Antenna
9. To analyze the characteristics and radiation pattern of Broad Side Arrays.
10. To simulate and synthesize the characteristics and radiation pattern of a Horn Antennas
11. To simulate and synthesize the radiation strength at a given distance from the Antenna
12. Investigate the radiation characteristics of reflector antennas.

PART-B Microwave Lab

1. Reflex Klystron Characteristics
2. Gunn Diode Characteristics
3. Directional Coupler Characteristics
4. Measurement of Scattering Parameters of a Magic Tee.
5. Measurement of Scattering Parameters of a Circulator
6. Microwave Frequency Measurement

Text Books:

1. Antennas for All Applications – John D. Kraus and R. J. Marhefka, and Ahmad S. Khan TMH, New Delhi, 4th ed., (Special Indian Edition) 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd edition 2000.

Reference Books:

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

E-Resources:

wireless.ictp.it/school_2007/lectures/Struzak/5Anten_theor_basics.pdf

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6HS03	HSMC	0	0	2	1	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. Enhance English language skills, communication skills and to practice soft skills.
3. Improve fluency and pronunciation intelligibility by providing an opportunity for practice in speaking.
4. Get trained in different interview and public speaking skills such as JAM, debate, role play, group discussion etc.
5. Instill confidence and make them competent enough to express fluently and neutralize their mother tongue influence.

COURSE OUTCOMES:

By the end of the course students will be able to

a) Develop better perception of nuances of English language through audio- visual experience.
b) Acquire Neutralization of accent for intelligibility.
c) Participate in group activities.
d) Employ speaking skills with clarity and confidence which in turn enhances their employability.

English Language and Communication Skills Lab (ELCS) shall have two parts:

a. Computer Assisted Language Learning (CALL) Lab

b. Interactive Communication Skills (ICS) Lab

Listening Skills

Objectives

1. To enable students develop their listening skills to appreciate its role in the LSRW skills approach to language and improve their pronunciation.
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions.

Listening for specific information Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Oral practice
- Just A Minute (JAM) Sessions
- Describing objects situations people
- Role play – Individual/Group activities
- Group Discussions
- Dabate

Experiment I:

CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening. *Practice*: Introduction to Phonetics – Speech Sounds – Word Stress and Rhythm

ICS Lab:
Understand: Communication at Work Place- Spoken vs. Written language.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Introductions- Greetings – Taking Leave.

Experiment II:

CALL Lab:
Understand: Structure of Syllables — Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.

ICS Lab:

Understand: Features of Good Conversation – Non-verbal Communication. *Practice:* Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions- Telephone Etiquette.
Experiment III:
CALL Lab: *Understand:* Intonation-Errors in Pronunciation-the Interference of Mother Tongue (MTI). *Practice:* Common Indian Variants in Pronunciation – Differences in British and American Pronunciation. **ICS Lab**: *Understand:* How to make Formal Presentations. *Practice:* Formal Presentations- Extempore
Experiment IV:
CALL Lab: *Understand:* Listening for General Details. *Practice:* Listening Comprehension Tests. **ICS Lab**: *Understand:* Public Speaking – Exposure to Structured Talks. *Practice:* Group Discussions, Debate
Experiment V:
CALL Lab: Understand: Listening for Specific Details. Practice: Listening Comprehension Tests. **ICS Lab**: Understand: Introduction to Interview Skills. Practice: Mock Interviews.
Text Books:
1. Thorpe, E. (2006). Winning at Interviews, Pearson Education. 2. Sethi, J. et al. (2005). A Practical Course in English Pronunciation (with CD), Prentice Hall of India.
Reference Books:
1. Whitby, N. Business Benchmark. Cambridge University Press (with CD) 2nd Edition. 2. Kumar, S. & Lata, P. (2011). Communication Skills. Oxford University Press. 3. Balasubramanian, T. (2008). A Text book of English Phonetics for Indian Students, Macmillan.
E-Resources: 1.https://www.englishlab.co.in/blog/types-of-communication-skills-lab-english-language-lab/

Mini Projects / Internships								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
A6EC29	**PWC**	0	0	4	2	-	100	100

COURSE OUTCOMES:

Upon successful completion of the mini project, the student is able to

1. Research independently in collecting the required information through various resources.
2. Review research literature to identify and formulate the engineering problem with clear statements of problem definition and the expected deliverables
3. Assess societal, health, safety, legal and cultural issues in finding a solution for the identified engineering problem
4. Formulate a sustainable solution to the identified engineering problem taking into account the societal and environmental factors.
5. Demonstrate compliance to the prescribed standards/ safety norms in the implementation of the identified engineering problem
6. Apply knowledge of mathematics/ science/ engineering to arrive at design and development of solution(s)for the identified engineering problem
7. Investigate multiple methods of finding solutions to the identified engineering problem taking into consideration; the cost, power requirement, durability, product life, etc.
8. Apply appropriate techniques, resources, and modern engineering and IT tools in finding a solution to the identified engineering problem
9. Apply engineering and management principles in preparing time line of activities for completion of the project and the budget analysis.
10. Exhibit oral communication skills during presentations of the project work, and writing skills in the preparation of the project report.
11. Function effectively as an individual or as a member to lead the project team and expand the networking platform of professionals.
12. Exhibit the industry culture abiding by the norms of professional ethics and engineering practice.

There shall be an Industry training (or) Internship (or) Industry oriented Mini-project (or) Skill Development Courses (or) Paper presentation in reputed journal (or) IndustryOriented Mini Project in collaboration with an industry of their specialization: Studentsshall register for this immediately after II-Year II Semester Examinations and pursue itduring summer vacation/semester break & during III Year without effecting regular course work. Internship at reputed organization (or) Skill development courses (or) Paper presentation in reputed journal (or) Industry Oriented Mini Project shall be submitted in a report form and presented before the committee in III-year II semester before end semester examination. It shall be evaluated for 100 external marks. The committee consists of an External Examiner, Head of the Department, Supervisor of the Industry Oriented Mini Project (or) Internship etc, Internal Supervisor and a SeniorFaculty Member of the Department. There shall be **NO internal marks** for Industry Training (or) Internship (or) Mini-Project (or) Skill Development Courses (or) Paper Presentation in reputed journal (or) Industry Oriented Mini Project.

ENVIRONMENTAL SCIENCE*

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6BS11	MC	3	0	0	0	50	--	50

COURSE OBJECTIVES:

The course should enable the students to:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understanding the environmental policies and regulations.
4. Determine the Natural resources on which the structure of development is raised for sustainability of the society through equitable maintenance of natural resources.
5. Illustrate about biodiversity that raises an appreciation and deeper understanding of species, ecosystems and also the interconnectedness of the living world and thereby avoids the mismanagement, misuse and destruction of biodiversity.
6. Summarize a methodology for identification, assessment and quantification of global environmental issues in order to create awareness about the international conventions for mitigating global environmental problems.
7. Sustainable development that aims to meet raising human needs of the present and future generations through preserving the environment.
8. Outline green environmental issue provides an opportunity to overcome the current global environmental issues by implementing modern techniques like CDM, green building, green computing etc.

COURSE OUTCOMES:

On Successful completion of this course, Students will be able to

1. Demonstrate an understanding of the Significance of environmental education.
2. Outline the context of environmentalism.
3. Comprehend the multidisciplinary nature of the course environmental Studies.
4. Illustrate the components of the environment and its interactions.
5. Outline the causes, effects and management options for various environmental problems related to Air, Water and land.

UNIT-I	ECOSYSTEMS	Classes: 6

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure and function of an ecosystem, Food chains, food web and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio magnification, ecosystem value, services and carrying capacity.

UNIT-II	NATURAL RESOURCES & MINERAL RESOURCES	Classes:6

Natural Resources: Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT-III	BIODIVERSITY AND BIOTIC RESOURCES	Classes: 6

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT-IV	ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES	Classes:6

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation.

Global Environmental Problems and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS).. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol.

UNIT-V	ENVIRONMENTAL POLICY, LEGISLATION & EIA	Classes: 6

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio economical aspects. Strategies for risk assessment, Towards Sustainable Future: Concept of Sustainable Development, Urban Sprawl, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

Reference Books:

1.Environmental Science: towards a sustainable future by Richard T.Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M.Masters and Wendell P. Ela .2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A.Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications

E-Resources:

1.https://www.youtube.com/watch?v=M0mx8S05v60&list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm
2. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL018B3BB2E6FE781D
3. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL803563859BF7ED8C
http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf
4. https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf

***Applicable to lateral entry students**

IV YEAR-
I SEMESTER

VLSI DESIGN

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC30	PCC	3	1	-	4	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the Basic NMOS, CMOS & Bi CMOS fabrication process
2. Understand the basic VLSI design flow and CMOS design rules.
3. Learn the concepts of Technology Scaling of MOS transistors.
4. Design basic CMOS logic circuits.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Identify the basic difference between NMOS, CMOS & Bi CMOS fabrication process
2. Designing of stick diagrams and layouts for MOS transistors.
3. Design a subsystem.
4. Test the basic CMOS logic circuits

UNIT-I	INTRODUCTION TO MOS TECHNOLOGY	Classes: 12

Introduction MOS and related VLSI technology – NMOS-CMOS-BICMOS fabrication Technology – Electrical properties of MOS circuits. Ids-Vds relationships, MOS transistor threshold voltage, gm, gds, figure of merit.

UNIT-II	VLSI CIRCUIT DESIGN PROCESS	Classes: 12

VLSI Design Flow, MOS layers, Stick Diagrams, Design Rules and Layout, 2µm CMOS 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	Classes: 12

Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, time delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out, Choice of layers.

UNIT-IV	VLSI SYSTEM DESIGN	Classes: 12

Data path subsystem: Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters. **Array subsystems**: SRAM, DRAM, ROM, Serial access memories.

UNIT-V	CMOS TESTING	Classes: 12

Design for testability - built in self test (BIST) – testing combinational logic –testing sequential logic – practical design for test guide lines – scan design techniques.

Text Books:

1. Basic VLSI design by Douglas A, Pucknell, Kamran Eshraghian, Prantice Hall, 1996 3rd edition.
2. VLSI DESIGN - K. Lal Kishore, V.S.V Prabhakar, I.K International, 2009.
3. CMOS VLSI Design- Neil H.E Weste, David Harris, AyanBanerjee, Pearson Education, 1999

Reference Books:

1. Mead, C.A and Conway, L.A., Introduction to VLSI Systems, Wesley – Wesley.
2. CMOS logic circuit design- John P. Uyemura, Springer, 2007.
3. Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.
4. Introduction to VLSI-Mead and convey, BS publications, 2010
5. Application Specific Integrated Circuits-smith

EMBEDDED SYSTEM AND RTOS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC31	PCC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Learn about the Basic functions, Structure, Concepts and Applications of Embedded systems.
2. Understand embedded hardware such as processor cores, memories, Sensors and Actuators.
3. Introduce Embedded C Programming and debugging tools & techniques of embedded system.
4. Impart Real Time Operating System structure and functions for embedded systems.
5. Understand Architectures Advanced Processor and Communication interfaces used in Embedded System Design.

COURSE OUTCOMES:

1. Demonstrate Basic functions, Structure, Concepts and Applications of Embedded systems.
2. Develop Embedded hardware such as processor cores, memories, Networked protocols.
3. Demonstrate debugging techniques for real time embedded applications.
4. Describe the architecture of ARM Explore the role of interrupt response mechanism Networked embedded systems
5. Describe Real Time Operating System structure and functions for Embedded System Design.

UNIT-I	Introduction To Embedded Systems	Classes: 9

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, the Embedded system design process, Characteristics and Quality Attributes of Embedded Systems.

UNIT-II	Introduction To Embedded Processors	Classes: 9

Introduction to Embedded processors: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS).

System on Chip (SoC)-Introduction to SoC Architecture, An approach for SOC Design, System Architecture and Complexity.

Memory: ROM, RAM, Memory Shadowing, Memory selection for Embedded Systems.

UNIT-III	Introduction To Arm & Networked Embedded Systems	Classes: 9

ARM Architectures: ARM and SHARC, processor and memory organization, instruction set and instruction level parallelism;

Networked embedded systems: Bus protocols, I2C bus and CAN bus; internet-enabled systems, design example- elevator controller.

UNIT-IV	The Embedded System Development Environment And Debugging Techniques	Classes: 9

Embedded Development Environment: The Integrated Development Environment (IDE), types of files Generated on Cross-Compilation, Disassembler/Decompiler, Simulators, and Emulators.

Debugging tools & techniques: Host and Target machines, Linker/Locators for Embedded software, getting Embedded Software into the Target system, Testing on Host machine, Using Laboratory tools.

UNIT-V	Real Time Operating Systems	Classes: 9

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Shared data problems, Semaphores, Task Scheduling, Message queues, Mail boxes, Pipes, Timer functions, Events, Memory management, Interrupt routines in an RTOS environment, RTOS uC-OS (open source).

TEXT BOOKS:

1. Wayne Wolf (2008), Computers as Components-principles of embedded computer system design, Elsevier, New Delhi, India.
2. Kenneth J. Ayala (2008), The 8051 Microcontroller, 3rd edition, Cengage Learning, India.
3. David E. Simon (1999), An Embedded Software Primer, Pearson Education, India.
4. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", ELSEVIER.
5. Practical Microcontroller Engineering with ARM Technology, Ying Bai, John Wiley & Sons, 2016

REFERENCE BOOKS:

1. Jean J. Labrosse (2000), Embedding System Building Blocks, 2nd edition, CMP publishers, USA.
2. Raj Kamal (2004), Embedded Systems, Tata McGraw hill, India.
3. Ajay V. Deshmukh (2005), Micro Controllers, Tata McGraw hill, India.
4. Frank Vahid, Tony Givargis (2002), Embedded System Design, John Wiley, India.
5. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M", Newness, ELSEVIER
6. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers,2014, Jonathan W Valvano CreateSpace publications ISBN: 978-1463590154.
7. Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition Jonathan W Valvano, CreateSpace publications ISBN-13: 978- 1477508992

Web References:

1.http://www.freebookcentre.net/electronics-ebooks-download/Microprocessor-and-Microcontroller.html
2.http://coen.boisestate.edu/smloo/smloo-courses/ece-332-microprocessors-fall07/lecture-notes/
3.http://www.freebookcentre.net/electronics-ebooks-download/Introduction-to Microcontrollers-Lecture-Notes.html
4. https://www.elprocus.com/basics-of-embedded-system-and-applications/
5.https://www.radio-electronics.com/info/processing-embedded/embedded-systems/embedded-processing-unit.php
6.https://www.theengineeringprojects.com/2016/11/top-10-embedded-systems-software-development-tools.html
7.https://www.controleng.com/single-article/six-debugging-techniques-for-embedded-system-development/468754f1404e71332ea2bad35f1d0166.html

MICROWAVE ENGINEERING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC32	PEC	3	-	-	3	40	60	100

Course Overview:

This subject starts with the introduction of principles of microwave and transmission lines with their applications. This subject explains about the microwave transmission lines like waveguides (rectangular, circular), micro-strips etc. and the various microwave components like T-junctions, circulator, isolator etc. Finally, about the M-type tubes, microwave solid state devices and microwave measurements.

COURSE OBJECTIVES:

1. To develop the knowledge on transmission lines for microwaves, cavity resonators and wave guide components and application.
2. To enable the students, understand and analyze the operation of microwave tubes like klystron, magnetron, travelling wave tube, etc.,
3. To familiarize with microwave solid state devices.
4. To understand the scattering matrix parameter and its use.
5. To introduce the student the microwave test bench for measure different parameter like attenuation, VSWR, etc.,

COURSE OUTCOMES:

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

1. Understand the significance of microwaves and microwave transmission lines.
2. Analyze the characteristics of microwave tubes and compare them.
3. Be able list and explain the various microwave solid state devices.
4. Can set up a microwave bench for measuring microwave parameters.

UNIT-I	MICROWAVE AND TRANSMISSION LINES	Classes 10

Introduction, microwave spectrum and bands, applications of microwaves. rectangular waveguides – solution of wave equations in rectangular coordinates, TE/TM mode analysis, expressions for fields, characteristic equation and cut-off frequencies, filter characteristics, dominant and degenerate modes, sketches of TE and TM mode fields in the cross-section, mode characteristics -phase and group velocities, wavelengths and impedance relations related problems rectangular guide- power transmission and power losses Impossibility of TEM mode, micro strip lines– introduction, ZO relations, effective dielectric constant, losses, Q factor ,cavity resonators– introduction, rectangular cavities, dominant modes and resonant frequencies, Q factor and coupling coefficients, related Problems.

UNIT-II	WAVEGUIDE COMPONENTS AND APPLICATIONS	Classes 10

Coupling mechanisms – probe, loop, aperture types, waveguide discontinuities – waveguide windows, tuning screws and posts, matched loads, waveguide attenuators – resistive card, rotary vane types; waveguide phase shifters – dielectric, rotary vane types, waveguide multiport junctions – E plane and H plane tees, magic tee, hybrid ring, directional couplers – 2 hole, bethe hole types, related problems ferrites– composition and characteristics, faraday rotation, ferrite components – gyrator, isolator, circulator, scattering matrix– significance, formulation and properties, S matrix calculations for – 2 port junction, e plane and h plane tees, magic tee, directional coupler, circulator and isolator, related problems.

UNIT-III	MICROWAVE TUBES	Classes 11

Limitations and losses of conventional tubes at microwave frequencies, microwave tubes – O type and M type classifications, O-type tubes: 2 cavity klystrons – structure, re-entrant cavities, velocity modulation process and apple gate diagram, bunching process and small signal theory – expressions for o/p power and efficiency. reflex klystrons – structure, apple gate diagram and principle of working, mathematical theory of bunching, power output, efficiency, oscillating modes and o/p characteristics, effect of repeller voltage on power o/p, related problems, HELIX TWTS: Significance, types and characteristics of slow wave structures, structure of TWT and amplification process (qualitative treatment), suppression of oscillations, gain considerations.

UNIT-IV	M-TYPE TUBES	Classes 9

Introduction, cross-field effects, magnetrons – different types, 8-cavity cylindrical travelling wave magnetron – Hull Cut-off and Hartree Conditions, modes of resonance and PI-mode operation, separation of Pi-mode, o/p characteristics.

MICROWAVE SOLID STATE DEVICES: Introduction, Classification, Applications. TEDs - Introduction, Gunn Diode - Principle, RWH Theory, Characteristics, Basic Modes of Operation, Gunn Oscillation Modes. LSA mode Avalanche Transit Time Devices.

UNIT-V	MICROWAVE MEASUREMENTS	Classes 9

Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement - Bolometers, Measurement of Attenuation, Frequency standing wave measurements – measurement of low and High VSWR, Cavity Q. Impedance Measurements.

TEXT BOOKS:

1. Samuel Y. Liao (1994), *Microwave Devices and Circuits*, 3rd edition, Prentice Hall of India, New Delhi.
2. Herbert J. Reich, J. G. Skalnik, P. F. Ordung, H. L. Krauss (2004), *Microwave Principles,* CBS Publishers, New Delhi, India.
3. M. Kulkarni (1998), *Micro Wave and Radar Engineering,* Umesh Publications, New Delhi.

REFERENCE BOOKS:

1. R. E. Collin (2002), *Foundations for Microwave Engineering,* 2nd edition, IEEE Press, John Wiley India.
2. M. L. Sisodia, G. S. Raghuvanshi (1995), *Microwave Circuits and Passive Devices,* Wiley Eastern Ltd., New Age International Publishers Ltd.
3. Peter A. Rizzi (1999), *Microwave Engineering Passive Circuits*, Prentice Hall of India, New Delhi.

COMPUTER NETWORKS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC61	PCC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Have a good understanding of the OSI Reference Model and in particular have a good knowledge of layers.
2. Describe the functions of data link layer and explain the protocols.
3. Classify the routing protocols and analyze how to assign the IP addresses for the given network.
4. Describe the Session layer design issues and Transport layer services.
5. Analyse the functions of Application layer and Presentation layer paradigms and Protocols

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to:

1. Understand the organization of computer networks, factors influencing computer network development and the reasons for having different types of networks
2. Recognize the different inter networking devices and their functions
3. Apply the contemporary issues in networking technologies.
4. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
5. Specify and identify the deficiencies in existing protocols and go then go on to formulate new and better protocols
6. Design an effective protocols for congestion free network

UNIT-I	INTRODUCTION	Classes: 09

Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet, Connection oriented network - X.25, frame relay. THE PHYSICAL LAYER: Theoretical basis for communication, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.

UNIT-II	THE DATA LINK LAYER	Classes: 09

Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet.
THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth

UNIT-III	THE NETWORK LAYAER	Classes: 09

Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

UNIT-IV	THE TRANSPORT LAYER	Classes: 09

Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP.

UNIT-V	THE APPLICATION LAYER	Classes: 09

Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

Text Books:

1. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition, TMH, 2006.
2. Computer Networks – Andrew S Tanenbaum, 4th Edition, Pearson Education.

Reference Books:

1. An Engineering Approach to Computer Networks – S.Keshav, 2nd Edition, Pearson Education.
2. Understanding Communications and Networks, 3rd Edition, W.A. Shay, Cengage, Learning.
3. Computer and Communication Networks, Nader F. Mir, Pearson Education.
4. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K.W. Ross, 3rd Edition, Pearson Education.
5. Data and Computer Communications, G.S.Hura and M.Singhal, CRC Press, Taylor and Group.
Data Communications and Computer Networks, P.C.Gupta, PHI.

VLSI DESIGN LAB								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC33	PCC	-	-	2	1	40	60	100

COURSE OBJECTIVES:

The course should enable the student to

1. Understand different circuit parameters.
2. Learn the schematic editor for circuit design.
3. Understand different simulation tools.
4. Lear to draw the layout of CMOS circuits.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Design any logic circuit using CMOS transistor.
2. Use different Cadence tools for design and analysis of the circuits.
3. Design and simulate analog and digital circuits.
4. Design layouts for any CMOS circuits.

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.

EMBEDDED AND RTOS LAB

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC34	PCC	-	-	3	1	40	60	100

COURSE OBJECTIVES:

1. To develop basic programming skills through graphical programming
2. Learn the working of ARM processor
3. Understand the Building Blocks of Embedded Systems
4. To learn hardware interfacing and debugging techniques
5. To design and develop android apps

COURSE OUTCOMES:

At the end of the course, student will be able to the algorithms for simple problems

1. CO 1: Able to demonstrate various sensor interfacing using Visual Programming Language.
2. CO 2: Able to analyze various Physical Components.
3. CO 3: Able to demonstrate Wireless Control of Remote Devices.
4. CO 4: Able to design and develop Mobile Application and which can interact with Sensors.

LIST OF EXPERIMENTS

WEEK - 1	Introduction to ARM with keil IDE
WEEK - 2	1.Program to toggle all the bits of Port P1 continuously with 250 ms delay 2. Develop and execute the program such that whenever a Switch is pressed corresponding LED glows.
WEEK - 3	Interfacing ADC and DAC and LED and PWM
WEEK - 4	Write an Embedded C program to Interface LCD And Seven Segment Display with ARM.
WEEK - 5	Interface a Stepper motor (or) DC motor and rotate it in clockwise and anti-clockwise direction using ARM.
WEEK - 6	Develop and execute the program such that control Relay, Buzzer and LED using Bluetooth &ARM.
WEEK - 7	Introduction to STM32 Cubel ide installation
WEEK - 8	Creating different led patterns and controlling them using push button switches using STM32
WEEK - 9	Calculate the distance of an object with the help of an ultrasonic sensor and display it on an LCD using STM32
WEEK -10	(a)Controlling relay state based on ambient light levels using LDR sensor. (b)Basic Burglar alarm security system with the help of PIR sensor and buzzer.
WEEK -11	Controlling LEDs/Motors from an Android/Web app, Controlling AC Appliances from an android/web app with the help of relay.
WEEK -12	Store humidity & temperature data to Thing Speak, periodically logging ambient light level to Thing Speak.

REFERENCES

1. Sylvia Libow Martinez, Gary S Stager, Invent To Learn: Making, Tinkering, and Engineering in the Classroom, Constructing Modern Knowledge Press, 2016
2. Michael Margolis, Arduino Cookbook, Oreilly, 2011

RESEARCH PROJECT STAGE-I								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC35	PWC	0	0	6	3	100		100

COURSE OUTCOMES:

Upon successful completion of the Research project, the student is able to

1. Research independently in collecting the required information through various resources.
2. Review research literature to identify and formulate the engineering problem with clear statements of problem definition and the expected deliverables
3. Assess societal, health, safety, legal and cultural issues in finding a solution for the identified engineering problem
4. Formulate a sustainable solution to the identified engineering problem taking into account the societal and environmental factors.
5. Demonstrate compliance to the prescribed standards/ safety norms in the implementation of the identified engineering problem
6. Apply knowledge of mathematics/ science/ engineering to arrive at design and development of solution(s)for the identified engineering problem
7. Investigate multiple methods of finding solutions to the identified engineering problem taking into consideration; the cost, power requirement, durability, product life, etc.
8. Apply appropriate techniques, resources, and modern engineering and IT tools in finding a solution to the identified engineering problem
9. Apply engineering and management principles in preparing time line of activities for completion of the project and the budget analysis.
10. Exhibit oral communication skills during presentations of the project work, and writing skills in the preparation of the project report.
11. Function effectively as an individual or as a member to lead the project team and expand the networking platform of professionals.
12. Exhibit the industry culture abiding by the norms of professional ethics and engineering practice.

The UG research project

shall be initiated at the end of the IV Year I Semester and the durationof the project work is one semester. The student must present Project Stage – I duringIV Year I Semester before II Mid examinations, in consultation with his Supervisor, the title, objective and plan of action of his Project work to the departmental committeefor approval before commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start his research project work.

UG research project work shall be carried out in two stages: Research Project Stage–I for approval of project before Mid-II examinations in IV Year I Semester and Research Project Stage – II duringIV Year II Semester. Student has to submit research project work report at the end of IV Year II Semester. The research project shall be evaluated for 100 marks before commencement of SEETheory examinations.

For Research Project Stage – I, the departmental committee consisting of Head of the Department, project supervisor and a senior faculty member shall approve the project work to begin before II Mid-Term examination of IV Year I Semester. The student is deemed to be not eligible to register for the Project work, if he does not submit a reporton Research Project Stage - I or does not make a presentation of the same before the evaluation committee as per schedule.

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if he fails in such 'one reappearance' evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

IV YEAR-
II SEMESTER

Research Project Stage-II								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC36	PWC	0	0	22	11	40	60	100

COURSE OUTCOMES:

Upon successful completion of the Research project, the student is able to

1. Research independently in collecting the required information through various resources.
2. Review research literature to identify and formulate the engineering problem with clear statements of problem definition and the expected deliverables
3. Assess societal, health, safety, legal and cultural issues in finding a solution for the identified engineering problem
4. Formulate a sustainable solution to the identified engineering problem taking into account the societal and environmental factors.
5. Demonstrate compliance to the prescribed standards/ safety norms in the implementation of the identified engineering problem
6. Apply knowledge of mathematics/ science/ engineering to arrive at design and development of solution(s)for the identified engineering problem
7. Investigate multiple methods of finding solutions to the identified engineering problem taking into consideration; the cost, power requirement, durability, product life, etc.
8. Apply appropriate techniques, resources, and modern engineering and IT tools in finding a solution to the identified engineering problem
9. Apply engineering and management principles in preparing time line of activities for completion of the project and the budget analysis.
10. Exhibit oral communication skills during presentations of the project work, and writing skills in the preparation of the project report.
11. Function effectively as an individual or as a member to lead the project team and expand the networking platform of professionals.

    Exhibit the industry culture abiding by the norms of professional ethics and engineering practice.

The UG research project

shall be initiated at the end of the IV Year I Semester and the durationof the project work is one semester. The student must present Project Stage – I duringIV Year I Semester before II Mid examinations, in consultation with his Supervisor, the title, objective and plan of action of his Project work to the departmental committeefor approval before commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start his research project work.

UG research project work shall be carried out in two stages: Research Project Stage–I for approval of project before Mid-II examinations in IV Year I Semester and Research Project Stage – II duringIV Year II Semester. Student has to submit research project work report at the end of IV Year II Semester. The research project shall be evaluated for 100 marks before commencement of SEETheory examinations.

For Research Project Stage – II, the external examiner shall evaluate the project work for 60 marks and the internal project committee shall evaluate it for 40 marks. Out of 40 internal marks, the departmental committee consisting of Head of the Department, Project Supervisor and a Senior Faculty Member shall evaluate the project work for 20marks and Project Supervisor shall evaluate for 20 marks. The topics for Industry Oriented Mini Project/ Internship/SDC etc. and the research Project shall be different fromthe topic already taken. The student is deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the External Examiner as per schedule, or (iii) secures less than 40% marks in the sum totalof the CIE and SEE taken together.

PROFESSIONAL ELECTIVES- I

FIBER OPTIC COMMUNICATION

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC37	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers.
2. To know about the signal degradation in optical fibers.
3. To learn about the various optical sources, detectors and transmission techniques.
4. To explore various idea about optical fiber measurements and various coupling techniques.
5. To enrich the knowledge about optical communication systems

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Identify the required optical elements for the suitable optical link.
2. Determine the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. select and use various optical sources in real time application.
4. Analyse the performance of various connectors and couplers in fiber optic system.
5. Design an optical link for a given specifications

UNIT-I	INTRODUCTION TO OPTICAL FIBERS	Classes:10

Evolution of fiber optic system- Element of an Optical Fiber Transmission link– Total internal reflection Acceptance angle – Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations - Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers- Graded Index fiber structure.

UNIT-II	SIGNAL DEGRADATION OPTICAL FIBERS	Classes:10

Attenuation – Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in Single Mode fibers-Polarization Mode dispersion, Intermodal dispersion.

UNIT-III	FIBER OPTICAL SOURCES	Classes: 10

Direct and indirect Band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations - External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser.

UNIT-IV	COUPLERS AND CONNECTORS	Classes:10

Power Launching and coupling, Lencing schemes, Fiber -to- Fiber joints, Fiber splicing- Distribution Networks, Directional Couplers, Star Couplers, Switches, Fiber Optical Isolator, Fiber Bragg Gratings, Optical Amplifier-EDFA

UNIT-V	SYSTEM DESIGN AND NOISE	Classes: 10

Introduction and working about optical detector (APD, PIN diodes)-Analog System Design, Digital System Design, Applications of Fiber Optics-Link power budget-rise time budget. Optical noise-Thermal noise, shot noise, Modal noise and Amplifier noise

Text Books:

1.Gerd Kaiser, Optial fiber communication‖, McGraw Hill, 4th Edition,2010.
2. Joseph. C. Palais, Fiber Optic Communications Pearson Education, Asia, 2002.
3. John M.Senior, Optical Fiber Communication: Principles and Practice, Pearson Education, 2nd edition.

Reference Books:

1.John Powers, Fiber Optic Systems, Irwin Publications, 1997.
2. Howes M.J., Morgan, D.V.Optical Fiber Communication‖, John Wiely.1992.

E-Resources:

1.https://easyengineering.net/optical-fiber-communications-principles-and-practice-by-senior nw/cvr_seni6812_03_se_cvr-indd/

1.https://www.electronics-notes.com/articles/connectivity/fibre-optics/optical-fibre-telecommunications-basis

SENSORS AND ACTUATORS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC38	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understanding basic laws and phenomena on which operation of sensors and actuators Transformation of energy
2. Create analytical design and development solutions for sensors and actuators.
3. To know the basic laws of behaviour of sensors and actuators.
4. To able to know about the Standards for Smart Sensor Interface
5. Analyse the development and application of sensors and actuators.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Apply the fundamental physical and technical base of sensors and actuators,
2. Analyse various premises, approaches, procedures and results related to sensors and actuators
3. Analyse basic laws and phenomena that define behaviour of sensors and actuators.
4. Apply the Smart Sensor Interface in various applications
5. Develop the application of sensors and actuators

UNIT-I	Sensors / Transducers	Classes:

Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Mechanical and Electro mechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Sensitivity and Linearity of the Sensor, Types- Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors using Quartz Resonators, Ultrasonic Sensors.

UNIT-II	Thermal Sensors	Classes:

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermo-sensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermo-EMF Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermo-electric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors.

UNIT-III	Radiation Sensors	Classes:

Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors. Electro Analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes – Sensor Electrodes – Electro ceramics in Gas Media.

UNIT-IV	Smart Sensors	Classes:

Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

UNIT-V	Actuators	Classes:

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators.

Text Books:
1. D. Patranabis, ―Sensors and Transducers‖, PHI Learning Private Limited. 2. W. Bolton, ―Mechatronics‖, Pearson Education Limited.
Reference Books:
1. Renganathan S.,‖ Transducer Engineering‖, Allied Publishers (P) Ltd., 2003
E-Resources: 1. https://www.sciencedirect.com/handbook/handbook-of-sensors-and-actuators

ASIC DESIGN

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC39	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVE:

The course should enable the students to

1. Learn the ASIC flow
2. Know the basic difference between memories.
3. Learn the synthesis, placement and routing
4. Know the different process in designing ASIC design flow

COURSE OUTCOMES:

1. Identify different steps in ASIC flow
2. Synthesize a digital design
3. Analyze placement and routing of any digital circuits
4. Apply entire ASIC flow for the design of digital ICs

UNIT-I	**INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN**	**Classes: 8**
Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.		
UNIT-II	**PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS**	**Classes:8**
Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.		
UNIT-III	**PROGRAMMABLE ASIC ARCHITECUTRE**	**Classes: 8**
Architecture and configuration of Spartan / Cyclone and Virtex / Stratix FPGAs – Micro-Blaze / Nios based embedded systems – Signal probing techniques		
UNIT-IV	**LOGIC SYNTHESIS, PLACEMENT AND ROUTING**	**Classes:8**
Logic synthesis - ASIC floor planning- placement and routing – power and clocking strategies.		
UNIT-V	**HIGH PERFORMANCE ALGORITHMS FOR ASICS/ SOCS**	**Classes: 8**
DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM, High speed data standards.		

Text Books:

1.M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson,2003
2. Steve Kilts, —Advanced FPGA Design,‖ Wiley Inter-Science.
3. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, —FPGA-based Implementation of Signal Processing Systems‖, Wiley, 2008
4. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", Mc Graw Hill, 1994.

Reference Books:

1. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Doone Publications, 1996.
2. Jose E. France, Yannis Tsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

E-Resources:

1.http://www.asic.co.in/Index_files/link.htm

2. https://www.intechopen.com/books/application-specific-integrated-circuits-technologies-digital-systemsand-design-methodologies/introductory-chapter-asic-technologies-and-design-techniques

PROFESSIONAL ELECTIVES- II

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC40	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To learn the difference between optimal reasoning vs human like reasoning
2. To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
3. To learn different knowledge representation techniques
4. To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

COURSE OUTCOMES:

1. Possess the ability to formulate an efficient problem space for a problem expressed in English.
2. Possess the ability to select a search algorithm for a problem and characterize its time and space complexities.
3. Possess the skill for representing knowledge using the appropriate technique
4. Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems, Machine Learning and Natural Language Processing
5. Apply advanced knowledge representation techniques.

UNIT-I	Introduction	Classes:10

Introduction, History, Intelligent Systems, Foundations of AI, Sub areas of AI, Applications. Problem Solving – State-Space Search and Control Strategies: Introduction, General Problem Solving, Characteristics of Problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction. Game Playing, Bounded Look-ahead Strategy and use of Evaluation Functions, Alpha-Beta Pruning

UNIT-II	Logic Concepts and Logic Programming & Knowledge Representation	Classes:10

Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Propositional Logic, Predicate Logic, Logic Programming. Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT-III	Expert System and Applications & Uncertainty Measure – Probability Theory	Classes: 10

Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems, List of Shells and Tools. Uncertainty Measure – Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainty Factor Theory, Dempster-Shafer Theory.

UNIT-IV	Machine-Learning Paradigms & Artificial Neural Networks	Classes:10

Machine-Learning Paradigms: Introduction. Machine Learning Systems. Supervised and Unsupervised Learning. Inductive Learning. Learning Decision Trees, Deductive Learning. Clustering, Support Vector Machines.

Artificial Neural Networks: Introduction, Artificial Neural Networks, Single-Layer Feed Forward Networks, Multi-Layer Feed-Forward Networks, Radial-Basis Function Networks, Design Issues of Artificial Neural Networks, Recurrent Networks.

UNIT-V	Advanced Knowledge Representation Techniques	Classes: 10

Advanced Knowledge Representation Techniques: Case Grammars, Semantic Web Natural Language Processing: Introduction, Sentence Analysis Phases, Grammars and Parsers, Types of Parsers, Semantic Analysis, Universal Networking Knowledge.

Text Books:

1. Saroj Kaushik. Artificial Intelligence. Cengage Learning. 2011
2. Russell, Norvig: Artificial intelligence, A Modern Approach, Pearson Education, Second Edition. 2004

Reference Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition 2009.
2. Introduction to Artificial Intelligence by Eugene Charniak, Pearson.
3. Introduction to Artificial Intelligence and expert systems Dan W.Patterson. PHI.
4. Artificial Intelligence by George Fluger rearson fifth edition.

E-Resources:

1. https://books.google.co.in/books?id=DDNHzcN6jasC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. https://books.google.co.in/books?id=YmH1tXFA14MC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

INTRODUCTION TO MEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC41	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To equip the students with the Finite Element Analysis fundamentals.
2. Understanding the basics of MEMS
3. Explain about various materials and technology of MEMS
4 Study about micro machine processing and fabrication techniques
5 Explore about MEMS sensors and accelerometers

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Apply the fundamental concept of MEMS & Micro system and their relevance to current Industry / scientific needs
2. demonstrate processes that are used in MEMS fabrication
3. Applying basic sensing principles of chem./bio systems to develop novel sensors
4. Identify the Design limitations and challenges in the design and fabrication of micro sensors, sensing modalities to build the desired micro system
5. Apply the general micromachining principles to build novel devices.

UNIT-I	INTRODUCTION TO MEMS AND MICRO FABRICATION	Classes:10

History of MEMS Development, Characteristics of MEMS-miniaturization - microelectronics integration - Mass fabrication with precision. Micro fabrication - microelectronics fabrication process- silicon based MEMS processes- new material and fabrication processing- points of consideration for processing.

UNIT-II	ELECTRICAL AND MECHANICAL PROPERTIES OF MEMS MATERIALS	Classes:10

Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain mechanical properties of silicon and thin films, Flexural beam bending analysis under single loading condition - Types of beam- deflection of beam-longitudinal stain under pure bending spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

UNIT-III	SENSING AND ACTUATION	Classes: 10

Electrostatic sensing and actuation-parallel plate capacitor – Application-
Inertial, pressure and tactile sensor parallel plate actuator- comb drive. Thermal sensing and Actuations-thermal sensors-Actuators- Applications- Inertial, Flow and Infrared sensors. Piezo resistive sensors piezo resistive sensor material- stress in flexural cantilever and membrane Application-Inertial, pressure, flow and tactile sensor.

UNIT-IV	BULK AND SURFACE MICROMACHINING	Classes:10

Anisotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), Isotropic wet etching, Basic surface micro machining process-structural and sacrificial material, stiction and antistiction methods, Foundry process.

UNIT-V	POLYMER AND OPTICAL MEMS	Classes: 10

Polymers in MEMS- polymide-SU-8 liquid crystal polymer (LCP)-PDMS-PMMA-Parylene-Flurocorbon, Application-Acceleration, pressure, flow and tactile sensors. Optical MEMS-passive MEMS optical components-lenses-mirrors-Actuation for active optical MEMS.

Text Books:

1.Chang Liu, —Foundations of MEMS‖, Pearson International Edition, 2006

Reference Books:

1.Gaberiel M.Rebiz, —RF MEMS Theory,Design and Technology‖, John Wiley & Sons,2003
2. Charles P.Poole, Frank J.Owens, —Introduction to nanotechnology‖ John Wiley & sons, 2003.

E-Resources: http://www-bsac.eecs.berkeley.edu/projects/ee245/index.htm

DIGITAL DESIGN THROUGH VERILOG

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC42	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the basics of Digital design using Verilog HDL
2. Understand the Digital design using Gate primitives.
3. Understand the concepts of Behavioral modeling.
4. Gain the knowledge on Switch level modelling and testing of Verilog

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Describe the basic concepts of Verilog language.
2. Comprehend the structural procedures in Verilog language.
3. Design a Verilog code using behavioral modeling.
4. Design and verify Verilog codes.
5.Implement digital circuits for the various applications

UNIT-I	INTRODUCTION TO VERILOG	Classes:10

Introduction to VerilLog HDL: Verilog as HDL, Levels of design description, Concurrency, Simulation and Synthesis, Function Verification, System Tasks, Programming Language Interface, Module, Simulation and Synthesis tools.

Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.

UNIT-II	GATE AND DATAFLOW LEVEL MODELING	Classes:10

Gate Level Modelling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delay, Strengths and Construction Resolution, Net Types, Design of Basic Circuit.

Modelling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators.

UNIT-III	BEHAVIORAL MODELING	Classes: 10

Behavioural Modeling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-Blocking Assignments, The case statement, Simulation Flow i*f* and i*f*-else constructs, Assign-De-Assign construct, Repeat construct, for loop, the Disable construct, While loop, Forever loop, Parallel Blocks, Force-Release construct, Event

UNIT-IV	SWITCH LEVEL MODELING	Classes:10

Switch Level Modelling:

Basic Transistor Switches, CMOS Switches, Bi-Directional Gates, Time Delays with Switch Primitives, Instantiation with 'Strenths' and 'Delays' Strength Contention with Tri-reg Nets.

System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters. System Tasks and Functions, File Based Tasks and Functions, Computer Directives, Hierarchical Access, User Defined Primitives.

UNIT-V	FUNCTIONS AND RECURSION	Classes: 10

Sequential Circuit Description: Sequential Models – Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis.

Components Test and Verification: Test Bench- Combinational Circuit Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.

Text Books:

1. Samir Palnitkar, ―Verilog HDL: A Guide to Digital Design and Synthesis‖, Prentice Hall PTR, 2003.
2. Srikanth Vijayaraghavan, Meyyappan Ramanathan, ―A Practical Guide for System Verilog Assertions‖, Springer, 2005.
3. Cook Book Mentor Graphics, http://verificationacademy.com.

Reference Books:

1.T.R. Padmanabhan and B. Bala Tripura Sundari, ―Design through Verilog HDL‘‘, WSE, 2004 IEEE Press.
2. J. Bhaskar, ―A Verilog Primier‖, BSP, 2003. 3. Michael D. Ciletti, ―Advanced Digital Design with Verilog HDL‖, Phi,2005.

E-Resources:

1. http://www.freebookcentre.net/electronics-ebooks-download/Digital-Design-Through-Verilog-Hdl.html
2. www.ece.umd.edu/class/enee359a/verilog_tutorial.pdf

PROFESSIONAL ELECTIVES- III

DIGITAL IMAGE PROCESSING

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC43	PEC	3	-	-	-	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the image fundamentals and mathematical transforms necessary for image processing.
2. Study the image enhancement techniques
3. Know the various image restoration procedures.
4. Learn the image compression procedures
5. Know about the Color image processing

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Review the fundamental concepts of a digital image processing system.
2. Analyze the images in frequency domain using various transform.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques and associated enhancements
5. Interpret the Image compression standards.

UNIT-I	Digital Image Fundamentals	Classes:

Digital Image Fundamentals: Fundamentals of Digital Image Processing, Origins of Digital Image Processing Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

UNIT-II	Spatial & Frequency Domain	Classes:

Noise models, Restoration in the Presence of Noise only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

UNIT-III	Restoration	Classes:

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation Morphological processing- erosion and dilation.

UNIT-IV	Color Image Processing	Classes:

Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multi resolution Expansions. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

UNIT-V	Segmentation	Classes:

Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. Representation and Description: Representation, Boundary descriptors.

Text Books:

1.Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition, 2010.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.

Reference Books:

1.Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.
2.Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Inc., 2011.

E-Resources:

1. http://sdeuoc.ac.in/sites/default/files/sde_videos/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez%2C%20R.%20Woods-ilovepdf-compressed.pdf

2.https://msoe.us/taylor/cs4802/

IOT ARCHITECTURE AND PROTOCOL

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC44	PCC	3	0	0	3	40	60	100

Course Objectives:

1. Understand IoT applications and IoT Architectures.
2. Learn about IoT devices and event driven analysis
3. Understand and analyze IoT.
4. Understand safety and security testing of IoT systems

Course Outcome:

1.Demonstrate the revolution of internet in mobile and cloud.
2.Examine the architecture and operation of IoT.
3.Explore various tools and programming paradigms for IoT applications.
4.Develop an IoT prototype for real time scenario.
5.Use IoT Data Link Layer, Network Layer IoT, Transport & Session Layer Protocols

UNIT-I	The IoT Landscape	Classes:8

Definition of IoT, Applications, Architectures, Wireless Networks, Devices, Security and Privacy, Event-Driven Systems. IoT System Architectures: Introduction, Protocols Concepts, IoT ooriented Protocols, Databases, Time Bases, Security.

UNIT-II	IoT-An Architectural Overview & Architecture-State of the Art	Classes:10

IoT-An Architectural Overview: Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. **IoT Architecture-State of the Art:** Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT-III	Industrial Internet of Things &Security and Safety	Classes: 8

Introduction, Industry 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.
Security and Safety: Introduction, Systems Security, Network Security, Generic Application Security, Application Process Security and Safety,

UNIT-IV	IoT Data Link Layer	Classes:8

IoT Data Link Layer: PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7

UNIT-V	Network Layer Protocols &IOT Transport & Session Layer Protocols	Classes: 8

Network Layer Protocols: Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP
IOT Transport & Session Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)- (TLS, DTLS) – Session Layer-HTTP, CoAP

Text Books:

1. Dimitrios Serpanos, Marilyn Wol, Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies, ISBN 978-3-319-69714-7.
2. Danial Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2015.

Reference Books:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.
3. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015. 2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David

Boswarthick, Omar Elloumi and Wiley, 2012
E-Resources: 1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCSA1408.pdf 2.https://www.studocu.com/in/document/jawaharlal-nehru-technological-university-anantapur/iot-communication-protocols/unit-iii-iot-notes/65078702

PHYSICAL DESIGN BASICS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC45	PEC	3	-	-	-	40	60	100

Course Objectives:

1. To know the IR drop, Power requirements, power mesh design, and electro migration.
2. To know the design of power optimization techniques.
3. To understand the On-chip variations and their impact on performance of design.
4. To know Foundry design rules and implementation methodologies.

Course Outcomes:

Student will be able to:

1. Design power mesh for given specifications, analyze IR drop and EM issues and fix them.
2. Implement the low power intent of the design using current industry standard UPF.
3. Verify whether the design meets the power intent in UPF
4. Perform physical verification both at LVS & DRC level and fix all issues.
5. Determine the power requirements of the systems.

UNIT-I	Power Analysis	Classes:10

Power Analysis: Introduction to power analysis, Goals and objectives, Data preparation, Power mesh design, Static IR analysis, Dynamic IR analysis, Signal and power EM.

UNIT-II	Low Power Design – I	Classes:10

Introduction, Low power optimization in the SOC flow, Special cells for power management, Architectural techniques for low power.

UNIT-III	Low Power Design – II	Classes: 10

Low power implementation techniques (multi voltage, power gating etc.), UPF formats, Low power checks.

UNIT-IV	Static timing analysis (STA)	Classes:10

Hierarchical STA (ILM, XILM, ETM), On-chip variations, Advanced on-chip variations, Parametric on chip variations, Introduction to LVF.

UNIT-V	Physical Verification	Classes: 10

Physical verification - Introduction, goals and objectives, design rule check, layout versus schematic check and electrical rule check, Design for manufacturability - Introduction, DFM aware routing, DFM checks and fixing (pattern matching, MAS).

Text Books:

1. Rakesh Chadha and J. Bhasker, "An ASIC Low Power Primer", Springer, 2013.

Reference Books:

1. Voltus Reference Manuals, 17.12.000.
2. Tempus Reference Manual, 17.12.000.
3. Calibre Reference Manual, 2017.1_17.12

E-Resources:

1.https://www.vlsiguru.com/physical-design-training/
2.https://www.synopsys.com/glossary/what-is-static-timing-analysis.html#:~:text=Definition, possible%20paths%20for%20timing%20violations.

PROFESSIONAL ELECTIVES- IV

SATELLITE COMMUNICATION

Course Code	Category	Hours / Week			Credits	Maximum Marks			
		L	T	P	C	PEC	CIE	SEE	Total
A6EC46	PEC	3	-	-	3	40	40	60	100

Course Objectives:

1. Define the various orbital parameters of satellites, orbital Mechanics and Launchers
2. Know about Tracking techniques of satellites and its subsystems
3. Learn about various multiple accessing techniques
4. Create link budgets for uplink and downlink for the specified carrier to noise ratio (C/N)
5. Design satellite communication systems using GEO or LEO Satellites

Course Outcomes:

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

1. Determine the orbital parameters of a satellites, azimuth, elevation angles and visibility of a geostationary satellite from earth stations.
2. Explain the orbital mechanisms, satellite monitoring systems
3. Evaluate and compare the various multiple accessing techniques used in satellite communications systems
4. Design the satellite links for specified C/N and apply the concepts of power test methods for satellite communications
5. Analyze the radio propagation channel, satellite navigation systems

UNIT-I	Introduction	Classes:9

Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. Orbital Mechanics and Launchers: Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbital determination, Launches and Launch vehicles, Orbital effects in communication systems performance, Payload, Recent advancements in launch vehicles

UNIT-II	Satellite Subsystems	Classes:8

Introduction-Attitude and Orbit control system, Telemetry, Tracking, Commanding and Monitoring, Power Systems, Communication Subsystems, Satellite antennas subsystems, propulsion subsystems Equipment reliability and Space qualification

UNIT-III	Multiple Access	Classes: 8

Frequency Division Multiple Access (FDMA), Intermodulation, calculation of C/N. Time Division Multiple Access (TDMA), Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception, TDMA, CDMA.

UNIT-IV	Satellite Link Design	Classes:9

Basic transmission theory, system noise temperature and G/T ratio, Design of downlinks, Uplink design, Design of satellite links for specified C/N, System design examples. Earth Station Technology: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial Interface, Primary Power test methods.

UNIT-V	Low Earth Orbit and Geo-Stationary Satellite Systems	Classes: 9

Orbit considerations, Coverage and Frequency Consideration, Delay and Throughput considerations, Systems considerations, Operational NGSO Constellation Designs. Satellite Navigation and Global Positioning System: Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS, Signal Levels, GPS Receiver Operation, GPS C/A code accuracy, Differential GPS.

Text Books:

1. Satellite Communications- Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. Satellite Communications Engineering- Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud,2nd Edition, Pearson Publications, 2003.

Reference Books:
1. Satellite Communications: Design Principles- M. Richharia, B S publications, 2nd Edition, 2003. 2. Satellite Communication- D.C Agarwal, Khanna Publications, 5th Edition. 3. Fundamentals of Satellite Communications- K.N. Raja Rao, PHI, 2004 4. Satellite Communications- Dennis Roddy, McGraw Hill, 4th Edition, 2009
Weblinks: https://www.britannica.com/technology/satellite-communication E Textbook: https://bookauthority.org/books/best-satellite-communication-books MOOC Course: https://www.coursera.org/learn/satellite-communications

MACHINE LEARNING TECHNIQUES

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6EC47	PEC	3	-	-	3	40	60	100

COURSE OBJECTIVES: To learn

1. To introduce the fundamental concepts of machine learning and its applications
2. To learn the classification, clustering and regression machine learning algorithms
3. To understand the methods of solving real life problems using the machine learning techniques

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Illustrate the basic concepts of machine learning
2. Implement the classification, clustering and regression algorithms
3. Design and implement a method for solving real life problem using a suitable machine learning technique
4. Combine the evidence from two or more models/methods for designing a system.

UNIT-I	INTRODUCTION AND BAYESIAN DECISION THEORY	Classes 10

Machine perception - feature extraction - classification, clustering and regression - design cycle - types of learning, Bayesian decision theory - classifiers, discriminant functions, and decision surfaces - univariate and multivariate normal densities - Bayesian belief networks.

UNIT-II	COMPONENT ANALYSIS AND HIDDEN MARKOV MODELS	Classes 9

Principal component analysis - Linear discriminant analysis - Independent component analysis. Expectation-maximization algorithm - hidden Markov models: Evaluation - decoding - learning.

UNIT-III	CLASSIFICATION ALGORITHMS	Classes 8

Perceptron and back propagation neural network - radial basis function neural network - probabilistic neural network - k-nearest-neighbor rule. Support vector machine: Training - multicategory generalizations. Decision trees: classification and regression tree - random forest.

UNIT-IV	CLUSTERING AND REGRESSION ALGORITHM	Classes 7

k-means clustering - fuzzy k-means clustering - Gaussian mixture models - auto associative neural network. Regression analysis - support vector regression.

UNIT-V	COMBINING MULTIPLE LEARNERS	Classes 8

Generating diverse learners - model combination schemes - voting - error-correcting output codes - bagging - boosting - mixture of experts revisited - stacked generalization - fine-tuning an ensemble - cascading.

TEXT BOOKS:

1. R. O. Duda, E. Hart, and D.G. Stork, "Pattern classification", Second edition, John Wiley & Sons, Singapore, 2003.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
3. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

REFERENCE BOOKS:

1. M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.

E Textbook:

https://www.kdnuggets.com/2020/04/10-best-machine-learning-textbooks-data-scientists.html

MOOC Course:

https://www.simplilearn.com/pgp-ai-machine-learning-certification-training-course

DESIGN FOR TESTABILITY

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A6EC48	PEC	3	1	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To study techniques in testing of VLSI chips.
2. To understand fault models and their use in testing of VLSI Circuits.
3. Ability to use Fault models for testing various VLSI circuits.
4. Design Circuits for Testability.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Describe the Testability of Combinational Circuits
2. Explain the Testability of Sequential Circuits
3. Illustrate the concepts of Built In Self-Test
4. Demonstrate the design for Testability of Memory Circuits
5. Illustrate Self Checking Circuits using various techniques

UNIT-I	Design for Testability for Combinational Circuits	Classes: 10

Stuck at Faults, Fault diagnosis by Path Sensitization Technique, Reed Muller's expansion technique, OR-AND-OR design, Automatic Synthesis of Testable Logic, Testable design of Multilevel Combinational Circuits.

UNIT-II	Design for Testability for Sequential Circuits	Classes: 10

Controllability and observability, Ad-Hoc Design Rules for Improving Testability, Scan Path Technique for testable Sequential Circuit design, Level Sensitive Scan Design (LSSD), Random Access Scan Technique, partial Scan, Boundary Scan.

UNIT-III	Built-In Self-Test	Classes:10

Test Pattern generation for BIST, Output Response Analysis, Circular BIST, Built-In logic Block observer, Self-Testing using an MISR and Parallel Shift register Sequence generator, LSSD On-Chip Self-Test.

UNIT-IV	Testable Memory Design	Classes: 10

RAM fault Models, Test Algorithms for RAMs-Galloping 0's and 1's, Walking 0's and 1's, March Test, MATS Check Board Test, Detection of Pattern-Sensitive Faults, BIST Techniques for RAM Chips.

UNIT-V	Self - Checking Circuits	Classes: 10

Basic concepts of Self checking circuits, Design of Totally Self Checking checker- Self Checking using m/n codes, Equality Checkers, Berger code, Self-Checking Combinational Circuits, Self -Checking Sequential Circuit.

Text Books:

1. Lala, Parag K. An Introduction to Logic Circuit Testing, Morgan & Claypool, 2009.
2. Parag K. Lala, Digital Circuits Testing and Testability, Academic Press, 1997.
3. M. Abramovili, M.A. Breues, A. D. Friedman, Digital Systems Testing and Testable Design, Jaico publications, 2001.

Reference Books:

1. Zainalabedin Navabi, Digital System Test and Testable Design Using HDL Models and Architectures, Springer, 2011.
2. Parag K. Lala, Fault Tolerant & Fault Testable Hardware Design, PS Publications, 2002.
3. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 2 nd edition, 2000.

PROFESSIONAL ELECTIVES- V

CELLULAR AND MOBILE COMMUNICATIONS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC49	PEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

1. To know the evolution of Mobile communication and cellular concepts to improve capacity of the system.
2. To know the fading mechanism and types of fading and effect of fading on Mobile communication.
3. To know the different types of Equalizers and Diversity techniques.
4. To know the types of channel coding techniques, data transmission modes and services of GSM, CDMA.
5. To know the concepts of Advanced Cellular Systems like 4G, 5G Systems.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Remember the cellular concepts like frequency reuse, hand-off and Interference.
2. Apply the propagation techniques to calculate link budget using path loss models.
3. Analyze the different Equalization and diversity techniques.
4. Know fundamentals of GSM, CDMA. viz., channels, coding techniques, data transmission, services.
5. Understand the fundamentals of 4G, 5G Mobile Cellular Systems.

UNIT I	INTRODUCTION TO MOBILE COMMUNICATION	Classes: 09

Evolution of Mobile Radio Communication, Examples of Wireless Communication Systems. Paging system, Cordless telephones systems, Cellular telephone Systems, Cellular concept: Frequency reuse, Channel Assignment strategies, Hand off strategies. Interference and System capacity, Improving coverage and capacity in cellular systems.

UNIT II	MOBILE RADIO PROPAGATION	Classes: 09

Large Scale Fading: Free space propagation model, three basic propagation mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical link budget using path loss models. Small Scale Fading: Multipath Propagation, Types of small-scale fading, Parameters of Mobile Multipath channels, fading effects due to multipath time delay Spread and Doppler spread.

UNIT III	EQUALIZATION AND DIVERSITY TECHNIQUES	Classes: 09

Fundamentals of Equalizers, Linear equalizers, Non-linear equalizers, Decision feedback equalizers, MLSE. Space diversity: MRC, EGC Selection diversity, Polarization diversity, Frequency diversity, Time diversity.

UNIT IV	MOBILE CELLULAR SYSTEMS: GSM, CDMA	Classes: 09

GSM: Historical overview, System overview, The air interface, Logical and physical channels, Synchronization, Coding, Equalizer, Circuit-switched data transmission, Handover. CDMA: Historical overview, System overview, Air interface, Coding, Spreading and Modulation, Handover.

UNIT V	ADVANCED MOBILE CELLULAR SYSTEMS	Classes: 09

Overview of 4G and its features, 4G Architecture, Overview of 5G requirements, spectrum sharing for 5G, 5G System concepts, Single and multi user MIMO.

TEXT BOOKS:

1. Theodore S. Rappaport - Wireless Communications Principles and Practice, 2nd Edition, Pearson Education, 2003.
2. Andreas F.Molisch - Wireless Communications, John Wiley, 2nd Edition, 2006.
3. Wei3.Xiang, Kan Zheng, Xuemin Shen "5G Mobile Communications" Springer publications-2016
4. AfifOsseiran, Jose F. Monserrat, Patrick Marsch. "5G Mobile and Wireless Communication Technology" Cambridge University Press-2016

REFERENCE BOOKS:

1. Kamilo Feher - Wireless Digital Communications, PHI, 2003.
2. W.C.Y. Lee - Mobile Cellular Communications, 2nd Edition, MC Graw Hill, 1995.
3. Yi-Bing Lin - Wireless and Mobile Network Architectures, 2nd Edition, Wiley, 2008.

Web References:

1. http://www.winlab.rutgers.edu/~narayan/Course/Wireless_Revolution/vts%20article.pdf
2. https://m.eet.com/media/1116127/mcclaning_3_pt2.pdf

E Text Books

1. https://www.pearson.com/us/higher-education/program/Rappaport-Wireless-Communications-Principles-and-Practice-2nd-Edition/PGM91547.html
2. https://www.wiley.com/en-in/Wireless+Communications%2C+2nd+Edition-p-9780470741863

MOOC Course

1.https://nptel.ac.in/courses/106/106/106106167/
2. https://nptel.ac.in/courses/117/104/117104118/

ARTIFICIAL NEURAL NETWORKS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC50	PEC	3	-	-	3	40	60	100

COURSE OBJECTIVES

1. To organize synaptic connectivity as the basis of neural computation and learning
2. To learn the ideological basics of artificial neural networks
3. To know some application of artificial neural networks
4. Understand the concepts of Perceptron and dynamical theories of recurrent networks
5. To learn how to design and how to supervised and unsupervised artificial neural networks

COURSE OUTCOMES

At the end of the course the student shall be able to

1. Organize synaptic connectivity as the basis of neural computation and learning
2. Apply the ideological basics of artificial neural networks
3. Implement the real time application of artificial neural networks
4. Analyse the Perceptron and dynamical theories of recurrent networks
5. Design and how to supervised and unsupervised artificial neural networks

UNIT-I	INTRODUCTION TO ANN	Classes: 09

Introduction to ANN: Features , structure and working of Biological Neural Network , Trends in Computing Comparison of BNN and ANN. Basics of Artificial Neural Networks -History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture.

UNIT-II	BACK PROPAGATION NETWORKS	Classes: 09

Back propagation networks -Architecture of feed forward network, single layer ANN, multilayer perception, back propagation learning, input - hidden and output layer computation, back propagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.

UNIT III	ACTIVATION & SYNAPTIC DYNAMICS	Classes: 09

Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks Basic functional units of ANN for pattern recognition tasks: Basic feed forward, Basic feedback and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks.

UNIT-IV	COMPETITIVE LEARNING NEURAL NETWORKS	Classes: 09

Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

UNIT-V	APPLICATIONS OF ANN	Classes: 09

Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.

TEXT BOOKS

1. B. Yegnanarayana - Artificial neural network PHI Publication.
2. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms
3. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005

REFERENCE BOOKS:

1.Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press ,1995
2. Nelson Morgan – Artificial neural network: Electronic Implementations – IEEE Press, 1990
3. Journal of Artificial neural networks, Volume 1 – Ablex Publishing corporation , 1994

Web References: 1. https://www.investopedia.com/terms/n/neuralnetwork.asp 2. https://towardsdatascience.com/understanding-neural-networks-19020b75823
E Text Books s://kupdf.net/download/ann-by-byegnanarayanapdf_5ab9885ae2b6f523273f5edb_pdf t//www.spiedigitallibrary.org/ebooks/TT/Artificial-Neural-Networks-AnIntroduction/eISBN-9780819478726/10.1117/3.633187?SSO=1
MOOC Course 1. https://nptel.ac.in/courses/117/105/117105084/ 2. https://nptel.ac.in/courses/108/108/108108148/

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CMOS ANALOG IC DESIGN								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC51	PEC	3	-	-	3	40	60	100

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Understand the fundamentals of analog circuits and MOS device models.
2. Apply the knowledge on various configurations of MOS transistors and feedback concepts
3. Know the different types of noise and different amplifier designs
4. Estimate the concepts of Op-Amp frequency compensation, capacitor switches and PLLs

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Design a simple current mirror.
2. Differentiate the basic difference in the design of amplifiers.
3. Analyze the characteristics of noise and frequency response of the amplifier
4. Design a op-amp and switched capacitor circuits.

UNIT-I	INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS	Classes: 09

Concepts of Analog Design – General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascade current mirrors- Active current mirrors- large and small signal analysis- Common mode properties.

UNIT-II	AMPLIFIERS AND FEEDBACK	Classes: 09

Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.

UNIT-III	FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE	Classes: 09

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascade stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.

UNIT-IV	OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION	Classes: 09

General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps- General consideration of stability and frequency compensation- Multipole system- Phase margin- Frequency compensation- Compensation of two stage op Amps- Other compensation techniques.

UNIT-V	SWITCHED-CAPACITOR FILTERS AND PHASE LOCKED LOOPS	Classes: 09

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL- Charge pump PLLs – Non ideal Effects in PLLs- Delay locked loops- its applications.

TEXT BOOKS:

1. Behzad Razavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003
2. Phillip Allen and Douglas Holmberg —CMOS Analog Circuit Design‖ Second Edition, Oxford University Press, 2004

REFERENCE BOOKS:

1. R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition, IEEE press, 2008.
2. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.
3. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer editions).

M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008.

Web References:

1.http://www-soc.lip6.fr/~hassan/lec5_freq_resp.pdf
2. https://user.eng.umd.edu/~neil/EE408D_02/Design_Ex/Mixer/mixer.html

E Text Books

1. https://xdevs.com/doc/_Books/ASIC_Design/design%20of%20analog%20cmos%20inegrated%20circuits%20%28razavi-2001%29.pdf

MOOC Course

1.https://nptel.ac.in/courses/117/101/117101105/
2.https://nptel.ac.in/courses/117/106/108106105/

PROFESSIONAL ELECTIVES- VI

RADAR SYSTEMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC52	PEC	3	-	-	3	40	60	100

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to
1. Know the block diagram of RADAR, radar frequencies and applications
2. Know False Alarm Time and Probability, Radar Cross Section, system losses.
3. Know Doppler Effect, CW and Frequency Modulated Radar.
4. Understand about FM-CW Radar, Multiple Frequency CW Radar.
5. Analyze the MTI and Pulse Doppler Radar Parameters.

UNIT-I	BASICS OF RADAR SYSTEMS	Classes: 09

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.

UNIT-II	RADAR EQUATION	Classes: 09

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), Illustrative Problems 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.

UNIT-III	FM-CW RADAR	Classes: 09

Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar. 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	Classes: 09

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, Matched Filter Receiver –Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Nonmatched Filters, Matched Filter with Non-white Noise.

UNIT-V	RADAR RECEIVERS	Classes: 09

Noise Figure and Noise Temperature. Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.

TEXT BOOKS:

1. Merrill I. Skolnik, Introduction to Radar Systems –TMH Special Indian Edition,2nd ed., 2007.

REFERENCE BOOKS:

1. Merrill I. Skolnik, Introduction to Radar Systems –Third Edition, Tata McGraw-Hill, 2001.
2. Radar: Principles, Technology, Applications-Byron Edde, Pearson Education.2004.
3.Levanon, N., Radar Principles, Wiley Interscience, 1988.

Web References:

1.https://fas.org/man/dod-101/navy/docs/es310/radarsys/radarsys.htm
2. https://www.jlab.org/ir/MITSeries/V1-1.pdf

E Text Books

1. https://www.jlab.org/ir/MITSeries/V1-1.pdf
2. https://deebak.files.wordpress.com/2009/05/skolnik.pdf
3. https://www.smartzworld.com/notes/radar-system-notes-rs/

MOOC Course

1. https://nptel.ac.in/courses/108/105/108105154/
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee58/

DEEP LEARNING ALGORITHMS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC53	PEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

1. To Understand basics of deep learning
2. To know the various deep learning models
3. To study the realign of high dimensional data using reduction techniques
4. To analyze optimization and generalization in deep learning
5. To know the various deep learning applications

COURSE OUTCOMES:

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

1. Estimate the basics of deep learning algorithms
2. Implement various deep learning models
3. Realign high dimensional data using reduction techniques
4. Analyze optimization and generalization in deep learning
5. Explore the deep learning applications

UNIT-I	INTRODUCTION TO MACHINE LEARNING	Classes: 09

Introduction to machine learning- Linear models (SVMs and Perceptron, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT-II	DEEP NETWORKS	Classes: 09

History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

UNIT-III	DIMENTIONALITY REDUCTION	Classes: 09

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.

UNIT-IV	OPTIMIZATION AND GENERALIZATION	Classes: 09

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning -Computational & Artificial Neuroscience

UNIT-V	DEEP LEARNING APPLICATIONS	Classes: 09

Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics

TEXT BOOKS:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. 1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.

REFERENCE BOOKS:

1. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Web References:

1. https://towardsdatascience.com/what-is-deep-learning-and-how-does-it-work-2ce44bb692ac
2. https://www.ibm.com/cloud/learn/deep-learning

E Text Books

1. https://www.stat.cmu.edu/~cshalizi/ADAfaEPoV/ADAfaEPoV.pdf
2. https://www.emerald.com/insight/content/doi/10.1108/03684920710743466/full/html

MOOC Course

1. https://nptel.ac.in/courses/106/106/106106184/
2. https://cdala14.com/atyfi9s/design-and-analysis-of-algorithms-nptel-2021

LOW POWER VLSI

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC54	PEC	3	1	0	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. This course addresses a profound analysis on the development of the CMOS & Bi-CMOS digital circuits for a low voltage low power environment.
2. To study the concepts of device behavior and modeling
3. To study the concepts of low voltage, low power logic circuits.

COURSE OUTCOMES

Upon successful completion of the course, the student is able to

1. Capability to recognize advanced issues in VLSI systems, specific to the deep-submicron silicon technologies.
2. Students able to understand deep submicron CMOS technology and digital CMOS design styles.
3. To design chips used for battery-powered systems and high-performance circuits

UNIT-I	INTRODUCTION TO LOW POWER DESIGN	Classes: 10

Introduction, Low Power design- an overview, low power design limitations: power supply voltage, threshold voltage, scaling, interconnect wires, Silicon-on-Insulator (SOI) From Devices to Circuits.

UNIT-II	MOS/BI-CMOS PROCESS TECHNOLOGY AND INTEGRATION	Classes: 10

The Realization of Bi-CMOS processes, Bi-CMOS manufacturing and Integration Considerations, Isolation in Bi-CMOS, Deep submicron processes, Future trends and directions of CMOS/BiCMOS processes.

UNIT-III	DEVICE BEHAVIOR AND MODELING	Classes:10

The MOS (FET) Transistor, The Bipolar (Junction) transistor, MOSFET SPICE models, Advanced, Bipolar Spice models, MOSFET in Hybrid Mode Environment-Surface p-Channel for Sub-HalfMicron Devices, Device Fabrication, Model Parameters Extraction, Sub-Half-Micron D.C. Model Formulation.

UNIT-IV	CONVENTIONAL CMOS AND BI-CMOS LOGIC GATES	Classes: 10

Conventional CMOS Logic Gates, Conventional Bi-CMOS Logic Gate, Bi-CMOS Circuits Utilizing Lateral pnp BJTs in pMOS structures, Performance evaluation and Comparison.

UNIT-V	LOW- VOLTAGE, LOW POWER LOGIC CIRCUITS	Classes: 10

Merged Bi-CMOS digital circuits, Full-Swing Multidrain/ Multicollector Complementary Bi-CMOS Buffers, QuasiComplementary Bi-CMOS Digital Circuits, Full-Swing Bi-CMOS/BiNMOS Digital circuits employing Schottky Diodes, Feedback-Type Bi-CMOS Digital Circuits, High-Beta Bi-CMOS Digital Circuits, Transiently Saturated Full-Swing Bi-CMOS Digital Circuits, Bootstrapped-type Bi-CMOS Digital circuits,ESD-free Bi-CMOS Digital circuit -circuit operation and comparative Evaluation. Evolution of Latches and Flip-Flops, Quality Measures for Latches and Flip-Flops, Design perspective.

Text Books:

1. KiatSeng Yeo, Samir S. Rofail, Wang-Ling Goh, “CMOS/Bi CMOS ULSI Low Voltage Low Power”, Pearson Education Asia 1st Indian reprint, 2002.

Reference Books:

1. J.Rabaey, “Digital Integrated Circuits”, PH. N.J 1996, 2nd Edition.
2. Sung-mokang and yusufleblebici, “CMOS Digital ICs”, TMH, 3rdedition, 2003.
3. Parhi, “VLSI DSP Systems”, John Wiley & sons, 2003 Reprint.
4. IEEE Trans Electron Devices, IEEE J.Solid State Circuits, and other National and International Conferences and Symposia.

OPEN ELECTIVES- I
OFFERED BY
DEPARTMENT OF ECE

MICROPROCESSORS AND INTERFACING								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC55	OEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand the basic of 8, 16-bit microprocessor architectures and its functionalities.
2. Develop an assembly language programming skills of various processors.
3. Interface different peripheral devices with microprocessors and microcontrollers.
4. Interface memory devices to 8086 processor.
5. Analyse Serial communication schemes of microprocessor-based systems.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Understand the architecture of microprocessor.
2. Understand the programming model of microprocessors.
3. Interface different external peripherals with microprocessors.
4. Analyse a problem and formulate appropriate computing solution for processor-based application.
5. Develop an assembly language program for specified application in communication.

UNIT-I	MICROPROCESSORS ARCHITECTURE	Classes: 09

Overview of 8085, 8086 architecture- functional diagram, Register organization, memory segmentation, Memory addresses, physical memory organization.

UNIT-II	SIGNAL DESCRIPTION OF 8086	Classes: 09

Signal description of 8086, timing diagrams, Interrupt structure of 8086, Vector interrupt table, Interrupts of 8086 Processor, Interrupt service routine.

UNIT-III	INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING OF 8086	Classes: 09

Programming model, Addressing modes, Instruction set, Assembler directives, Programs involving logical, branch and call instructions, Sorting, evaluating arithmetic expressions, and string manipulations.

UNIT-IV	I/O INTERFACE	Classes: 09

Introduction to 8255 PPI, various modes of operation of 8255 PPI, interfacing 8255 to 8086, Stepper motor interfacing, D/A &A/D converter, Memory interfacing to 8086.

UNIT-V	SERIAL COMMUNICATION INTERFACE	Classes: 09

Serial communication standards, serial data transfer schemes, 8251 USART architecture, Interfacing of 8251/ USART to 8086 Processor.

Text Books:

6. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition 2006.
2. Advanced microprocessors and peripherals-A. K ray and K.M.Bhurchandani, TMH, 2nd edition 2006.
3. R.S.Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996.

Reference Books:

1. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
2.Micro computer system 8086/8088 family architecture, programming and design- By Liu and GA Gibson, PHI, 2nd Ed.,

Web References:

1.http://www.freebookcentre.net/electronics-ebooks-download/Microprocessor-and-Microcontroller.html
2.http://coen.boisestate.edu/smloo/smloo-courses/ece-332-microprocessors-fall07/lecture-notes/
3.http://www.freebookcentre.net/electronics-ebooks-download/Introduction-to-Microcontrollers-Lecture-Notes.html

E-Text Books:

1.http://gen.lib.rus.ec/book/index.php?md5=67C5AC79DC8180A7F0641609D0C7800C
2.http://www.faadooengineers.com/threads/9039-8085-microprocessor-by-RAMESH-GANOKAR-ebook-pdf-download

3.https://e.edim.co/123389964/The_8051_Microcontroller_Architecture_Programming_And_Applications.pdf 4.https://e.edim.co/123389964/A.K._Ray_and_K.M._BhurchandiAdvanced_Microprocessors_and_Peripherals_3e-Tata_Mcgraw_Hill.pdf
MOOC Course 1.https://www.mooc-list.com/tags/microprocessors 2.https://www.coursera.org/courses?query=microprocessor

PRINCIPLES OF COMMUNICATIONS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC56	OEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

The students are able to:

1. Describe the basic concepts of analog communication
2. Significance of digital & analog communication
3. Compare the digital modulation techniques
4. Learn the various multiple access techniques
5. Understanding the Satellite and Optical fiber concepts.

COURSE OUTCOMES:

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

1. Understand the concepts of analog modulations
2. Illustrate the basic concepts of digital modulations.
3. Analyse the various digital modulation methodologies.
4. Distinguish the concepts of multiple access techniques.
5. Differentiate the various orbits and associated satellite launches.

UNIT I	FUNDAMENTALS OF ANALOG COMMUNICATION	Classes: 09

Modulation, Principles of Amplitude Modulation, AM modulator and Demodulator, Types of Amplitude modulation (DSBSC, SSBSC, VSB). Angle modulation FM and PM waveforms, phase deviation and modulation index, frequency deviation and percent modulation.

UNIT II	DIGITAL TRANSMISSION	Classes: 09

Introduction, Sampling theorem, Types of pulse modulations, PCM, companding, differential pulse code modulation, delta modulation, adaptive delta modulation, Inter symbol interference.

UNIT III	DIGITAL MODULATION TECHNIQUES	Classes: 09

Introductions, Shannon limit for information capacity, ASK FSK, BPSK QPSK and DPSK modulators and demodulators, comparison of digital modulation techniques.

UNIT IV	SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES	Classes: 09

Introduction, Pseudo noise sequence, DS spread spectrum with coherent binary PSK, FH spread spectrum, multiple access techniques-FDMA, TDMA and CDMA.

UNIT V	SATELLITE AND OPTICAL COMMUNICATION	Classes: 09

Satellite Communication Systems, Kepler's Law, LEO, MEO and GEO Orbits, Link model Optical Communication Systems-Fiber losses-scattering, absorption attenuation and bending losses, types of optical Sources and Detectors.

TEXTBOOKS:

1. Wayne Tomasi, —Advanced Electronic Communication Systems|, 6/e, Pearson Education, 2007.
2. Simon Haykin, —Communication Systems|, 4th Edition, John Wiley & Sons., 2001.

REFERENCES:

1. H.Taub,D L Schilling, G Saha ,|Principles of Communication|3/e,2007.
2. B.P.Lathi,|Modern Analog And Digital Communication systems|, 3/e, Oxford University Press, 2007
3. Blake, —Electronic Communication Systems|, Thomson Delmar Publications, 2002.
4. Martin S.Roden, —Analog and Digital Communication System|, 3rd Edition, PHI, 2002.
5. B.Sklar,|Digital Communication Fundamentals and Applications|2/e Pearson Education 2007.

Web References:

1.https://personal.utdallas.edu/~torlak/courses/ee4367/lectures/FIBEROPTICS.pdf

2.Bricker G (2012) 2-D bar codes, Journal of Computing Sciences in Colleges, **28**:1, (25-32), Online publication date: 1-Oct-2012.

E-Text Books:

1. https://books.google.co.in/books/about/Principles_Of_Communication.html?id=6Zunu4Acfg8C

OPEN ELECTIVES- II
OFFERED BY
DEPARTMENT OF ECE

MICROCONTROLLERS AND APPLICATIONS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC57	OEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

1.To introduce the students about architectural features of microcontrollers and its registers
2. To introduce about the instruction set of 8051
3. To know about the I/O Ports and Interrupts of 8051
4. To know about Timers/Counters of 8051
5. To introduce Arduino programming and interfacing of sensors

COURSE OUTCOMES:

Upon completion of the course, students will be able to:
1. Understand the architectural features of MCS-51 and select a suitable microcontroller to suit the application.
2. Develop programs for control applications using assembly language and embedded C
3. Use timers and counters for delay generation and event counting and Illustrate the use of interrupts and service routines
4. Write algorithms and develop programs for serial data communication applications.
5. Design microcontroller based-applications for simple real-world applications

UNIT I	8051 ARCHITECTURE	Classes: 9

Introduction to microcontrollers, RISC, CISC, Harvard and Von Neumann architectures. Architecture of 8051, Signal descriptions of 8051, General purpose registers of 8051, register banks, Memory organization.

UNIT II	INSTRUCTION SET OF 8051	Classes: 9

Assembly language Instruction format, 8051 Addressing modes, Instruction set of 8051: Classification, syntax and function of instructions, Simple programs.

UNIT III	I/O PORT AND INTERRUPT PROGRAMMING	Classes: 9

I/O Ports of 8051, Features of I/O ports, configuring I/O ports, interface I/O devices such as LED, buzzer, push-button switch, example programs with assembly & C. Interrupts of 8051 and its priorities, IE and IP registers, Interrupt enabling/disabling and priority setting, example programs in assembly and C.

UNIT IV	TIMERS /COUNTERS AND SERIAL I/O	Classes: 9

Bit structure and function of TMOD and TCON registers, Timer/Counter modes of operations, Timer/Counter programs in assembly and C. Bit structure and function of SCON, PCON registers, SBUF register, Serial Communication modes in 8051, programs on serial communication.

UNIT V	INTRODUCTION TO ARDUINO	Classes: 9

Introduction to Arduino-uno board, Analog and Digital pins, programming structure of Arduino, introduction to sensors and actuators , Sensor interfacing, programming to sensors, Motor interfacing, LCD interfacing.

TEXTBOOKS:

1. The 8051 Microcontroller(3rd edition) - Kenneth J Ayala
2. The 8051 Microcontroller & Embedded systems using assembly and C (2ndEdition) –M.A.Mazidi , J.C. Mazidi & R.D.McKinlay ISBN: 81-317-1026-2

REFERENCES:

1. The 8051 Microcontroller(4th Edition)- MacKenzie , ISBN:81-317-2018-7
2. The 8051 Microcontroller(1st Edition) – Dr.Uma Rao & Andhe Paallavi, ISBN: 81-317-3252-5
3. Microcontrollers & applications, Ramani Kalpathi, & Ganesh Raja , ISBN: 81-888-4918-9
4. Programming Arduino: Getting Started with Sketches, Second Edition (Tab) 2nd Edition – Simon Monk

Web References:

https://www.the8051microcontroller.com/web-references

E-Text Books: 1. https://www.freebookcentre.net/Electronics/Microcontroller-Books.html 2. https://www.freebookcentre.net/Electronics/Microcontroller-Application-Books.html
MOOC Course 1.https://nptel.ac.in/courses/117/104/117104072/

FUNDAMENTALS OF IMAGE PROCESSING								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
A6EC58	OEC	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100

COURSE OBJECTIVES:

The students are able to:

1. To become familiar with digital image fundamentals
2. To get exposed to image enhancement techniques in Spatial and Frequency domain.
3. To learn concepts of degradation function and restoration techniques.
4. To study the image segmentation and representation techniques.
5. To become familiar with image compression and recognition methods

COURSE OUTCOMES:

1. Know and understand the basics and fundamentals of digital image processing.
2. Operate on images using the techniques of smoothing, sharpening and enhancement.
3. Apply the restoration concepts and filtering techniques on digital images.
4. Learn the basics of segmentation and features extraction.
5. Analyze the compression and recognition methods for color images.

UNIT I	INTRODUCTION OF IMAGE PROCESSING	Classes: 09

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighbourhood, adjacency, connectivity, distance measures.

UNIT II	IMAGE ENHANCEMENT	Classes: 09

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Image Enhancement in Frequency Domain: Low Pass and High Pass Filters in Frequency Domain, Homomorphic filtering

UNIT III	IMAGE TRANSFORMS	Classes: 09

Image Transforms: 2 D- Discrete Fourier Transform and its properties, Discrete Cosine Transform (DCT), Haar Transform, Hadmard Transform, Hotelling Transform and Slant transform.

UNIT IV	IMAGE SEGMENTATION	Classes: 09

Introduction-Edge detection, Edge linking and boundary detection – Thresholding – Region based segmentation – Region growing – Region splitting and merging- Watershed segmentation algorithm.

UNIT V	IMAGE COMPRESSION	Classes: 09

Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

TEXTBOOKS:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- Mc Graw Hill Edn., 2010.

REFERENCES:

1. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
2.Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015.
3. S. Sridhar , Digital Image Processing, Oxford University Press, 2nd Ed, 2016.

Web References:

1. http://homepages.inf.ed.ac.uk/rbf/BOOKS/VERNON/Chap004.pdf

E-Text Books:

1. https://books.google.co.in/books/about/Digital_Image_Processing.html?id=a62xQ2r_f8wC

MOOC Course:

1. https://nptel.ac.in/courses/117105079/

OPEN ELECTIVE –III
OFFERED BY
DEPARTMENT OF ECE

INTRODUCTION TO SENSORS AND ACTUATORS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC59	OEC	3	-	-	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. Understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy.
2. Create analytical design and development solutions for sensors and actuators.
3. To know the basic laws of behaviour of sensors and actuators.
4. To able to know about the Standards for Smart Sensor Interface
5. Analyse the development and application of sensors and actuators.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Apply the fundamental physical and technical base of sensors and actuators,
2. Analyse various premises, approaches, procedures and results related to sensors and actuators
3. Analyse basic laws and phenomena that define behavior of sensors and actuators.
4. Apply the Smart Sensor Interface in various applications
5. Develop the application of sensors and actuators

UNIT-I	SENSORS & TRANSDUCERS	Classes: 9

Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Resistance Strain Gauge, Semiconductor Strain Gauges, Capacitive Sensors, Electrostatic Transducer, Ultrasonic Sensors.

UNIT-II	THERMAL SENSORS	Classes: 9

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermo-sensors, Nuclear Thermometer, Thermo-EMF Sensors, Thermal Radiation Sensors, Quartz Crystal Thermo-electric Sensors, Spectroscopic Thermometry, Noise Thermometry.

UNIT-III	RADIATION SENSORS	Classes: 9

Introduction – Basic Characteristics – Types of Photosensistors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors. Electro Analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Sensor Electrodes.

UNIT-IV	SMART SENSORS	Classes: 9

Introduction, Primary Sensors, Excitation, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors.

UNIT-V	ACTUATORS	Classes: 9

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves.

Text Books:

1.D. Patranabis, “Sensors and Transducers”, PHI Learning Private Limited.
2.W. Bolton, “Mechatronics”, Pearson Education Limited.

INTRODUCTION TO COMPUTER VISION								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A6EC60	OEC	3		-	3	40	60	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To review image processing techniques for computer vision.
2. To understand the concepts of Image Enhancement.
3. To understand the basics of segmentation and its applications.
4. To know about the feature extraction and Hough Transform.
5. To understand three-dimensional image analysis techniques.

COURSE OUTCOMES:

Upon successful completion of the course, the student is able to

1. Implement fundamental image processing techniques required for computer vision.
2. Analyze the various spatial and frequency domain filtering.
3. Understand the idea about segmentation
4. Apply Hough Transform for line, circle, and ellipse detections.
5. Apply 3D vision techniques and motion related techniques.

UNIT-I	IMAGE PROCESSING FOUNDATIONS	Classes: 09

Fundamental steps in Digital Image Processing, Components of Digital Image Processing Image sensing and acquisition, Image formation model, Pixels, Basic relationship between pixels, Sampling and Quantization in Digital Image Processing

UNIT-II	IMAGE ENHANCEMENT	Classes: 09

Intensity transformations, contrast stretching, histogram equalization, Spatial filtering: Smoothing filters, sharpening filters, Frequency domain filtering, Homomorphic filtering,

UNIT-III	BAICS OF SEGMENTATION	Classes: 09

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour models, Texture feature-based segmentation, Graph based segmentation, Wavelet based Segmentation - Applications of image segmentation.

UNIT-IV	FEATURE EXTRACTION	Classes: 09

First and second order edge detection operators, Phase congruency, Localized feature extraction - detecting image curvature, shape features, Introduction to Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors.

UNIT-V	3D IMAGE VISUALIZATION	Classes: 09

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing',Pearson,Education, Inc.,Second Edition, 2004.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press,2008.
3. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.

Reference Books:

1. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
2. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012.
3. R. Szeliski, “Computer Vision: Algorithms and Applications”, Springer 2011.
4. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012.

Web References:

1.https://machinelearningmastery.com/what-is-computer-vision/

E-Text Books:

1. https://machinelearningmastery.com/computer-vision-books/

MOOC Course

1. https://onlinecourses.nptel.ac.in/noc21_ee23/preview