ACADEMIC REGULATIONS (BH23)
COURSE STRUCTURE AND
DETAILED SYLLABUS

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech. Four Year Degree Course

(Applicable for the batches admitted from AY 2023-24 onwards)

VISHNU
UNIVERSAL LEARNING

BVRIT H

BVRIT HYDERABAD College of Engineering for Women
(UGC Autonomous Institution | Approved by AICTE | Affiliated to JNTUH)
(NAAC Accredited – A Grade | NBA Accredited B.Tech. (EEE, ECE, CSE and IT))
Bachupally, Hyderabad -500 090
www.bvrithyderabad.edu.in

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BVRIT HYDERABAD College of Engineering for Women

VISION

To emerge as the best among the institutes of technology and research in the country dedicated to the cause of promoting quality technical education.

MISSION

At BVRITH, we strive to

- Achieve academic excellence through innovative learning practices.
- Enhance intellectual ability and technical competency for a successful career.
- Encourage research and innovation.
- Nurture students towards holistic development with emphasis on leadership skills, life skills and human values.

CORE VALUES

1. Holistic Development
2. Excellence in Education
3. Women Empowerment
4. Integrity
5. Social Responsibility
6. Accountability and Transparency
7. Freedom of Expression

Department of Electronics and Communication Engineering

VISION

To emerge as a centre of academic and research excellence in Electronics and Communication Engineering and create globally competent women technocrats with a high degree of social consciousness in a holistic learning environment.

MISSION

M1: To provide quality education to the students with emphasis on training related to latest technologies as per industrial needs

M2: To impart research culture, professional ethics and moral values to the students by committed and competent faculty striving for excellence.

M3: To inculcate a perceptive alacrity in students to identify real life problems, formulate strategies and evolve into contextually effective solutions.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

After 3 to 6 years of graduation, the graduates will be able to

PEO-1: Excel in contemporary problem solving in Electronics and Communication Engineering and the allied fields through the knowledge base provided by the program.

PEO-2: Demonstrate their technical, communication and leadership skills in professional environment or as entrepreneurs with social responsibility.

PEO-3: Analyze the latest issues and technology growth in the field of Electronics and Communication Engineering and update their knowledge and skills accordingly through continuous learning.

PEO-4: Demonstrate ethical and human values in multicultural and multidisciplinary environments.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO-1: Provide optimized solutions for digital, signal processing and communication systems.

PSO-2: Develop compact, energy efficient and low-cost products to assist the differently abled people.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Academic Regulations (BH23) for B.Tech. Regular Students with effect from Academic Year 2023-24

The B.Tech. degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates, admitted to the programme and fulfill all the requirements for the award of the Degree.

1.0 Under-Graduate Degree Programme in Engineering & Technology (UGP in E&T)

BVRIT HYDERABAD College of Engineering for Women (Autonomous) – BVRITHCEW(A) offers 4 Year (8 Semesters) **Bachelor of Technology** (B.Tech.) Degree Programme, under **Choice Based Credit System** (CBCS) with effect from the Academic Year 2023-24 onwards, in the following branches of Engineering.

S. No.	Branch Code	Branch Name
1	02	Electrical and Electronics Engineering (EEE)
2	04	Electronics and Communication Engineering (ECE)
3	05	Computer Science and Engineering (CSE)
4	12	Information Technology (IT)
5	66	Computer Science and Engineering (AI & ML)

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 (TGEAPCET) or the University or on the basis of any other order of merit approved by the University, 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 (≥ 90 instructional days) each, each semester having - '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 as suggested by AICTE are followed.

3.2.2 Credit courses

All subjects / courses are to be registered by the students 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 BVRITHCEW(A) 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 Courses
2		ES – Engineering Sciences	Includes Fundamental Engineering Courses
3		HS – Humanities and Social sciences	Includes Courses related to Humanities, Social Sciences and Management
4	Core Courses (CoC)	PC – Professional Core	Includes core courses related to the parent discipline / department / branch of Engineering.
5	Elective Courses (EℓC)	PE – Professional Electives	Includes elective courses related to the parent discipline / department / branch of Engineering.
6		OE – Open Electives	Elective offered by all the disciplines / departments / branches 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		Real-time Research Project/ Field Based Project	Real-time Research Project / Field Based Project
10		Seminar	Seminar / Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
11	Minor courses	-	1 or 2 Credit Courses (subset of HS)
12	Mandatory Courses (MC)	-	Mandatory Courses (non-credit)

4.0 Course registration

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

4.2 A student can apply for on-line registration by consulting Faculty Advisor / Counselor / Head of the Department (HoD).

4.3 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 to 6 Credits (any 2 elective subjects), based on progress and SGPA / CGPA, and completion of the '**prerequisites'** as indicated for various subjects / courses, in the department course structure and syllabus contents.

4.4 Choice for '**additional subjects / courses'**, not more than any 2 elective subjects in any semester, must be clearly indicated.

4.5 If the student submits ambiguous choices or multiple options or erroneous entries during online 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.

4.6 Subject / course options exercised through online 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.

4.7 Dropping of subjects / courses may be permitted, only after obtaining prior approval from the faculty counselor and HoD **'within a period of 15 days'** from the beginning of the current semester.

4.8 **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 her 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 with any category (Professional Core, Professional Electives, Mandatory Courses, etc.) of subjects even in the forthcoming semesters.

4.9 **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 An Elective Course may be offered to the students, only if a minimum of 30 students opt for it. The maximum strength of a section is limited to 75.

5.2 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 (excluding 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. **This attendance should also be included in the fortnightly upload of attendance to the Academic Section.**

6.2 Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned by the Academic Council 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; if there 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 be eligible 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 the student secures not less than 35% (14 marks out of 40 marks) in the Continuous Internal Evaluation (CIE), not less than 35% (21 marks out of 60 marks) in the semester end examinations (SEE), 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 is deemed to have failed, if she (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 re-appearance'** 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), and CGPA ≥ 5.0 (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 Engineering.) other than those listed subjects totalling to 160 credits as specified in the course structure of her department, the performance in those '**extra subjects**' (although evaluated and graded using the same procedure as that of the required 160 credits) will not be taken into account while calculating the SGPA and CGPA. For such '**extra subjects'** registered, percentage of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 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 reappear for 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 for evaluating performance in that subject.

7.7 A student **detained in a semester due to shortage of attendance may be re-admitted in the same semester in the next academic year for fulfilment of academic requirements.** The academic regulations under which a student has been readmitted shall be applicable. However, 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 academic credits.** The academic regulations under which the student has been readmitted shall be applicable to her.

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 choices, 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 shall be 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 overall 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), her performance in that subject in SEE shall stand cancelled in spite of appearing the SEE.

There is NO Computer Based Test (CBT) for BH23 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.

8.2.2 For the subject, **Computer Aided Engineering Graphics**, the Continuous Internal

Evaluation (CIE) and Semester End Examinations (SEE) evaluation pattern is same as for other theory subjects.

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 marks for 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 shall be evaluated for 10 marks.
4. The remaining 10 marks are for Laboratory Report / Project and Presentation, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course 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 by the Controller of Examinations / Chief Superintendent on the recommendation of BoS chairman of the concerned department.

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 same laboratory 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 overall 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), her performance in that subject in SEE shall stand cancelled in spite 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 Semester course (*ex.*, ***Elements of EEE / ECE / CSE*** *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 are 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 she (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

   For CSE / IT and allied branches the Continuous Internal Evaluation (CIE) will be for 50 marks. Each Mid-Term examination consists of two parts **i) Part – A** for 20 marks, ii) **Part–B** for 20 marks with a total duration of 2 hours.

   Part A: Objective / quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 20 marks. **Part B:** Descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks.

   The remaining 10 marks of Continuous Internal Evaluation are for Assignment (5 marks) and Subject Viva-Voce / PPT / Poster Presentation / Case Study (5 marks) and the evaluation pattern will remain same as for other theory subjects.

   For all other branches, the Continuous Internal Evaluation (CIE) will be for 50 marks. Out of the 50 marks for internal evaluation:
   a) 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
   b) **10 marks for viva-voce (**or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.
   c) Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for15 marks.
   d) The remaining 15 marks are for Laboratory Report/Project and Presentation, which consists of the Design (or) Software/Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

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 and II Mid-Term examination. The average marks of two Mid-Term examinations are 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 she (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 (iii) secures less than 40% marks in this course.

8.5 There shall be 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 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 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 in the IV Year I Semester and the duration of the project work is one year. The student must present Project Stage - I during IV Year I Semester before II Mid examinations, in consultation with her Supervisor, the title, objective and plan of action of her Project work to the departmental committee for approval before commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start her 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 during IV Year 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 report on 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 for the above evaluation, when it is scheduled again; if she fails in such **'one reappearance'** evaluation also, she has to reappear for 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 20 marks 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 from the topic already taken. The student is deemed to have failed, if she (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, Controller of Examinations / Chief Superintendent select an external examiner from the list of experts in the relevant branch submitted by the BoS Chairman of the concerned department.

A student, who has failed, may reappear once for the above evaluation, when it is scheduled again; if the student fails in such **'one reappearance'** evaluation also, she 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) are less 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 class work in next academic year.

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

8.11 For mandatory courses of Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab, a student has to secure 40 marks out of 100 marks (i.e. 40% of the 100 marks allotted) in the Continuous Internal Evaluation for passing the subject / course. These marks should also be uploaded along with the internal marks of other subjects.

8.12 No marks or letter grades shall be allotted for mandatory / non-credit courses. Only Pass / Fail shall be indicated in Grade Card.

9.0 Grading procedure

9.1 Grades will be awarded to indicate the performance of students in each Theory Subject, Laboratory / Practicals, Seminar, Industry Oriented Mini Project, and Project Stage-I & II. 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 she 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 (∑CP) 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

$$\textbf{SGPA} = \{ \sum_{i=1}^{N} C_i G_i \} / \{ \sum_{i=1}^{N} C_i \} \text{ .... for each semester}$$

where 'i' is the subject indicator index (takes into account 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 awarded for 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 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

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

(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'** i.e., from the 1^{st} semester onwards up to and inclusive of the 8^{th} semester, 'j' is the subject indicator index (takes into account all subjects from 1 to 8 semesters), C_j is the no. of credits allotted to the j^{th} subject, and G_j represents the grade points (GP) corresponding to the letter grade awarded for that j^{th} subject. After registration and completion of I year I semester, 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	Course1	3	A	8	24
I	Course2	3	O	10	30
I	Course3	3	B	6	18

I	Course4	4	A	8	32
I	Course5	3	A+	9	27
I	Course6	4	C	5	20
II	Course7	4	B	6	24
II	Course8	4	A	8	32
II	Course9	3	C	5	15
II	Course10	3	O	10	30
II	Course11	3	B+	7	21
II	Course12	4	B	6	24
II	Course13	4	A	8	32
II	Course14	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 above illustrated calculation process of CGPA 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 SGPA and CGPA shall be mentioned only on the Memorandum of Grades in which sitting she passed her 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 she secures a GP ≥ 5.0 (**'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 she shall be declared successful or 'passed' in the entire undergraduate programme, only when gets a CGPA ≥ 5.0 (**'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.), 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 chosen 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, she

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

12.4 Students with final CGPA (at the end of the undergraduate programme) ≥ 7.00 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 < 6.00, 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 engineering

branch on completion of all the academic requirements and earned all the 80 credits (within 4 years from the date of admission) up to B.Tech. II Year II Semester, if the student wants to exit the 4-Year B.Tech. Programme and *requests for the 2 –Year* B.Tech. (*UG) Diploma Certificate.*

2. The student **once opted and awarded 2-Year UG Diploma Certificate, the student will be permitted to join** in B.Tech. III Year I Semester and continue for completion of remaining years of study for 4-Year B.Tech. Degree ONLY in the next academic year along with next batch students. *However, if any student wishes to continue the study after opting for exit, she should register for the subjects / courses in III Year I Semester before commencement of class work for that semester.*
3. *The students, who exit the 4-Year B.Tech. Programme after II Year of study and wish to re-join the B.Tech. Programme, must submit the 2 - Year* B.Tech. (*UG) Diploma Certificate awarded to her, subject to the eligibility for completion of Course / Degree.*
4. 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 university permission through the principal of the college 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. within 8 Years for 4-Year Programme).

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/R22 Regulations due to lack of attendance, shall be permitted to join I Year I Semester of BH23 Regulations and she is required to complete the study of B.Tech. 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/R22 regulations for want of attendance, shall be permitted to join the corresponding semester of BH23 Regulations and is required to complete the study of B.Tech. within the stipulated period of eight academic years from the date of first admission in I Year. The BH23 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.

B. For students detained due to shortage of credits:

3. A student of R18/R22 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of BH23 Regulations only after acquiring

the required number of credits as per the corresponding regulations of her first admission. The total credits required are 160 including both R18/R22 & BH23 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 BH23 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in BH23 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 her study including BH23 Regulations. **There is NO exemption of credits in any case**.
6. If a student is readmitted to BH23 Regulations and has any subject with 80% of syllabus common with her previous regulations, that particular subject in BH23 Regulations will be substituted by another subject to be recommended by the Academic Council (AC), and approved by Governing Body (GB).

Note: If a student readmitted to BH23 Regulations and has not studied any subjects / topics in her earlier regulations of study which is prerequisite for further subjects in BH23 Regulations, the concerned department HoD shall conduct remedial classes to cover those subjects / topics for the benefit of the students.

15.0 Student Transfers

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

15.2 The students seeking transfer to BVRITHCEW(A) from various other Universities / Institutions have to pass the failed subjects which are equivalent to the subjects of BVRITHCEW(A), and also pass the subjects of BVRITHCEW(A) 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 BVRITHCEW(A), the students have to study those subjects in BVRITHCEW(A) in spite of the fact that those subjects are repeated.

15.3 The BVRITHCEW(A) will provide one chance to write the internal examinations in the equivalent subject (s) to the students transferred from other universities / institutions, as per the clearance (equivalence) letter issued by the University.

16.0 Scope

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

16.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the AC is final.

16.3 The AC 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 AC.

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Academic Regulations (BH23) for B.Tech. (Lateral Entry Scheme) from the AY 2024-25

1. Eligibility for 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 ≥ 5.0 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 rules

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.

Malpractices Rules

Disciplinary Action for Malpractices / 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 which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other 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, she will be handed over to the police and a case is registered against her.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and allot her 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 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, she will be handed over to the police and a case is registered against her.
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	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

	after the examination.	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 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 her to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the chief superintendent/assistant -superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walkout, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to her person or to any of her 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 her 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 there of 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 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 fire arm 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 Chief Superintendent 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.

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Academic Regulations for B.Tech. with Minor program

1. Introduction

The philosophy behind Engineering as an academic discipline has been to orient the knowledge seekers in a manner that shatters the theoretical boundaries and pushes them into the realms of a practical world view.

The emphasis of BVRITHCEW has always been to orient the students towards the technologies that shall drive the world in the years to come; with this philosophy the Institution has decided to launch the **Bachelor of Technology in a particular branch with minor in a specified program** (Ex. B.Tech. in ECE / EEE with Minor in AI&ML) from the AY 2025-26 onwards.

The **Bachelor of Technology (B.Tech.) with Minor** program focuses on the fundamental principles of multiple Engineering disciplines, critical & analytical thinking and the ability to develop a distinctive approach to the interdisciplinary problems.

2. Objectives

The key objectives of offering B.Tech. with Minor program are:

- To expand the domain knowledge of the students in one of the other branches of engineering.
- To increase the employability of undergraduate students keeping in view of better opportunity in inter-disciplinary areas of engineering & technology.
- To provide an opportunity to students to pursue their higher studies in the inter-disciplinary areas in addition to their own branch of study.
- To offer the knowledge in the areas which are identified as emerging technologies / thrust areas of Engineering.

3. Minor courses and the offering departments

S. No.	Minor Program	Eligible branch of students	@Offering Department	Award of Degree
1.	Data Science	All branches, except B.Tech. in CSE (Data Science) / B.Tech. (Data Science)	CSE	"B. Tech. in branch name with Minor in Data Science"
2.	IOT	All branches, except B.Tech. in CSE (IOT) / B.Tech. (IOT)	ECE	"B.Tech. in branch name with Minor in IOT"
3.	Innovation and Entrepreneurship	All branches	Management Science / MBA	"B.Tech. in branch name with Minor in Innovation and Entrepreneurship"

Note: @As per AICTE guidelines.

4. Academic Regulations for B.Tech. Degree with Minor programs

1. The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4-Years B.Tech. program.
2. For B.Tech. with Minor, a student needs to earn additional 18 credits (over and above the required 160 credits for B. Tech degree). All these 18 credits need to be completed in III year and IV year only.
3. After registering for the Minor program, if a student is unable to earn all the required 18 credits in a specified duration (twice the duration of the course), she shall not be awarded Minor degree. However, if the student earns all the required 160 credits of B.Tech., she will be awarded only B. Tech degree in the concerned branch.
4. There is no transfer of credits from Minor program courses to regular B.Tech. degree course & vice versa.
5. These 18 credits are to be earned from the additional courses offered by the host department in the college as well as from the MOOCs platform.
6. **For the course selected under MOOCs platform following guidelines may be followed:**
    a) Prior to registration of MOOCs courses, formal approval of the courses, by the Academic Council is essential. Academic Council considers the parameters viz., the institute / agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation, etc. before the issue of approval.
    b) Minimum credits for MOOCs course must be equal to or more than the credits specified in the Minor course structure provided by the University.
    c) Only Pass-grade / marks or above shall be considered for inclusion of grades in minor grade memo.
    d) Any expenses incurred for the MOOCs courses are to be met by the students only.
7. The choice to opt/ take a Minor program is purely on the choice of the students.
8. The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Minor program at anytime; and in that case the student will be awarded only B.Tech. degree in the concerned branch on earning the required credits of 160.
9. The student can choose only one Minor program along with her basic engineering degree. **A student, who chooses an Honors program, is not eligible to choose a Minor program and vice-versa.**
10. The B.Tech. with a Minor program shall be offered from the AY 2025-26 onwards. The students, pursuing their III year I semester from the AY 2025-26 onwards can register for the Minor program if they fulfil the eligibility criteria.

11. A student can graduate with a Minor if she fulfils the requirements for her regular B.Tech. program as well as fulfils the requirements for Minor program.
12. The institute shall maintain a record of students registered and pursuing their Minor programs, minor program-wise and parent branch-wise.
13. The concerned department shall prepare the time-tables for each Minor course offered at without any overlap / clash with other courses of study in the respective semesters.

5. Eligibility conditions for the student to register for Minor course

a) A student can opt for B.Tech. degree with Minor program if she has no active backlogs till II Year I Semester (III semester) at the time of entering into III year I semester.

b) Prior approval of mentor and Head of the Department for the enrolment into Minor program, before commencement of III year I Semester (V Semester), is mandatory

c) If more than 50% of the students in a branch fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 50%.

6. Registration for the courses in Minor Program

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in semester.

b) The students should choose a course from the list against each semester (from Minors course structure) other than the courses they have studied / registered for regular B.Tech. programme. No course should be identical to that of the regular B.Tech. course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.

c) The maximum no. of courses for the Minor is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.

d) The registration fee to be collected from the students by the College is **Rs. 1000/-** per one credit.

e) A fee for late registration may be imposed as per the norms.

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Academic Regulations (BH23) for B.Tech. with Honors program

1. Objectives

The key objectives of offering B.Tech. with Honors program are:

- To expand the domain knowledge of the students laterally and vertically.
- To increase the employability of undergraduate students with expanded knowledge in one of the core Engineering disciplines.
- To provide an opportunity for the students to pursue their higher studies in wider range of specializations.

2. Academic Regulations for B.Tech. Honors degree

1) The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4-Years B.Tech. program.
2) For B. Tech with Honors program, a student needs to earn additional 20 credits (over and above the required 160 credits for B.Tech. degree). All these 20 credits need to be completed in III year and IV year only.
3) After registering for the Honors program, if a student is unable to pass all courses in first attempt and earn the required 20 credits, she shall not be awarded Honors degree. However, if the student earns all the required 160 credits of B.Tech., she will be awarded only B.Tech. degree in the concerned branch.
4) There is no transfer of credits from courses of Honors program to regular B.Tech. degree course & vice versa.
5) These 20 credits are to be earned from the additional courses offered by the host department in the college or from a closely related department in the college as well as from the MOOCs platform.
6) **For the courses selected under MOOCs platform following guidelines may be followed:**
    a) Prior to registration of MOOCS courses, formal approval of the courses, by the Academic Council is essential. The Academic Council considers the parameters viz., the institute / agency, offering the course, syllabus, credits, duration of the programme and mode of evaluation, etc., before the issue of approval
    b) Minimum credits for a MOOCS course must be equal to or more than the credits specified in the Honors course structure provided by the Institution.
    c) Only Pass-grade / marks or above shall be considered for inclusion of grades in the Honors grade memo.
    d) Any expenses incurred for the MOOCS courses are to be met by the students only.
7) The choice to opt / take the Honors program is purely on the choice of the students.

8) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Honors program at anytime; and in that case the student will be awarded only B.Tech. degree in the concerned branch on earning the required credits of 160.

9) The students of every branch can choose Honors program in their respective branches if they are eligible for the Honors program. A student who chooses an Honors program is not eligible to choose a Minor program and vice-versa.

10) The B.Tech. with Honors program shall be offered from the AY 2025-26 onwards. The students, pursuing their III year I semester from the AY 2025-26 onwards can register for the Honors program if they fulfil the eligibility criteria.

11) A student can graduate with Honors if she fulfils the requirements for her regular B.Tech. program as well as fulfils the requirements for Honors program.

12) The Institution shall maintain a record of students registered and pursuing their Honors programs branch-wise.

13) The department shall prepare the time-tables for each Honors program offered at their respective departments without any overlap / clash with other courses of study in the respective semesters.

3. Eligibility conditions of the students for the Honors degree

a) A student can opt for B.Tech. degree with Honors, if she passed all subjects in first attempt in all the semesters till the results announced and maintaining 7.5 or more CGPA.

b) If a student fails in any registered course of either B.Tech. or Honors in any semester of four years program, she will not be eligible for obtaining Honors degree. She will be eligible for only B.Tech. degree

c) Prior approval of mentor and Head of the Department for the enrolment into Honors program, before commencement of III year I Semester (V Semester), is mandatory.

d) If more than 30% of the students in a branch fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 30%. The criteria to be followed for choosing 30% candidates in a branch may be the CGPA secured by the students till II year I semester.

e) The department concerned should be preferably NBA accredited and shall offer at least one M.Tech. Program.

f) Successful completion of 20 credits earmarked for Honors program with at least 7.5 CGPA along with successful completion of 160 credits earmarked for regular B.Tech. Program with at least 7.5 CGPA and passing all subjects in first attempt gives the eligibility for the award of B. Tech. (Honors) degree.

g) For CGPA calculation of B.Tech. course, the 20 credits of Honors program will not be considered.

4. Registration for the course in Honors program

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.

b) The students should choose a course from the list against each semester (from Honors course structure) other than the courses they have studied / registered for regular B.Tech. programme. No course should be identical to that of the regular B.Tech. course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.

c) The maximum no. of courses for the Honors is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.

d) The registration fee to be collected from the students by the College is **Rs. 1000/-** per one credit.

e) A fee for late registration may be imposed as per the norms.

5. The broad guidelines for the courses of Honors program, their respective credits weightage and semester-wise break-up of the course are:

S. No.	Year/ Semester	Course to be chosen from/studied	Mode of Learning	No. of Credits
1	III-I	PE-I or PE-II	Blended/Conventional	3
2	III-II	Research Methodologies	Conventional	3
3	III-II	PE-III	Conventional	3
4	IV-I	PE-IV	Conventional	3
5	IV-I	PE-V	Conventional	3
6	IV-II	Technical Paper writing	Under the mentorship of a supervisor	2
7	IV-II	PE-VI or an Inter-disciplinary subject as suggested by the Academic Council	MOOCs	3
	Total Credits			20

Note:

i. Professional Elective (PE) course should be selected (which is not studied) from each Professional Electives' list provided in regular B.Tech. course.

ii. Courses can be chosen as in above table.

1. Technical paper writing:

a) The student shall take up a problem / topic of engineering branches (inter-disciplinary nature) and apply the knowledge which they acquired while pursuing their engineering branch. It is expected to analyze, design and develop an application for the identified problem and write a technical paper / document.

Alternatively, the student i) shall identify a research topic, analyze the problem, carryout the experiments, write a technical paper and publish in / communicate for a Scopus indexed journal / any journal with decent reputation or ii) Demonstrate a talent / an idea / development of an innovative product.

b) The evaluation shall be done by the same committee which is constituted for project evaluation, along with the final semester project work.

c) The students should start exploration for the Technical Paper Writing immediately after the semester exams of III-II semester. Only the evaluation part shall be carried in IV-II semester.

2. The institute shall offer a course on Research Methodologies by combining the students of all branches (if the number of students is more, multiple parallel sessions may be conducted). The time slots in the time-tables of respective branches should be aligned. Both the CIE and SEE for the Research Methodologies course shall be done as regular B.Tech. courses.

3. If the blended course option is chosen, for the subject in III-I semester, the learning should be partially in online mode and partially in offline mode. The external evaluation shall be done as regular B.Tech. courses; however, for the CIE component, online assessment should also be taken into account while finalizing the internal marks by the course teacher.

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Academic Regulations for B.Tech. - MOOCs

1. Introduction

As per NEP, to inculcate the habit of self-learning and in compliance with the UGC guidelines, MOOC (Massive Open Online Courses) have been introduced.

The proposed MOOCs would be additional choices, proposed by concern department BoS (having credits >= the required credits) and approved by the Academic Council, in all the elective group courses subjected to the availability in the MOOC platforms during the respective semesters.

After the approval, at the beginning of the semester, the concerned departments shall declare the list of permitted courses to the student.

The progress of the MOOCs shall be monitored by the course coordinator of the department, nominated by the concerned HoD.

2. Eligibility

A student is eligible to register for OE / PE in Third Year First semester by having a CGPA of ≥ 6.5 without any active backlogs up to II Year I Semester. Similarly, the eligibility to register for OE / PE, in the Third Year Second semester by having a CGPA of ≥ 6.5 without any active backlogs up to II Year II Semester and to register for OE / PE, in the Fourth Year First semester by having a CGPA of ≥ 6.5 without any active backlogs up to III Year I Semester.

3. Course Registration

Students interested in pursuing MOOCs shall register the course title at their department office before the start of the semester.

A student can register at most two MOOCs throughout the course of study after approval from Faculty Advisor / Counselor / HoD.

Detailed guidelines regarding credit transfer of the courses pursued through MOOC (NPTEL-SWAYAM) shall be issued time to time by the Institution.

Academic Regulations for B.Tech. - Acceleration of Course Work

1. Introduction

In order to allow the bright and motivated students, a provision is made to complete the final semester three elective subjects in advance. These subjects are offered through MOOCs / additional subjects and credit transfer is permitted.

These credits are shown in the Final Semester Grade card in order to calculate SGPA and CGPA. This provision is made to allow the students for industry internship or to undertake projects in industry in the final semester.

2. Eligibility

A student is eligible to register for OE / PE in Third Year First semester by having a CGPA of ≥ 6.5 without any active backlogs up to II Year I Semester. Similarly, the eligibility to register for OE / PE, in the Third Year Second semester by having a CGPA of ≥ 6.5 without any active backlogs up to II Year II Semester and to register for OE / PE, in the Fourth Year First semester by having a CGPA of ≥ 6.5 without any active backlogs up to III Year I Semester.

3. Course Registration

A student can register at most two additional PE / OE in a semester after approval from Faculty Advisor / Counselor / HoD.

These additional courses have to be completed either through regular class work / MOOCs as per the directions of College Academic Committee.

The list of electives offered will be notified by the departments at the time of course work registration.

COURSE STRUCTURE (BH23 Regulations)
Applicable from AY 2023-24 Batch

I Year I Semester

S. No.	Code	Title	L	T	P	Credits
1	MA101BS	Matrices and Calculus	3	1	0	4
2	PH102BS	Applied Physics	3	1	0	4
3	EC103ES	C Programming for Engineers	3	0	0	3
4	ME104ES	Engineering Workshop	0	1	3	2.5
5	EE105ES	Basic Electrical Engineering	2	0	0	2
6	EC106ES	Elements of Electronics and Communication Engineering	0	0	2	1
7	PH107BS	Applied Physics Laboratory	0	0	3	1.5
8	EC108ES	C Programming for Engineers Laboratory	0	0	2	1
9	EE109ES	Basic Electrical Engineering Laboratory	0	0	2	1
		Induction Programme				
		Total	11	3	12	20

I Year II Semester

S. No.	Code	Title	L	T	P	Credits
1	MA201BS	Ordinary Differential Equations and Vector Calculus	3	1	0	4
2	CH202BS	Engineering Chemistry	3	1	0	4
3	ME203ES	Computer Aided Engineering Graphics	1	0	4	3
4	EC204ES	Electronic Devices and Circuits	2	0	0	2
5	EN205HS	English for Skill Enhancement	2	0	0	2
6	EC206ES	Applied Python Programming Laboratory	0	1	2	2
7	CH207BS	Engineering Chemistry Laboratory	0	0	2	1
8	EN208HS	English Language and Communication Skills Laboratory	0	0	2	1
9	EC209ES	Electronic Devices and Circuits Laboratory	0	0	2	1
		Total	11	3	12	20

II Year I Semester

S. No.	Code	Title	L	T	P	Credits
1	MA301BS	Numerical Methods and Complex Variables	3	1	0	4
2	EC302PC	Analog Circuits	3	0	0	3
3	EC303PC	Network analysis and Synthesis	3	0	0	3
4	EC304PC	Digital Logic Design	3	0	0	3
5	EC305PC	Signals and Systems	3	1	0	4
6	EC306PC	Analog Circuits Laboratory	0	0	2	1
7	EC307PC	Digital logic Design Laboratory	0	0	2	1
8	EC308PC	Basic Simulation Laboratory	0	0	2	1
9	MC311	Environmental Science	3	0	0	0
		Total	18	2	6	20

II Year II Semester

S. No.	Code	Title	L	T	P	Credits
1	EC401PC	Probability Theory and Stochastic Processes	3	0	0	3
2	EC402PC	Electromagnetic Fields and Transmission Lines	3	0	0	3
3	EC403PC	Analog and Digital Communications	3	0	0	3
4	EC404PC	Linear and Digital IC Applications	3	0	0	3
5	EC405PC	Electronic Circuit Analysis	3	0	0	3
6	EC406PC	Analog and Digital Communications Laboratory	0	0	2	1
7	EC407PC	Linear and Digital IC Applications Laboratory	0	0	2	1
8	EC408PC	Electronic Circuit Analysis Laboratory	0	0	2	1
9	EC409PC	Real Time Project/ Field Based Project	0	0	4	2
10	MC410	Gender Sensitization Lab	0	0	2	0
		Total	15	0	12	20

III Year I Semester

S. No.	Code	Title	L	T	P	Credits
1	EC501PC	Microcontrollers	3	1	0	4
2	EC502PC	Antennas and Wave Propagation	3	0	0	3
3	EC503PC	Control Systems	3	1	0	4
4	SM504MS	Business Economics & Financial Analysis	3	0	0	3
5		Professional Elective – I	3	0	0	3
6	EN505HS	Advanced English Communication Skills Laboratory	0	0	2	1
7	EC506PC	Advanced Communication Laboratory	0	0	2	1
8	EC507PC	Microcontrollers Laboratory	0	0	2	1
9	MC508	Intellectual Property Rights	3	0	0	0
		Total	18	2	6	20

III Year II Semester

S. No.	Code	Title	L	T	P	Credits
1	EC601PC	IoT Architectures and Protocols	3	0	0	3
2	EC602PC	Digital Signal Processing	3	0	0	3
3	EC603PC	CMOS VLSI Design	3	0	0	3
4		Professional Elective – II	3	0	0	3
5		Open Elective – I	3	0	0	3
6	EC604PC	Digital Signal Processing Laboratory	0	0	2	1
7	EC605PC	CMOS VLSI Design Laboratory	0	0	2	1
8	EC606PC	IoT Architectures and Protocols Laboratory	0	0	2	1
9	EC607PC	Industry Oriented Mini Project/ Internship	0	0	4	2
10	MC608	Constitution of India	3	0	0	0
		Total	18	0	10	20

IV Year I Semester

S. No.	Code	Title	L	T	P	Credits
1	**EC701PC**	Microwave and Optical Communications	**3**	**1**	**0**	**4**
2		Professional Elective – III	**3**	**0**	**0**	**3**
3		Professional Elective – IV	**3**	**0**	**0**	**3**
4		Open Elective – II	**3**	**0**	**0**	**3**
5	**SM702MS**	Professional Practice, Law & Ethics	**2**	**0**	**0**	**2**
6	**EC703PC**	Microwave and Optical Communications Laboratory	**0**	**0**	**4**	**2**
7	**EC704PC**	Project Stage – I	**0**	**0**	**6**	**3**
		Total	**14**	**1**	**10**	**20**

IV Year II Semester

S. No.	Code	Title	L	T	P	Credits
1		Professional Elective – V	**3**	**0**	**0**	**3**
2		Professional Elective – VI	**3**	**0**	**0**	**3**
3		Open Elective – III	**3**	**0**	**0**	**3**
4	**EC801PC**	Project Stage – II including Seminar	**0**	**0**	**22**	**11**
		Total	**9**	**0**	**22**	**20**

Professional Electives

PE-I	**EC511PE**	Computer Organization and Operating Systems
	EC512PE	Data Communications and Computer Networks
	EC513PE	Electronic Measurements and Instrumentation
	EC514PE	Artificial Intelligence
PE-II	**EC611PE**	Digital Design through Verilog HDL
	EC612PE	Cellular and Mobile Communications
	EC613PE	Machine Learning
	EC614PE	Electronic Sensors
PE-III	**EC711PE**	Embedded System Design
	EC712PE	CMOS Analog IC Design
	EC713PE	System Verilog for Verification
	EC714PE	Speech Signal Processing
PE-IV	**EC721PE**	Image and Video Processing
	EC722PE	Coding Theory and Techniques
	EC723PE	VLSI Physical Design
	EC724PE	Satellite Communications
PE-V	**EC811PE**	System on Chip Architecture
	EC812PE	FPGA Architectures
	EC813PE	Wireless Sensor Networks
	EC814PE	Radar Systems
PE-VI	**EC821PE**	Testing & Testability
	EC822PE	Navigational Systems
	EC823PE	5G and Beyond Communications
	EC824PE	Low Power VLSI Design

Open Electives

Open Electives	Department Offering	Course Code	Course Name
OE-I	EEE	EE600OE	Renewable Energy Sources
		EE601OE	Green Energy Technologies
		EE602OE	Fundamentals of Electric Vehicles
	ECE	EC600OE	Microcontrollers
		EC601OE	Fundamentals of IoT
		EC602OE	VLSI Design
	CSE/ CSE (AIML) /IT	CS600OE	Problem Solving using Data Structure
		CS601OE	Introduction to Java Programming
		CS602OE	Fundamentals of AI
OE-II	EEE	EE700OE	Utilization of Electrical Energy
		EE701OE	Electric Drives and Control
		EE702OE	Principles of Power Systems
	ECE	EC700OE	Electronic Sensors
		EC701OE	Digital Image Processing
		EC702OE	Principles of Communications
	CSE/ CSE (AIML) /IT	CS700OE	Scripting Languages
		CS701OE	Database Management Systems
		CS702OE	Machine Learning
OE-III	EEE	EE800OE	Basics of Power Plant Engineering
		EE801OE	Energy Sources and Applications
		EE802OE	Battery Management Systems
	ECE	EC800OE	Electronic Measurements and Instrumentation
		EC801OE	Embedded System Design
		EC802OE	FPGA based System Design
	CSE/ CSE (AIML) /IT	CS800OE	Operating Systems
		CS801OE	Software Engineering
		CS802OE	Computer Networks

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
MA101BS	**Matrices and Calculus**	3	1	0	4

Prerequisite: Mathematical Knowledge at pre-university level

Course Description: The course contains various topics related to Rank of the Matrix and their related properties, Echelon form, Normal form, Solving linear system of equations, Eigen values and vectors, Reduction of Quadratic form to canonical forms, Mean value theorems, Improper Integration and their applications of beta, gamma functions, Maxima and minima of functions of two variables and three variables, PartialDifferentiation, Evaluation of Double Integrals (Cartesian and polar coordinates), Change of order of integration, Evaluation of triple Integrals.

Course Outcomes: After completion of this course, the students will be able to

- **C101.1** Apply matrix techniques to solve system of linear equations.
- **C101.2** Find the Eigen values and Eigen vectors and reduce the Quadratic form to canonical Form.
- **C101.3** Apply Mean value theorems for given functions
- **C101.4** Evaluate the improper integrals using Beta and Gamma functions
- **C101.5** Find the extreme values of functions of two variables with/ without constraints.
- **C101.6** Evaluate the multiple integrals and apply the concept to find areas, volumes

Unit – I Matrices

Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss- Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneousequations by Gauss elimination method, Gauss Seidel Iteration Method.

Unit - II Eigen Values and Eigen Vectors

Linear Transformation and Orthogonal Transformation: Eigen values, Eigenvectors and their properties,Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

Unit– III Single Variable Calculus

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their GeometricalInterpretation and applications, Cauchy's Mean value Theorem, Taylor's Series, Maclaurin Series. Definition of Improper Integrals: Beta, Gamma functions and their properties, Relation between Beta& Gamma functions and their applications.

Unit – IV Multivariable Calculus (Partial Differentiation and Applications)

Definitions of Limit and continuity. Partial Differentiation: Introduction to Partial Differentiation, Euler's Theorem, Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers**.**

Unit – V Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Change of variables (Cartesian to polar) for double integrals. Evaluation of triple integrals (Cartesian Coordinates) Applications: Areas (by double integrals) and volumes (by triple integrals).

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition, 2016.

REFERENCE BOOKS

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
4. H. K. Dass and Er. RajnishVerma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
PH102BS	**Applied Physics**	3	1	0	4

Course Description: This course consists of principles of Quantum mechanics with advanced topics in their respective engineering branches. It introduces the principles of semiconductors and some widely used semiconductor devices for various applications. It introduces fundamental concepts related to the dielectric and magnetic materials. It introduces the importance of Lasers, optical fibers with propagation characteristics. It also introduces the fundamentals of nanotechnology and various material growth and characterization techniques.

Course Outcomes: After completion of this course, the students will be able to

- **C102.1** Understand the physical world from a fundamental point of view by the concepts of quantum mechanics.
- **C102.2** Identify the role of semiconductor devices in science and technology applications.
- **C102.3** Explore the fundamental properties of dielectric and magnetic materials for device applications.
- **C102.4** Understand various aspects of Lasers and their applications in diverse fields.
- **C102.5** Explain the principle of optical fibers and their significance in communication
- **C102.6** Appreciate the features and applications of nanomaterials.

Unit – I Principles of Quantum Mechanics

Quantum Mechanics: Introduction, blackbody radiation – Stefan-Boltzmann's law, Wein's and Rayleigh-Jean's law (qualitative) - Planck's radiation law - photoelectric effect – De-Broglie hypothesis - matter waves - Davisson and Germer experiment –Heisenberg uncertainty principle – time independent Schrodinger wave equation - Born interpretation of the wave function - particle in a 1-D potential well.

Unit – II Semiconductors and Devices

Intrinsic and extrinsic semiconductors – Hall effect – construction, working principle and characteristics of P-N Junction diode, Zener diode and Bipolar Junction Transistor (BJT) – direct and indirect band gap semiconductors – LED – photodiodes: PIN photodiode, avalanche photodiode (APD) and solar cells: structure, materials, working principle and characteristics.

Unit – III Dielectric and Magnetic Materials

Dielectric Materials: Basic definitions - types of polarizations (qualitative) - ferroelectric, piezoelectric and pyroelectric materials – applications - liquid crystal displays (LCD) and crystal oscillators.

Magnetic Materials: Origin of the magnetic moment - classification of magnetic materials - domain theory of ferromagnetism - hysteresis - soft and hard magnetic materials -

magnetostriction, magnetoresistance – applications – magnetic field sensors and multiferroics.

Unit – IV Lasers and Fiber Optics

Lasers: Laser beam characteristics - three quantum processes - Einstein coefficients and their relations - laser components - lasing action - pumping methods - Types of Lasers: Ruby laser, Nd: YAG laser, He-Ne laser, CO_2 laser - semiconductor laser – applications.

Fiber Optics: Introduction - total internal reflection - construction of optical fiber - acceptance angle - numerical aperture - classification of optical fibers - losses in optical fiber - optical fiber for communication system – advantages and applications.

Unit – V Nanotechnology

Introduction - Nanoscale, surface-to-volume ratio, quantum confinement - bottom-up approach: sol-gel and precipitation methods – top-down approach: ball milling, physical vapor deposition (PVD) and chemical vapor deposition (CVD) - characterization techniques - XRD, SEM &TEM - applications of nanomaterials.

TEXT BOOKS

1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy, A Text book of Engineering Physics -S. Chand Publications, 11th Edition 2019.
2. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2nd Edition, 2022
3. Donald A, Neamen, Semiconductor Physics and Devices- Basic Principle, Mc Graw Hill, 4th Edition, 2021.
4. Narasimha Reddy Katta, Essentials of Nanoscience & Nanotechnology, Typical Creatives NANO DIGEST, 1st Edition, 2021.

REFERENCE BOOKS

1. H.C. Verma, Quantum Physics, TBS Publication, 2nd Edition 2012.
2. Halliday, Resnick and Walker, Fundamentals of Physics, John Wiley & Sons, 11th Edition, 2018.
3. A.K. Bhandhopadhya - Nano Materials, New Age International, 1st Edition, 2007.
4. Aliaksandr S. Bandarenka, Energy Materials a Short Introduction to Functional Materials for Energy Conversion and Storage, CRC Press Taylor & Francis Group Energy Materials Taylor & Francis Group, 1st Edition, 2022.

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
EC103ES	C Programming for Engineers	3	0	0	3

Course Description: The course contains topics related to fundamentals of problem solving using structured programming approach. It introduces standard programming techniques like alternation, iteration and recursion using C. It aims on using arrays, pointers and structures to formulate algorithms and programs. The course also covers files, searching and sorting problems.

Course Outcomes: After completion of this course, the students will be able to

C103.1 Identify various components of Computer and understand the basics of algorithms and flowcharts.
C103.2 Implement control structures using C programming language
C103.3 Develop reusable code using the concept of modular programming.
C103.4 Use arrays and various string handling functions to solve problems.
C103.5 Explore pointers and file handling functions using C
C103.6 Apply the knowledge of user defined data types and demonstrate various searching and sorting techniques along with their time complexities

Unit – I Introduction to Computer Algorithms and Programming

Components of a computer system: Memory, processor, I/O devices, storage, operating system, the concept of assembler, compiler, interpreter, loader, and linker.

From algorithm to program: Representation of an algorithm, flowchart, Pseudo code with examples, converting algorithms to programs.

Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object, and executable code. Components of C language, standard I/O in C, data types, variables and constants, memory storage, and storage classes.

Unit – II Expressions and Statements

Expressions and their evaluation: Operands and Operators, formation of expressions using arithmetic, relational, logical, and bitwise operators, precedence and associativity rules, mixed operands, type conversion, and evaluation of expressions.

Statements: Simple and compound statements, Conditional Branching: if and switch statements, nested if-else, dangling else problem, use of break and default with switch. Iteration and loops: use of while, do-while and for loops, nested loops, use of break and continue statements

Unit – III Functions and Arrays

Designing Structured Programs: Introduction to functions, advantages of modularizing a program into functions, types of functions, passing parameters to functions: call by value, call by reference, passing arrays to functions, recursion with example programs.

Arrays: Array notation and representation, manipulating array elements, using multi-dimensional arrays, character arrays, C strings, string input/output functions, Array of strings, string manipulation functions with example programs

Unit – IV Pointers and File handling

Pointers: Introduction, declaration, applications, dynamic memory allocation (malloc, calloc, realloc, free), use of pointers in self-referential structures.

File handling: File I/O functions, standard C pre-processors, defining and calling macros, command- line arguments.

Unit – V Derived types and Basic Algorithms

Structures, Union, Enums and Bit-fields: Defining, declaring, and usage of structures, unions, and their arrays, passing structures, and unions to functions, introduction to enums and bit-fields.

Basic Algorithms: Searching and Sorting Algorithms (Bubble, Insertion, and Selection), finding roots of equations, notion of order of complexity through example programs.

TEXT BOOKS

1. B. A. Forouzan and R. F. Gilberg - Programming & Data Structures, 3rd Ed., Cengage Learning.
2. Byron Gottfried - Schaum's Outline of Programming with C, McGraw-Hill.

REFERENCE BOOKS

1. Ajay Mittal - Programming in C: A practical approach, Pearson Education, 2010.
2. Kernighan Brian W. and Ritchie Dennis M. - The C programming, Pearson Education.
3. J. R. Hanlyand, E. B. Koffman -Problem Solving and Program Design, 5th Ed., Pearson Education.
4. H. Cheng - C for Engineers and Scientists, McGraw-Hill International Edition.
5. V. Rajaraman - Computer Basics and C Programming, PHI Learning, 2015.
6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivert, Clifford Stein, - Introduction to Algorithms, 4th Edition, MIT Press.

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
ME104ES	**Engineering Workshop**	0	1	3	2.5

Course Description:

- To Study of different hand operated power tools, uses and their demonstration.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipment's and processes those are common in the engineering field.
- To develop a right attitude, team working, precision and safety at work place.
- It explains the construction, function, use and application of different working tools, equipment and machines.
- To study commonly used carpentry joints.
- To have practical exposure to various welding and joining processes.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

Course Outcomes: After completion of this course, the students will be able to

C104.1 Distinguish carpentry, fitting, black smithy and welding manufacturing processes.

C104.2 Develop house hold and engineering goods from metallic sheets in tin smithy.

C104.3 Apply basic electrical engineering knowledge for house wiring practice.

C104.4 Construct a sand mould for a given pattern using foundry tools.

1. TRADES FOR EXERCISES: (At least two exercises from each trade)

Cycle 1:

1. Tin Smithy – (Square Tin, Rectangular Tray & Conical Funnel)
2. Foundry – (Preparation of Green Sand Mould using Single Piece and Split Pattern)
3. Carpentry – (T-Lap Joint, Dovetail Joint, Mortise & Tenon Joint)
4. Black Smithy – (Round to Square, Fan Hook and S-Hook

Cycle 2:

5. Fitting – (Square fit, V-Fit, & Dovetail Fit)
6. House-wiring – (Parallel & Series, Two-way Switch and Tube Light)
7. Welding Practice – (Arc Welding & Gas Welding

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Machine Shop, Metal Cutting, Power tools in construction and Wood Working.

TEXT BOOKS

1. Workshop Practice /B. L. Juneja / Cengage.
2. Workshop Manual / K. Venugopal / Anuradha.

REFERENCE BOOKS

1. Work shop Manual - P. Kannaiah/ K.L. Narayana/ Scitech.
2. Workshop Manual / Venkat Reddy/ BSP.

B.Tech. I Year I Semester

Course code	Course Title	L	T	P	Credits
EE105ES	**Basic Electrical Engineering**	2	0	0	2

Course Description: Basic Electrical Engineering is a professional engineering subject that deals with the study and application of electrical engineering. A good grasp of the fundamentals of Electrical Engineering is an absolute necessity to become a good engineer in any discipline. Our day-to-day life is completely dependent on electricity. A reasonable understanding on the basics of electricity is therefore important for every engineer. This course deals with the basics of DC and AC circuit analysis under steady state and transient conditions. The basic knowledge on the constructional details and working principles of the commonly used DC and AC machines are included in the course. This course also gives an overview of the components in electrical installations.

Course Outcomes: After completion of this course, the students will be able to

- **C105.1** Analyze DC electric circuits with basic electrical components.
- **C105.2** Analyze single phase and three phase AC circuits.
- **C105.3** Illustrate the performance of transformers.
- **C105.4** Explain the construction of DC and AC machines
- **C105.5** Explain the working Principle of DC and AC machine
- **C105.6** Differentiate various components in electrical installations

Unit – I D.C. Circuits

Electrical circuit elements (R, L and C), voltage and current sources, KVL & KCL, analysis of simple circuits with dc excitation - Network reduction techniques, Mesh Analysis, Super-Mesh Analysis, Nodal Analysis and Super-Node Analysis. Superposition, Thevenin and Norton Theorems. (Problems with independent sources).
Time-domain analysis of first-order RL and RC circuits.

Unit – II A.C. Circuits

Representation of sinusoidal waveforms, peak, rms, and average values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit.
Three-phase balanced circuits, voltage and current relations in star and delta connections.

Unit – III Transformers

Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Working principle of Auto-transformer and three-phase transformer connections.

Unit – IV Electrical Machines

Construction and working principle of dc motor, performance characteristics of dc shunt motor. Generation of rotating magnetic field, Construction and working principle of a three-

phase induction motor, Significance of torque-slip characteristics, Single-phase induction motor - Capacitor-start Capacitor run motor (elementary treatment only). Construction and working principle of synchronous generator.

Unit – V Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Types of Cables, Earthing. Elementary calculations for energy consumption, power factor improvement, Applications of Batteries as Energy storage devices.

TEXT BOOKS

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019.
2. P. Ramana, M. Suryakalavathi, G.T. Chandrasheker, "Basic Electrical Engineering", S. Chand, 2nd Edition, 2019.

REFERENCE BOOKS

1. MS Naidu and S Kamakshaiah, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, 2008.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. M. S. Sukhija, T. K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford, 1st Edition, 2012.
4. Abhijit Chakrabarthi, Sudipta Debnath, Chandan Kumar Chanda, "Basic Electrical Engineering", 2nd Edition, McGraw Hill, 2021.
5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
EC106ES	**Elements of Electronics and Communication Engineering**	0	0	2	1

Course Description: This course introduces the various electronic components, measuring devices and software tools used in Electronics and Communication Engineering.

Course Outcomes: After completion of this course, the students will be able to

- **C106.1** Identify the different components and ICs used for electronic applications.
- **C106.2** Measure different parameters using various measuring devices.
- **C106.3** Distinguish various signal used for analog and digital communications
- **C106.4** Describe the significance of Electronics and communication subjects and various Software tools

List of Experiments

1. Understand the significance of Electronics and communications subjects.
2. Identify the different passive and active components.
3. Colour code of resistors, finding the types and values of capacitors.
4. Measure the voltage and current using voltmeter and ammeter.
5. Measure the voltage, current with Multimeter and study the other measurements using Multimeter.
6. Study the CRO/DSO and measure the frequency and phase of given signal.
7. Draw the various Lissajous figures using CRO/DSO.
8. Soldering and De-soldering Practice.
9. Study the function generator for various signal generations.
10. Study of Spectrum analyser and measure the spectrum.
11. Operate Regulated power supply for different supply voltages.
12. Study the various gates module and write down the truth table of them.
13. Identify various Digital and Analog ICs.
14. Observe the various types of modulated signals.
15. Know the available Software for Electronics and communication applications.

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
PH107BS	**Applied Physics Laboratory**	0	0	3	1.5

Course Description: This course is designed for the students to provide an opportunity for learning through observation, interpretation and application. It includes the instruments related to the Hall Effect, Photoelectric Effect, dielectric constant and B-H curve experiments and their measurements. It introduces the characteristics of various devices such as P-N junction diode, Zener diode, BJT, LED, solar cell, LASERs and optical fibers, measurement of energy gap and resistivity of semiconductor materials.

Course Outcomes: After completion of this course, the students will be able to

C107.1 Estimate the work function of metal using Photoelectric effect and identify the type of semiconductor material whether it is n-type or p-type by Hall effect.

C107.2 Determine energy gap and resistivity of semiconductors and draw the characteristics of semiconductor and optoelectronic devices.

C107.3 Understand the electrical and magnetic properties of materials

C107.4 Demonstrate the working principle of lasers and optical fibers

List of Experiments:

1. Determination of work function of a metal and Planck's constant using photoelectric effect.
2. Determination of Hall co-efficient, carrier concentration and carrier mobility of a given semiconductor.
3. Characteristics of series and parallel LCR circuits.
4. V-I characteristics of a p-n junction diode and Zener diode.
5. Input and output characteristics of BJT (CE / CB configurations).
6. V-I and L-I characteristics of light emitting diode (LED).
7. V-I Characteristics of solar cell.
8. Determination of energy gap of a semiconductor using p-n junction diode.
9. Determination of the resistivity of semiconductor by two probe methods.
10. Study B-H curve characteristics of a magnetic material.
11. Determination of dielectric constant of a given material.
12. a) Determination of the beam divergence of a given LASER beam.
    b) Determination of acceptance angle and numerical aperture of an optical fiber.

Note: Any 8 experiments are to be performed.

REFERENCE BOOK

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
EC108ES	C Programming for Engineers Laboratory	0	0	2	1

Course Description: This lab introduces the importance of programming, C language constructs, and program development. It introduces standard programming techniques like alternation, iteration and modular programming.

Course Outcomes: After completion of this course, the students will be able to

C108.1 Build programs using control structures to solve simple mathematical problems.
C108.2 Use functions to develop modular reusable code.
C108.3 Apply derived data types and file handling functions to solve problems.
C108.4 Implement searching and sorting algorithms

List of Programs

Cycle 1:

1. Write a C program to find the sum of individual digits of a positive integer.
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence.
3. Write a C program to generate the first n terms of the sequence.
4. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
5. Write a C program to find the roots of a quadratic equation.
6. Write a C program to find the factorial of a given integer.
7. Write a C program to find the GCD (greatest common divisor) of two given integers.
8. Write a C program to solve Towers of Hanoi problem.
9. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
10. Write a C program to find both the largest and smallest number in a list of integers.
11. Write a C program that uses functions to perform the following:
    i) Addition of Two Matrices ii) Multiplication of Two Matrices
12. Write a C program that uses functions to perform the following operations:
    i) To insert a sub-string in to a given main string from a given position.
    ii) To delete n Characters from a given position in a given string.
13. Write a C program to determine if the given string is a palindrome or not.

Cycle 2:

14. Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T.
15. Write a C program to count the lines, words and characters in a given text.
16. Write a C program to generate Pascal's triangle.
17. Write a C program to construct a pyramid of numbers
18. Write a C program to convert a Roman numeral to its decimal equivalent.
19. Write a C program that uses functions to perform the following operations:
    i. Reading a complex number
    ii. Writing a complex number
    iii. Addition of two complex numbers
    iv. Multiplication of two complex numbers

    (Note: represent complex number using a structure.)
20. i. Write a C program which copies one file to another.

    Ii Write a C program to reverse the first n characters in a file. (Note: The file name and n are specified on the command line.)
21. i. Write a C program to display the contents of a file.
    ii. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)
22. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order

    i) Bubble sort ii) Selection sort iii) Insertion sort
23. Write C programs that use both recursive and non-recursive functions to perform the following searching operations for a key value in a given list of integers:

    i) Linear search ii) Binary search

B.Tech. I Year I Semester

Course Code	Course Title	L	T	P	Credits
EE109ES	**Basic Electrical Engineering Laboratory**	0	0	2	1

Course Description: BEE lab is part of the curriculum for the first year students. The lab is intended for introducing the basic methods and instruments used for measuring the electrical quantities to the newly joined students. The experiments are modeled in such a way that it can be used as a learning aid for the students, as it goes in hand with the theory.

Course Outcomes: After completion of this course, the students will be able to

C109.1 To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach

C109.2 To Analyze the transient responses of first order circuits.

C109.3 To Evaluate the performance of Transformers through various testing methods.

C109.4 To Evaluate the performance of DC and AC Motors by direct testing methods.

The following experiments are required to be conducted as compulsory.

PART-A

1. Verification of KVL and KCL.
2. Verification of Thevenin's and Norton's theorems.
3. Transient Response of Series RL and RC circuits for DC excitation.
4. Resonance in series RLC circuit.
5. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits.
6. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer.
7. Performance Characteristics of a DC Shunt Motor.
8. Torque-Speed Characteristics of a Three-phase Induction Motor.

In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted

PART-B

1. Verification of Superposition theorem.
2. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star).
3. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation).
4. Measurement of Active and Reactive Power in a balanced Three-phase circuit.
5. No-Load Characteristics of a Three-phase Alternator.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
MA201BS	Ordinary Differential Equations and Vector Calculus	3	1	0	4

Prerequisite: Mathematical Knowledge at pre-university level

Course Description: The course contains various topics related to Exact differential equations, Orthogonal trajectories, Newton's law of cooling, Natural growth and decay, Second order linear differential equations with constant coefficients and their models, Equations reducible to linear ODE with constant coefficients, Applications to Electric Circuits, Laplace Transforms and their application, Vector point functions and scalar point functions, Vector Differentiation, Vector Integral theorems and their applications.

Course Outcomes: After completion of this course, the students will be able to

- **C201.1** Solve first order Ordinary differential equations by analytical methods.
- **C201.2** Solve higher Ordinary differential equations by analytical methods.
- **C201.3** Find Laplace and inverse Laplace transform of given functions and solve ODEs byapplying Laplace Transform
- **C201.4** Calculate divergence, curl of a vector point function and gradient of scalar point function.
- **C201.5** Apply and verify Gauss, Green's & Stoke's theorems and find volume, surface of the solid and work done by force.
- **C201.6** Evaluate the line, surface & volume integrals and converting them from one toanother

Unit – I First Order Ordinary Differential Equations

Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling, Law of natural growth and decay.

Unit – II Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: non-Homogeneous terms of thetype e^{ax}, sinax, cosax, polynomials in x, $e^{ax}(x)$, and $xV(x)$, Method of variation of parameters.

Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Eulerequation. Applications: Electric Circuits.

Unit– III Laplace Transforms

Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shiftingtheorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by 't', Laplace transforms of derivatives and integrals of function, Evaluation of integrals by Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform by different methods, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

Unit – IV Vector Differentiation

Vector point functions and scalar point functions, Gradient, Divergence and Curl, Directional derivatives, Tangent plane and normal line, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

Unit – V Vector Integration

Line, Surface and Volume Integrals, Vector Integral theorems: Green, Gauss and Stokes (without proofs) and their applications.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5thEditon, 2016.

REFERENCE BOOKS

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
CH202BS	**Engineering Chemistry**	3	1	0	4

Prerequisite: Fundamental knowledge and solid understanding of chemistry

Course Description: Engineering Chemistry is a fundamental course designed to provide students with a solid foundation in the principles and applications of chemistry relevant to engineering disciplines. The course aims to equip students with the knowledge and skills necessary to understand the chemical properties of materials, analyze chemical reactions, and apply chemical concepts in engineering practice.

Course Outcomes: After completion of this course, the students will be able to

- **C202.1** Analyze the basic properties of water and its usage in domestic and industrial purposes.
- **C202.2** Inspect the working principles and reaction mechanisms of various energy storage devices
- **C202.3** Acquire the basic knowledge of electrochemical procedures related to corrosion and its control.
- **C202.4** Impart the fundamental knowledge and sustainability implemented through smart engineering materials.
- **C202.5** Distinguish various energy sources to prioritise eco-friendly fuels for environmentally sustainable development.
- **C202.6** Discriminate the limitations of conventional basic engineering materials for developing multiphase materials.

Unit – I Water and its Treatment

Hardness of water – Types of hardness, Units, Estimation of hardness of water by complexometric method; numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by ozonisation and chlorination - breakpoint chlorination. Defluoridation - Determination of F^- ion by ion-selective electrode method. 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 Brackish water – Reverse osmosis.

Unit – II Battery Chemistry and Corrosion

Introduction to Electrochemistry- Galvanic Cells, Electrode Potentials, Nernst Equation, EMF of the cell, Cell representation. Classification of batteries- primary, secondary, flow and reserve batteries with examples. Basic requirements for commercial batteries. Construction, working and applications of Zn-air, Pb/$HClO_4$ and Lithium-ion battery, Applications of Li-ion battery to electrical vehicles. 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 – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, Water line and Pitting corrosion. Factors affecting rate of 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, Teflon, Fiber reinforced plastics (FRP).

Rubbers: Natural rubber and its vulcanization.

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 - Polylactic acid and poly vinyl alcohol and their applications.

Unit – IV Energy Sources

Calorific value of fuel – HCV, LCV- Dulongs formula. Classification- solid fuels: coal – analysis of coal – Proximate and Ultimate analysis and their significance. Liquid fuels – petroleum and its refining, cracking types – moving bed catalytic cracking. Knocking – octane and cetane rating, Gaseous fuels – composition and uses of natural gas, LPG and CNG, Biodiesel – Transesterification, advantages. Hydrogen as fuel-Production, Storage & applications.

Unit – V Engineering Materials

Composites: Introduction- Constituents of composites – advantages, classification and constituents of composites. Applications of composites.

Smart Materials and Engineering Applications: Smart Materials- Classification- (Piezo-electric materials, Shape Memory Alloys, Thermoresponse Materials, Magnetorhetroic Materials, Smart Polymers) SMAs-Nitinol. Thermoresponse materials- 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 Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi (2011).
3. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015).
4. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, 2016.

REFERENCE BOOKS

1. Textbook of Engineering Chemistry by Jaya Shree Anireddy, Wiley Publications.
2. A text book of Engineering Chemistry by M. Thirumala Chary, E. Laxminarayana and K. Shashikala, Pearson Publications, 2021.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
ME203ES	Computer Aided Engineering Graphics	1	0	4	3

Course Description:

- To develop the ability of visualization of different objects through technical drawings
- To acquire computer drafting skill for communication of concepts, ideas in thedesign of engineering products

Course Outcomes: After completion of this course, the students will be able to

C203.1 Construct different types of non-circular curves and scales used in various engineeringapplications.
C203.2 Analyze the projections of points and lines.
C203.3 Analyze the projections of planes and solids.
C203.4 Apply different types of sectional planes to get the interior features of the objects bymeans of sectional views.
C203.5 Develop the surfaces to fabricate the objects
C203.6 Identify orthographic, Isometric projections and various CAD commands.

Unit – I

Introduction to Engineering Graphics: Principles of Engineering Graphics and their Significance, Geometrical Constructions.
Scales: Plain & diagonal.
Conic Sections: Conic Sections including the rectangular hyperbola- General methods only.
Cycloidal curves: Cycloid, Epicycloid and Hypocycloid -General methods only.

Unit – II

Orthographic Projections: Principles of orthographic projections- conventions- Projectionsof points in all positions.
Projection of straight lines: Line inclined to one reference plane and with two reference planes.

Unit – III

Projections of Planes: Projections of Plane geometric figures
Projections of Regular Solids: Projections of solids (prisms, pyramids, cylinders and cones) in simpleposition and axis inclined to one reference plane and with two reference plane
Introduction to computer aided drafting: (For internal evaluation weightage only)
Introduction to AutoCAD Software: The Menu System, Toolbars (Standard, Object Properties, Draw)

Unit – IV

Section of Regular solids: Section or Sectional views of Right Regular Solids- Prism, Cylinder,Pyramid and Cone.

Development of Surfaces of Right Regular Solids

Unit – V

Isometric Projections: Principles of Isometric Projection – Isometric Scale Isometric Views – Isometric views of Lines, Planes and Simple Solids only. Orthographic Views: Conversion of Isometric Views to Orthographic Views and Vice-Versa.

Auto CAD Software: (For internal evaluation weightage only)

Toolbars (Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System),Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

TEXT BOOKS

1. Engineering Drawing, 53rd Edition, Bhatt N.D / Charotar Publishing house Pvt. Ltd., 2016.
2. Engineering Drawing and graphics Using AutoCAD Third Edition, T. Jeyapoovan, Vikas: S. Chand and company Ltd.

REFERENCE BOOKS

1. Engineering Drawing, Basant Agrawal and C M Agrawal, Third Edition McGraw Hill.
2. Engineering Drawing and Graphics Plus AutoCAD, Venugopal.K, New Age International (P) Ltd., New Delhi,2010.
3. Engineering Graphics and Design, WILEY, Edition 2020.
4. Engineering Drawing, M. B. Shah, B.C. Rane / Pearson.
5. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford.
6. Computer Aided Engineering Drawing – K Balaveera Reddy et al – CBS Publishers.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
EC204ES	**Electronic Devices and Circuits**	2	0	0	2

Course Description: This course provides an in-depth understanding of the principles, operation, and design of electronic devices and circuits, equipping students with the knowledge and skills necessary to analyze, design, and troubleshoot electronic systems.

Course Outcomes: After completion of this course, the students will be able to

- **C204.1** Analyze the characteristics of PN junction diode.
- **C204.2** Construct diode circuits for various applications.
- **C204.3** Illustrate the transistor working in different configurations.
- **C204.4** Differentiate between FET and BJT devices.
- **C204.5** Illustrate the operation and characteristics of special purpose diodes.
- **C204.6** Use diode and transistor as switches in electronic circuits.

Unit – I Diodes

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

Unit – II Diode Applications

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)

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

Unit – IV Junction Field Effect Transistor (FET)

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

Unit – V Special Purpose Devices

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

TEXT BOOKS

1. Jacob Millman - Electronic Devices and Circuits, McGraw Hill Education.
2. Robert L. Boylestad, Louis Nashelsky- Electronic Devices and Circuits theory, 11th Edition, 2009, Pearson.

REFERENCE BOOKS

1. David A. Bell - Electronic Devices and Circuits, 5th Edition, Oxford.
2. Chinmoy Saha, Arindam Halder, Debaati Ganguly - Basic Electronics-Principles and Applications, Cambridge, 2018.
3. Thomas L. Floyd - Electronic Devices, 9th Edition, 2012, Pearson.
4. A. Anand Kumar - Pulse and Digital Circuits - PHI Learning.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
EN205HS	**English for Skill Enhancement**	2	0	0	2

Course Description: With the growing importance of English as a tool for global technical communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop the linguistic, communicative, creative and critical thinking competencies of Engineering students. In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. The focus in this syllabus is on skill development.

Course Outcomes: After completion of this course, the students will be able to

- **C205.1** Apply English language effectively in spoken and written forms
- **C205.2** Analyze the given texts and essence of poem, respond appropriately
- **C205.3** Apply various grammatical structures in personal and academic fronts.
- **C205.4** Develop appropriate vocabulary for professional communication
- **C205.5** Make use of competency in various forms of academic and professional writing.
- **C205.6** Improve language skills for the enhancement of employability opportunities.

Unit – I Toasted English by R. K. Narayan

Vocabulary: The concept of Word Formation, Prefixes and Suffixes

Grammar: Identifying Common Errors in Writing with Reference to Articles and prepositions

Reading Skills: Reading and Its Importance- Techniques for Effective Reading.

Writing Skills: 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 Appro JRD by Sudha Murty

Vocabulary: Words Often Confused, Homophones, Homonyms and Homographs & collocations

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun and Subject-verb Agreement.

Reading Skills: Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice

Writing Skills: Nature and Style of Writing

Unit – III The Character of a Happy Life by **Sir Henry Wotton (Poem)**
Vocabulary: Words Often Misspelt, - Words from Foreign Languages and their Use in English
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses
Reading Skills: Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice.
Writing Skills: 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 by Abdul Kalam
Vocabulary: Standard Abbreviations in English.
Grammar: Redundancies and Clichés in Oral and Written Communication
Reading Skills: Reading Techniques- Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice
Writing Skills: Writing Practices- Essay Writing-Writing Introduction, Body and Conclusion

Unit – V Go, Kiss the World by Subroto Bagchi
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 Skills: Reading Comprehension-Exercises for Practice
Writing Skills: Technical Reports- Introduction – Characteristics of a Report – Categories of Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

TEXT BOOKS

1. *English: Language, Context and Culture by* Orient Black Swan Pvt. Ltd, Hyderabad, 2022 Print.

REFERENCE BOOKS

1. Liss and Davis, Effective Academic Writing, 2 nd Edition, 2017, Oxford University Press.
2. Wood F.T, Remedial English Grammar, 2 nd Edition, 2017, Macmillan.
3. Technical Communication, 2019, Wiley India Pvt. Ltd.
4. Swan, Michael, Practical English Usage, 4 th Edition, 2016, Oxford University Press.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
EC206ES	**Applied Python Programming Laboratory**	0	1	2	2

Course Description: This Course Covers Installation procedure of python, packages and implementation of different control structures. This course also focuses on installation of OS on Raspberry Pi, importing packages and usage of GPIO pins for collecting sensor data.

Course Outcomes: After completion of this course, the students will be able to

C206.1: Build basic programs using fundamental programming constructs.
C206.2: Develop reusable code using standard library functions
C206.3: Use different packages for processing data from files and plotting graphs.
C206.4: Implement applications on hardware boards using Python.

List of Programs

Cycle 1:

1. Downloading and Installing Python and Modules
   a) Python 3 on Linux
      Follow the instructions given in the URL
      https://docs.python- guide.org/starting/install3/linux/
   b) Python 3 on Windows
      Follow the instructions given in the URL
      https://docs.python.org/3/using/windows.html (Please remember that Windows installation of Python is harder!)
   c) pip3 on Windows and Linux
      Install the Python package installer by following the instructions given in the URL
      https://www.activestate.com/resources/quick-reads/how-to-install-and-use-pip3/
   d) Installing numpy and scipy
      You can install any python3 package using the command pip3 install <packagename>
   e) Installing jupyterlab
      Install from pip using the command pip install jupyterlab

2. Introduction to Python3
   a) Printing your biodata on the screen
   b) Printing all the primes less than a given number
   c) Finding all the factors of a number and show whether it is a *perfect* number, i.e., the sum of all its factors (excluding the number itself) is equal to the number itself.

3. Defining and Using Functions
   a) Write a function to read data from a file and display it on the screen
   b) Define a Boolean function *is palindrome*(<input>)
   c) Write a function *collatz(x)* which does the following: if *x* is odd, *x = 3x + 1*; if *x* is even, then *x = x/2*. Return the number of steps it takes for *x* = 1
   d) Write a function N *(m, s) = exp (-(x-m)^2/(2s^2))/sqrt(2π) s* that computes the Normal distribution

4. The package numpy
   a) Creating a matrix of given order *m x n* containing *random numbers* in the range 1 to 99999
   b) Write a program that adds, subtracts and multiplies two matrices. Provide an interface such that, based on the prompt, the function (addition, subtraction, multiplication) should be performed
   c) Write a program to solve a system of *n* linear equations in *n* variables using matrix inverse

5. The package scipy and pyplot
   a) Finding if two sets of data have the same *mean* value
   b) Plotting data read from a file
   c) Fitting a function through a set a data points using *polyfit* function
   d) Plotting a histogram of a given data set

6. The strings package
   a) Read text from a file and print the number of lines, words and characters
   b) Read text from a file and return a list of all *n* letter words beginning with a vowel
   c) Finding a secret message hidden in a paragraph of text
   d) Plot a histogram of words according to their length from text read from a file

Cycle 2:

7. Installing OS on Raspberry Pi
   a) Installation using PiImager
   b) Installation using image file
      i. Downloading an Image
      ii. Writing the image to an SD card
      iii. using Linux
      iv. using Windows
      v. Booting up

8. Accessing GPIO pins using Python
   a) Installing GPIO Zero library.

i. First, update your repositories list:
ii. sudo apt update
iii. Then install the package for Python 3:
iv. sudo apt install python3-gpiozero

b) Blinking an LED connected to one of the GPIO pin
c)Adjusting the brightness of an LED
d)Adjust the brightness of an LED (0 to 100, where 100 means maximum brightness) using the in-built PWM wavelength

9. Collecting Sensor Data
   a) DHT Sensor interface
   b) Connect the terminals of DHT GPIO pins of Raspberry Pi.
   c) Import the DHT library using import Adafruit_DHT
   d) Read sensor data and display it on screen.

REFERENCE BOOKS

1. Pethuru Raj and Anupama C. Raman "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press).
2. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”.
3. Introduction to Python, Kenneth A. Lambert, Cengage.
4. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
5. Learning Python, Mark Lutz, O’Reilly.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
CH207BS	**Engineering Chemistry Laboratory**	0	0	2	1

Prerequisite: Fundamental knowledge of quantitative and qualitative analysis

Course Description: The Engineering Chemistry Laboratory is a practical course designed to provide students with hands-on experience in conducting chemical experiments relevant to engineering applications. This laboratory-based course aims to reinforce the theoretical concepts learned in the engineering chemistry lecture course and develop students' practical skills in chemical analysis, synthesis, and material testing.

Course Outcomes: After completion of this course, the students will be able to

- **C207.1** Analysis of materials using small quantities of materials involved for quick and accurate results
- **C207.2** Interpret a new application by the analysis of physical principle involved in various instruments.
- **C207.3** Develop experimental skills in building technological advances by qualitative and quantitative analysis of materials.
- **C207.4** Learn and apply basic techniques used in chemistry laboratory for preparation, purification and identification.

List of Experiments

1. Determination of total hardness of water by complexometric method using EDTA.
2. Estimation of concentration of an acid by Conductometric titrations.
3. Estimation of concentration of an acid by pH metry..
4. Estimation of Concentration of Ferrous Iron (II) by Potentiometry using $KMnO_4$.
5. Estimation of Concentration of Fluoride ion by UV-Visible spectrometer.
6. Determination of viscosity of lubricant oil by using Ostwald's viscometer.
7. Preparation of Bakelite.
8. Determination of rate of corrosion of mild steel in presence and absence of inhibitor.
9. Determination of Acid value of given coconut oil.
10. Proximate analysis of solid fuel- Coal.

Virtual Lab Experiments

1. Batteries for Electric Vehicles.
2. Conducting Polymers-Study and Working.
3. Smart Materials-Engineering Applications.
4. Construction of Fuel Cell & It's Working.

TEXT BOOKS

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. Vogel's text book 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).
5. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
EN208HS	**English Language and Communication Skills Laboratory**	0	0	2	1

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

a. Computer Assisted Language Learning (CALL) Lab
b. Interactive Communication Skills (ICS) Lab

Course Outcomes: After completion of this course, the students will be able to

C208.1	Understand the nuances of English language through audio - visual experience
C208.2	Apply soft skills effectively while working in group activities
C208.3	Create Neutralize accent for intelligibility
C208.4	Understand and discuss with clarity and confidence which in turn enhances their employability skills

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 intonation 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. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions
- Describing objects/situations/people
- Role play – Individual/Group activities
- Group Discussions
- Debate

Exercise-1

CALL Lab:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening.

Practice: Introduction to Phonetics–Speech Sounds–Vowels and Consonants–Minimal Pairs-Consonant Clusters-Past Tense Marker and Plural Marker-*Testing Exercises*

ICS Lab:

Understand: Spoken vs. Written language- Formal and Informal English.

Practice: Ice-Breaking Activity and JAM Session - Situational Dialogues–Greetings–Taking Leave – Introducing Oneself and Others.

Exercise II

CALL Lab:

Understand: Structure of Syllables –Word Stress–Weak Forms and Strong Forms–Stress pattern in sentences– Intonation.

Practice: Basic Rules of Word Accent– Contractions –Stress Shift-Weak Forms and Strong Forms – Intonation in context -*Testing Exercises*

ICS Lab:

Understand: Features of Good Conversation–Strategies for Effective Communication.

*Practice:*SituationalDialogues–RolePlay-ExpressionsinVariousSituations–Making Requests and Seeking Permission-Telephone Etiquette

Exercise-III

CALL Lab:

Understand: Errors in Pronunciation-Neutralizing Mother Tongue Interference (MTI).

Practice: Common Indian Variants in Pronunciation–Differences between British and American Pronunciation-*Testing Exercises*

ICS Lab:

*Understand:*Descriptions-Narrations-GivingDirectionsandGuidelines–BlogWriting-Netiquette

Practice: Giving Instructions–Seeking Clarifications–Asking for and Giving Directions–Thanking and Responding in a forum–Agreeing and Disagreeing–Seeking and Giving Advice –Making Suggestions.

Exercise-IV

CALL Lab:

Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests-*Testing Exercises*

ICS Lab:

Understand: Public Speaking–Structured Talks - signposting in speech-Non-verbal Communication-Presentation Skills.

Practice: Making a Short Speech – Extempore-Making a Presentation

Exercise-V

CALL Lab:

Understand: Listening for Inference *(focus on implicit meaning)*

Practice: Listening Comprehension Tests-*Testing Exercises*

ICS Lab:

Understand: Introduction to Group Discussion & Interview Skills

Practice: Group Discussion & Mock Interviews

Minimum Requirement of Infrastructural Facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:**

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii) High Fidelity Headphones

2. **Interactive Communication Skills (ICS) Lab:**

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V. or LCD, a digital stereo –audio & video system and camcorder, etc.

Source of Material (Master Copy):

- *Exercises in Spoken English. Part1, 2, 3*. CIEFL and Oxford University Press

Note: Teachers are requested to make use of the master copy and get it tailor-made to suit the contents of the syllabus.

SUGGESTED SOFTWARE

- Cambridge Advanced Learners' English Dictionary with CD.
- Grammar Made Easy by Darling Kindersley.
- Punctuation Made Easy by Darling Kindersley.
- Oxford Advanced Learner's Compass, 10th Edition.
- English in Mind (Series1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
- English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.

- English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
- TOEFL & GRE (KAPLAN, AARCO &BARRONS, USA, Cracking GRE by CLIFFS).
- Digital All
- Orell Digital Language Lab (Licensed Version)

REFERENCE BOOKS

1. Y. Prabhavathi, People Interface: English Language Communication Skills Manual/Workbook, 1st Edition, 2023, CL India
2. Board of Editors, ELCS Lab Manual A Workbook for CALL and ICS Lab Activities, Orient Black Swan Pvt. Ltd.
3. Shobha K N & Rayen J. Lourdes, Communicative English–A work book, 2019, Cambridge University Press.

B.Tech. I Year II Semester

Course Code	Course Title	L	T	P	Credits
EC209ES	**Electronic Devices and Circuits Laboratory**	0	0	2	1

Course Description: This course provides hands-on experience in applying theoretical concepts to design and build electronic circuits using different electronic components.

Course Outcomes: After completion of this course, the students will be able to

- **C209.1** Analyze the characteristics of PN junction diode and its applications.
- **C209.2** Verify the characteristics of various configurations of BJT and FET devices.
- **C209.3** Analyze the switching characteristics of a transistor.
- **C209.4** Verify the characteristics of various special purpose diodes and transistors.

List of Experiments (Twelve experiments to be done):

Verify any twelve experiments in H/W Laboratory

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Full Wave Rectifier with & without filters
3. Types of Clippers at different reference voltages
4. Types of Clampers at different reference voltages
5. The steady state output waveform of clampers for a square wave input
6. Input and output characteristics of BJT in CB Configuration
7. Input and output characteristics of BJT in CE Configuration
8. Input and output characteristics of BJT in CC Configuration
9. Input and Output characteristics of the JFET in CS configuration.
10. Input and output characteristics of MOSFET in CS Configuration
11. Input and output characteristics of MOSFET in CD Configuration
12. Switching characteristics of a transistor
13. Zener diode characteristics and Zener as voltage Regulator
14. SCR Characteristics.
15. UJT Characteristics and identify negative region

Major Equipment required:

1. Regulated Power Suppliers, 0-30V
2. 20 MHz, Dual Channel Cathode Ray Oscilloscopes
3. Functions Generators-Sine and Square wave signals
4. Multimeters, voltmeters and Ammeters
5. Electronic Components and devices

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
MA301BS	**Numerical Methods and Complex Variables**	3	1	0	4

Prerequisite: Mathematics courses of first year of study

Course Description: The course contains the topics Fourier transforms and Fourier series, Solutions of Algebraic and Transcendental equations, Interpolation with equal and unequal intervals, Numerical Integration, Numerical solutions of first order ordinary differential equations, Complex number and their properties.Complex differentiation & related topics and Complex integration.

Course Outcomes: After completion of this course, the students will be able to

C301.1	Express any periodic function in terms of sine and cosine transforms.
C301.2	Find the root of a given polynomial and transcendental equations.
C301.3	Estimate the value for the given data using interpolation.
C301.4	Find the numerical solutions for a given first order ODE.
C301.5	Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems.
C301.6	Taylor's and Laurent's series expansions in complex function.

Unit – I Fourier series & Fourier Transforms

Fourier series - Dirichlet's Conditions - Half-range Fourier series - Fourier Transforms: Fourier Sine and cosine transforms - Inverse Fourier transforms.

Unit – II Numerical Solutions of Algebraic & Transcendental Equations and Interpolation

Solution of polynomial and transcendental equations: Bisection method, Iteration Method, Newton- Raphson method and Regula-Falsi method. Jacobi and Gauss-Seidel iteration methods for solving linear systems of equations. Finite differences: forward differences, backward differences, central differences, symbolic relations and separation of symbols, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae, Lagrange's method of interpolation.

Unit – III Numerical Integration

Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.
Ordinary differential equations: Taylor's series, Picard's method, Euler and modified Euler's methods, Runge-Kutta method of fourth order for first order ODE

Unit – IV Complex Differentiation

Limit, Continuity and Differentiation of Complex functions. Cauchy-Riemann equations

(without proof), Milne- Thomson methods, analytic functions, harmonic functions, finding harmonic conjugate,elementary analytic functions (exponential, trigonometric, logarithm) and their properties. (All theorems without Proofs), Conformal mappings, Mobius transformations.

Unit – V Complex Integration

Line integrals, Cauchy's theorem, Cauchy's Integral formula, zeros of analytic functions, singularities,Taylor's series, Laurent's series, Residues, Cauchy Residue theorem and their properties. (All theorems without proofs)

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

REFERENCE BOOKS

1. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computations, New Age International publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, Mc-Graw Hill, 2004.

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
EC302PC	**Analog Circuits**	3	0	0	3

Prerequisite: Electronic Devices and Circuits

Course Description: This course is advanced level of Electronics Devices & Circuits and it contains biasing techniques of BJT, FET Amplifiers, different Multistage & Feedback Amplifiers and Oscillators.

Course Outcomes: After completion of this course, the students will be able to

- **C302.1** Apply the biasing and stabilization techniques for the bipolar junction transistor and FET.
- **C302.2** Explore different types of single and multistage BJT amplifiers.
- **C302.3** Analyze the small signal model of various FET Amplifiers.
- **C302.4** Derive high frequency transistor parameters using hybrid pi model.
- **C302.5** Examine the characteristics of different Feedback Amplifiers.
- **C302.6** Design various sinusoidal oscillator circuits for given frequencies.

Unit – I BJT Biasing & Analysis and Design of Small Signal Low Frequency BJT Amplifiers

BJT Biasing: Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing -Fixed Bias, Self-Bias, Bias Stability, Bias Compensation using Diode.

Analysis and Design of Small Signal Low Frequency BJT Amplifiers: Transistor Hybrid model, Determination of h-parameters from transistor characteristics, Typical values of h-parameters in CE, CB and CC configurations, Transistor amplifying action, Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors on CE Amplifier.

Unit – II FET Amplifiers

FET- Biasing Techniques

FET Amplifiers: Analysis of CS, CD, CG JFET Amplifiers, comparison of performance with BJT, Amplifiers, Basic Concepts of MOSFET Amplifiers, MOS Small signal model, Common source amplifier with resistive, Diode connected and Current source loads, Source follower, Common Gate Stage, Cascode and Folded Cascode Amplifier – frequency response.

Unit – III Multistage Amplifiers & Transistor at High Frequency

Multistage Amplifiers: Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Frequency response and Analysis of multistage amplifiers, Cascade RC Coupled amplifiers, Cascade amplifier, Darlington pair.

Transistor at High Frequency: Hybrid –π model of Common Emitter transistor model, f_α, f_β and unity gain bandwidth, Gain-bandwidth product.

Unit – IV Feedback Amplifiers

Feedback Amplifiers: Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations – Simple problems.

Unit – V Oscillators

Oscillators: Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators, Frequency and amplitude stability of Oscillators, Crystal Oscillator.

TEXT BOOKS

1. Jacob Millman, Christos C Halkias -Integrated Electronics, McGraw Hill Education.
2. Robert L. Boylestad, Louis Nashelsky -Electronic Devices and Circuits theory, 11th Edition, 2009, Pearson.

REFERENCE BOOKS

1. David A. Bell – Electronic Devices and Circuits, 5th Edition, Oxford.
2. Adel S. Sedra, Kenneth C. Smith- Microelectronic Circuits- Theory and Applications, Oxford.
3. Chinmoy Saha, Arindam Halder, Debaati Ganguly -Basic Electronics-Principles and Applications, 2018, Cambridge.
4. Behzad Razavi – Fundamentals of Microelectronics – 3rd Edition, Wiley.

B.Tech. II Year I Semester

Course code	Course Title	L	T	P	Credits
EC303PC	**Network Analysis and Synthesis**	3	0	0	3

Prerequisite: Basic Electrical Engineering

Course Description: Network analysis and synthesis is a professional engineering course that deals with the study and application of network concepts in communication engineering. This course gives significance of magnetically coupled circuits and graph theory in communication engineering. It also deals with transient and steady state analysis of RLC circuits, two port network parameters, design and analysis of filter circuits and network synthesis.

Course Outcomes: After completion of this course, the students will be able to

- **C303.1** Analyze the electrical circuits using the concepts of network topology and coupled circuits.
- **C303.2** Analyze the Steady state and transient analysis of RLC Circuits.
- **C303.3** Characterization of two port network parameters
- **C303.4** Analyze the design aspects of various types of filters and attenuators
- **C303.5** Evaluate various transmission line parameters
- **C303.6** Synthesize various types of networks using network functions

Unit – I Network Topology

Basic cutset and tie set matrices for planar networks, Magnetic Circuits, Self and Mutual inductances, dot convention, impedance, reactance concept, Impedance transformation and coupled circuits, co-efficient of coupling, equivalent T for Magnetically coupled circuits, Ideal Transformer.

Unit – II Transient and Steady state analysis

RC, RL and RLC Circuits, Sinusoidal, Step and Square responses. RC Circuits as integrator and differentiators. 2nd order series and parallel RLC Circuits, damping factor, over damped, under damped, critically damped cases, quality factor and bandwidth for series and parallel resonance, resonance curves.

Unit – III Two port network parameters

Z, Y, ABCD, h and g parameters, Characteristic impedance, Image transfer constant, image and iterative impedance, network function, driving point and transfer functions – using transformed (S) variables, Poles and Zeros. Standard T, π, L Sections, Characteristic impedance, image transfer constants, Design of Attenuators, impedance matching network.

Unit – IV Filters

Classification of Filters, Filter Networks, Constant-K Filters-Low pass, high pass, Band pass, band-stop filters, M-derived Filters- T and π filters- Low pass, high pass Attenuators: Types – T, π , L, Bridge T and lattice ,Asymmetrical Attenuators T, π , L Equalizers-Types- Series,

Shunt, Constant resistance, bridge T attenuation, bridge T phase, Lattice attenuation, lattice Phase equalizers

Unit – V Network Synthesis

Driving point impedance and admittance, transfer impedance and admittance, network functions of Ladder and non ladder networks, Poles, Zeros analysis of network functions, Hurwitz polynomials, Positive Real Functions, synthesis of LC, RC and RL Functions by foster and causer methods.

TEXT BOOKS

1. Van Valkenburg -Network Analysis, 3rd Ed., Pearson, 2016.
2. JD Ryder - Networks, Lines and Fields, 2nd Ed., PHI, 1999.

REFERENCE BOOKS

1. J. Edminister and M. Nahvi - Electric Circuits, Schaum's Outlines, Mc Graw Hills Education, 1999.
2. A. Sudhakar and Shyammohan S Palli - Networks & Circuits, 4th Ed., Tata McGraw-Hill Publications.
3. William Hayt and Jack E. Kimmerley - Engineering Circuit Analysis, 6th Ed., McGraw Hill Company.
4. S P Eugene Xavier – Statistical Theory of Communication, New Age Publications, 2003.

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
EC304PC	**Digital Logic Design**	3	0	0	3

Prerequisite: Electronic Devices and Circuits

Course Description: This course provides thorough understanding of basic concepts required for digital system design and various logic families.

Course Outcomes: After completion of this course, the students will be able to

- **C304.1** Apply the concepts of number systems and codes in digital system design.
- **C304.2** Minimize Boolean expressions using various techniques
- **C304.3** Compare various characteristics of logic families.
- **C304.4** Realize combinational logic circuits for given specifications
- **C304.5** Design sequential circuits and state machines
- **C304.6** Realize logic circuits using programmable logic devices

Unit – I Number Systems & Boolean Algebra

Number Systems: Number systems, Complements of Numbers, Codes- Weighted and Non-weighted codes and its Properties, Parity check code and Hamming code.

Boolean algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates, Multilevel NAND/NOR realizations.

Unit – II Minimization Techniques & Logic Families

Minimization of Boolean functions: Karnaugh Map Method - Up to five Variables, Don't Care Map Entries, Tabular Method

Realization of Logic Gates Using Diodes & Transistors: AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL, CML and CMOS Logic Families and its Comparison, standard TTL NAND Gate-Analysis & characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tri-state outputs, IC interfacing- TTL driving CMOS & CMOS driving TTL.

Unit – III Combinational Circuits and fundamentals of Sequential Circuits

Combinational Logic Circuits: Adders, Subtractors, Comparators, Multiplexers, Demultiplexers, Encoders, Decoders and Code converters, Hazards and Hazard Free Relations.

Sequential Circuits Fundamentals: Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another.

Unit – IV Registers, Counters & Sequential Machines

Registers and Counters: Shift Registers – Left, Right and Bidirectional Shift Registers, Applications of Shift Registers - Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.

Sequential Machines: Finite State Machines, Synthesis of Synchronous Sequential Circuits- Serial Binary Adder, Sequence Detector, Parity-bit Generator, Synchronous Modulo N –Counters.

Unit – V Finite State Machines and Programmable Logic Devices

Finite state machine: capabilities and limitations, Mealy and Moore models, State equivalence and machine minimization, simplification of incompletely specified machines, Merger graphs. Asynchronous design-modes of operation, Hazards, synthesis of SIC fundamental mode circuits, synthesis of burst mode circuits.

Programmable Logic Devices: Read Only Memory, Programmable Array Logic, Programmable Logic Array, Introduction to Field Programmable Gate Array.

TEXT BOOKS

1. Zvi Kohavi & Niraj K. Jha – Switching and Finite Automata Theory, 3rd Ed., Cambridge, 2010.
2. R. P.Jain-Modern Digital Electronics, 3rdEdition, 2007- Tata McGraw-Hill
3. Morris Mano, Fredriac J. Hill, Gerald R. Peterson - Introduction to Switching Theory and Logic Design –3rd Ed., John Wiley &Sons Inc.

REFERENCE BOOKS

1. Charles H. Roth – Fundamentals of Logic Design, 5th Ed., Cengage Learning, 2004.
2. Stephen M. Trimberger, “Field Programmable Gate Array Technology”, Springer International Edition.
3. A. Anand Kumar – Switching Theory and Logic Design, 3rd Edition, 2016.

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
EC305PC	**Signals and Systems**	3	1	0	4

Course Description: The course presents and integrates the basic concepts for both continuous-time and discrete-time signals and systems and their analysis using various transformation techniques. Further it presents the sampling theorem and its types.

Course Outcomes: After completion of this course, the students will be able to

- **C305.1** Analyze the orthogonality of real and complex signals
- **C305.2** Determine the Spectral characteristics of Periodic and Aperiodic continuous signals
- **C305.3** Analyze the signal transmission through linear time invariant systems
- **C305.4** Apply the concepts of correlation for removal of noise
- **C305.5** Analyze continuous and discrete-time signals and systems using Laplace & Z Transforms respectively
- **C305.6** Illustrate the need for sampling theorem for analog to digital signal conversion

Unit – I Signal Analysis

Signal Analysis: Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function, Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions.

Unit – II Fourier series and Fourier Transforms

Fourier series: Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function, Introduction to Hilbert Transform

Unit – III Signal Transmission through Linear Systems

Signal Transmission through Linear Systems: Linear System, Impulse response, Response of a Linear System, Linear Time lnvariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution and Correlation

(Autocorrelation and Cross Correlation) of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution, Detection of Periodic Signals in the presence of Noise by Correlation, Extraction of Signal from Noise by Filtering.

Unit – IV Laplace Transforms and Z-Transforms

Laplace Transforms: Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.

Z-Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

Unit – V Sampling theorem

Sampling theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling - Aliasing, Introduction to Band Pass Sampling.

TEXT BOOKS

1. B.P. Lathi -Signals, Systems & Communications, BSP, 2013.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawabi -Signals and Systems, 2nd Ed., Prentice Hall

REFERENCE BOOKS

1. Simon Haykin and Van Veen, A. Rama Krishna Rao, -Signals and Systems, TMH, 2008.
2. Michel J. Robert - Fundamentals of Signals and Systems, MGH International Edition, 2008.
3. C. L. Philips, J. M. Parr and Eve A. Riskin -Signals, Systems and Transforms, 3rd Ed., PE, 2004

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
EC306PC	**Analog Circuits Laboratory**	0	0	2	1

Course Description: Analog Circuits lab provides practical knowledge on amplifiers with required Q point and analyze amplifier characteristics, frequency response of multistage amplifiers and feedback concept in amplifiers and oscillators

Course Outcomes: After completion of this course, the students will be able to

- **C306.1** Design amplifiers with required Q point.
- **C306.2** Examine the frequency response of CE amplifier for low and high frequencies.
- **C306.3** Analyze the frequency response of multistage and feedback amplifiers
- **C306.4** Design and verify the Colpitts and RC phase shift Oscillators for a given frequency.

List of Experiments (Twelve experiments are to be done):
Verify any twelve experiments in H/W Laboratory

1. Perform an experiment to choose Q-point for a Transistor that operate in active region and observe the effect of external Load resistance on Q-point.
2. Design a Self-bias Circuit and determine the Q-point of the Transistor and its Stability factor by both simulation and realization with hardware components.
3. Obtain the I/O Characteristics of CE, CB, CC amplifiers. Calculate h-parameters from the characteristics.
4. Design and simulate a Common Drain Amplifier with voltage divider bias and determine the Stability factor.
5. Obtain the frequency response of the CS JFET amplifier and find the bandwidth.
6. By experiment prove that the voltage gain of Emitter Follower Circuit is one.
7. Design a Common Emitter Amplifier with a gain of 30db and Bandwidth of 10KHZ and plot the frequency response practically.
8. Design a two stage RC Coupled amplifier and prove that gain is increased and analyze the effects of coupling capacitance.
9. Practically prove that the Darlington pair has high input impedance.
10. Draw the high frequency response of common emitter transistor amplifier and calculate f_α, f_β and gain bandwidth product.
11. Design a cascade amplifier for a given specifications.
12. Design four topologies of feedback amplifiers and draw the frequency response of them with and without feedback.
13. Design an RC phase shift oscillator circuit and derive the gain condition for oscillations practically for given frequency.
14. Design a Colpitts oscillator circuit for the given frequency and draw the output waveform.

Major Equipment required:

1. Regulated Power Suppliers, 0-30V
2. 20 MHz, Dual Channel Cathode Ray Oscilloscopes
3. Functions Generators-Sine and Square wave signals
4. Multimeters
5. Electronic devices

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
EC307PC	**Digital Logic Design Laboratory**	0	0	2	1

Prerequisite: Electronic Devices and Circuits

Course Description: This course is about the realization, implementation and verification of Boolean functions, combinational circuits, sequential circuits and logic families.

Course Outcomes: After completion of this course, the students will be able to

- **C307.1** Realize different combinational circuits using gates
- **C307.2** Implement Boolean functions using combinational building blocks
- **C307.3** Design and verify sequential circuits and state machines using flip flops
- **C307.4** Realize all logic gates using DTL and TTL logic families

List of Experiments:

1. Realization of Logic circuit to generate r's Compliment using Logic Gates.
2. Realization of given Boolean function using universal gates and minimizing the same. Compare the gate count before and after minimization.
3. Design and realize Full Adder circuit using gates/universal gates. Implement Full Subtractor using full adder.
4. Designing a 2 – bit Comparator using AND, OR and NOT gates. Realize 4 – bit Comparator using 2– bit Comparators.
5. Realize 2:1 MUX using the given gates and Design 8:1 using 2:1 MUX.
6. Implement the given Boolean function using the given MUX (ex: code converters).
7. Realize a 2x4 Decoder using logic gates and implement 3x8 Decoder using 2x4 Decoder.
8. Implement the given Boolean function using given Decoders.
9. Convert Demultiplexer to Decoder and vice versa.
10. Verification of truth tables of flipflops using different clocks (level triggering, positive and negative edge triggering) also converts the given flipflop from one type to other.
11. Designing of Universal n-bit shift register using flipflops and Multiplexers. Draw the timing diagram of the Shift Register.
12. Design a Synchronous binary counter using D-flipflop/given flipflop.
13. Design an asynchronous counter for the given sequence using given flipflops.
14. Designing of MOD 8 Counter using JK flipflops.
15. Designing of sequence detecting State Machine with minimal states using the given flipflops.
16. Designing of Parity Bit (even/odd) generator using the given flipflops.
17. Realize all logic gates with TTL logic.
18. Realize all logic gates with DTL logic.

Note: Minimum of 12 experiments are to be performed

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
EC308PC	**Basic Simulation Laboratory**	0	0	2	1

Course Description: This laboratory course introduces simulation software (MATLAB or equivalent) and its use to implement the various concepts like basic operations on Matrices, analysis of signals and systems using various transformation techniques, Convolution and Correlation operations and related applications

Course Outcomes: After completion of this course, the students will be able to

- **C308.1** Perform various operations on signals
- **C308.2** Verify the properties of LTI system and its response for different inputs.
- **C308.3** Analyse the signals and systems using various transforms
- **C308.4** Verify the application of convolution and correlation in signal analysis

List of Programs

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sine.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding.
4. Computation of Energy and Average Power.
5. Finding the Even and Odd parts of Signal / Sequence and Real and Imaginary parts of Signal
6. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum
7. Gibbs Phenomenon Simulation.
8. Verification of Linearity and Time Invariance Properties of a given Continuous / Discrete System.
9. Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI system and verifying its physical realizability and stability properties
10. Design a LPF and HPF
11. Relation between bandwidth and rise time.
12. Convolution for Signals and sequences.
13. Auto Correlation and Cross Correlation for Signals and Sequences.
14. Removal of noise by Autocorrelation / Cross correlation.
15. Extraction of Periodic Signal masked by noise using Correlation.
16. Waveform Synthesis using Laplace Transform.
17. Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function.
18. Verification of Sampling Theorem.
19. Analysis of Spectrogram for Speech Signal

Note: Minimum of 15 Programs are to be executed

Major Equipment required:

1. Computer System with latest specifications
2. Window XP or equivalent
3. Simulation software-MATLAB or any equivalent simulation software

B.Tech. II Year I Semester

Course Code	Course Title	L	T	P	Credits
MC311	**Environmental Science**	3	0	0	0

Course Description: This course enables the students engage with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems. It provides the scope to examine alternative solutions for resolving or preventing them. It is essentially a multidisciplinary approach that brings out an appreciation of our natural world and human impact on its existence and integrity. Its components include Biology, Geology, Chemistry, Physics, Engineering, Sociology, Health, Anthropology, Economics, Statistics, Computers and Philosophy.

Course Outcomes: After completion of this course, the students will be able to

- **C311.1** Analyze the important components of environment.
- **C311.2** Illustrate the major environmental effects of exploiting natural resources.
- **C311.3** Utilize environmental laws for the protection of forest and wildlife.
- **C311.4** Categorize different types of pollutions and their control measures and discover effective methods of waste management.
- **C311.5** Identify global environmental problems and come out with best possible solutions.
- **C311.6** Illustrate green environmental issues.

Unit – I Ecosystems

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

Unit – II Natural Resources: Classification of Resources

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

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. Field visit.

Threats to biodiversity: habitat loss, poaching of wildlife, man-wild life conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation.

Unit – IV Environmental Pollution and Control Technologies: Environmental Pollution

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Waste water Treatment methods: Primary, secondary and Tertiary.
International conventions /Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.
Green Environmental Issues: Clean development mechanism, carbon foot printing, carbon credits, carbon sequestration and Polluter pay principle

Unit – V Environmental Policy, Legislation & EIA

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act-1981, Water Act, Forest Act, Wildlife 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 base line data acquisition. Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS

1. Erach Bharucha. Textbook of Environmental Studies for Undergraduate Courses. 1st edition, Universities press, 2005.
2. Anubha Kaushik, C.P. Kaushik. Perspectives in Environmental Studies. 4th edition, New age international publishers
3. S. Deswal and A. Deswal. A basic course in environmental studies. 2nd edition, Dhanapathirai & Co., 2004.
4. Benny joseph. Environmental studies. 3rd edition, McGraw Hill Education (India) Private Limited.

REFERENCE BOOKS

1. Daniel B. Botkin and Edwards A. Keller. Environmental science. 8th edition, Wiley India (P) Ltd.
2. Richard T. Wright. Environmental Science: towards a sustainable future. 4th edition, PHL Learning Private Ltd.
3. P. D. Sharma. Ecology And Environment. 5th edition, Rastogi Publications.

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC401PC	**Probability Theory and Stochastic Processes**	3	0	0	3

Course Description: In this course students will study the important theorems of probability that are useful for various applications and analysis, Random variable and operations to be performed to extract the information, analysis of random process in time and frequency domain and estimation of noise parameters required for analysis of various systems.

Course Outcomes: After completion of this course, the students will be able to

- **C401.1** Apply the basic concepts, theorems related to probability and its applications
- **C401.2** Analyze various distribution and density functions of a random variable.
- **C401.3** Perform operations on single and multiple random variables for information retrieval
- **C401.4** Estimate the statistical parameters of a random process in time domain.
- **C401.5** Estimate the spectral characteristics of a random process.
- **C401.6** Summarise various types of noise and its impact on system performance

Unit – I Probability & Random Variable

Probability: Experiment, Sample Space, Discrete and Continuous Sample Spaces, Event, Probability - Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem, Independent Events

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

Unit – II Operations on Single and Multiple Random Variables

Operations On Single Random Variable: Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic and Non-monotonic Transformations of Continuous Random Variable, Transformation of a Discrete Random Variable.

Operations on Multiple Random Variables: Vector Random Variables, Joint Distribution Function and its Properties, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence. Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected). Unequal Distribution, Equal Distributions. Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two

Random Variables case, N Random Variable Case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

Unit – III Random Processes – Temporal Characteristics

The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-Order and Wide-Sense Stationarity, (N-Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal Response of Linear Systems: System Response–Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output

Unit – IV Random Processes – Spatial Characteristics

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. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.

Unit – V Noise and Parameters

Resistive / Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow-band noise& its properties.

TEXT BOOKS

1. Probability, Random Variables & Random Signal Principles – Peyton Z. Peebles, TMH, 4thEdition, 2001.
2. Probability, Random Variables and Stochastic Processes –Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition,2002.
3. Probability and Random Processes with Application- Henry Strack, John W.Woods, Pearsons Publication, 3rd Edition , 2000

REFERENCE BOOKS

1. Random Processes for Engineers –Bruce Hajck, Cambridge unipress,2015
2. Probability, Statistics & Random Processes - K. Murugesan, P. Guruswamy, Anuradha Agencies, 3rdEdition, 2003.
3. Principles of Communication Systems by Taub and Schilling (TMH),2008

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC402PC	**Electromagnetic Fields and Transmission Lines**	3	0	0	3

Course Description: In this course students will study the Electromagnetic Fields and Waves provides a comprehensive introduction to the fundamental concepts and principles of electromagnetism. It explores the behavior of electromagnetic fields and waves which covering the electric filed, magnetic fields, Maxwell's equations and wave propagation. They will also learn how to apply electromagnetic concepts to practical applications like antennas, electromagnetic compatibility and communication systems. The students will gain the solid understanding of transmission line theory and practical design consideration.

Course Outcomes: After completion of this course, the students will be able to

C402.1	Apply the laws of electrostatics for different types of charge distributions.
C402.2	Understand the principles of steady magnetic field.
C402.3	Analyze boundary conditions using Maxwell's equations at different media interfaces.
C402.4	Solve the Maxwell's equations of Time Varying fields and obtain the wave phenomenon in various media.
C402.5	Analyze the Wave Equations and classify conductors, dielectrics and evaluate the UPW Characteristics for several practical media of interest.
C402.6	Analyze the Design aspect of transmission line parameters and configurations.

Unit – I Electrostatics

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

Unit – II Magnetostatics

Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law.

Unit – III Maxwell's Equations (Time Varying Fields)

Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Two Equations for Magnetostatic Fields, Maxwell's Two Equations for Electrostatic Fields Maxwell's Equations in Different Forms, Conditions at a Boundary Surface - Dielectric-Dielectric and Dielectric-Conductor Interfaces.

Unit – IV EM Wave Characteristics

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definitions, Relation between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem.

Unit – V Transmission Lines

Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Equivalent Circuit, Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless / Low Loss Characterization, Condition for Distortion less line, Minimum Attenuation, Loading - Types of Loading.SC and OC Lines, $\lambda/4$, $\lambda/2$, $\lambda/8$ Lines, Reflection Coefficient, VSWR Smith Chart – Configuration and Applications, Single Stub Matching.

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. Probability and Random Proc
3. Umesh Sinha, Satya Prakashan -Transmission Lines and Networks, (Tech. India Publications), New Delhi, 2001.

REFERENCE BOOKS

1. Engineering Electromagnetics – William H. Hayt Jr. and John A. Buck, TMH, 7th ed., 2006.
2. Engineering Electromagnetics - Nathan Ida, Springer (India) Pvt.Ltd., New Delhi, 2nd ed., 2005.
3. Schaum’s Outline of Electromagnetics - Joseph Edminister and Mahmood Nahvi, 4th edition

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC403PC	**Analog and Digital Communications**	3	0	0	3
Prerequisites	Signals & Systems				

Course Description: In this course students will study about analog and digital communications systems. Especially students will learn importance of modulation and various types of Analog, Digital and Pulse Modulation and Demodulation techniques along with source coding techniques to minimize redundancy

Course Outcomes: After completion of this course, the students will be able to

C403.1 Analyze various modulation/demodulation techniques of amplitude modulation.
C403.2 Explain various modulation/demodulation techniques of angle modulation.
C403.3 Explain different types of pulse analog modulation techniques.
C403.4 Classify various types of transmitters and receivers used in AM and FM.
C403.5 Explain various pulse code modulation techniques.
C403.6 Analyze various digital modulation/demodulation techniques and source codes.

Unit – I Amplitude Modulation

Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSBSC modulation - time and frequency domain description, Generation of DSBSC Waves – Balanced Modulators, Coherent detection of DSB –SC Modulated waves, COSTAS Loop, SSB Modulation – time and frequency domain description, frequency discrimination and Phase discrimination methods for generating SSB, Demodulation of SSB Waves, principle of Vestigial sideband modulation.

Unit – II Angle Modulation

Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Narrowband FM, Wideband FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slope detector, Phase locked loop, Comparison of FM and AM, Concept of Pre-emphasis and de-emphasis.

Unit – III Pulse Analog Modulation - Transmitters and Receiver

Pulse Analog Modulation: Types of Pulse modulation - PAM, PWM and PPM. Comparison of FDM and TDM.

Transmitters and Receivers: AM Transmitters, FM Transmitters, Receiver Types - Tuned radio frequency receiver, Super heterodyne receiver, Comparison of AM and FM Receivers.

Unit – IV Pulse Code Modulation

PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, DPCM, Adaptive DPCM, DM and Adaptive DM, Noise in PCM and DM.

Unit – V Digital Modulation Techniques- Information Theory and Source Coding

Digital Modulation Techniques: ASK - Modulator, Coherent ASK Detector, FSK - Modulator, Non-Coherent FSK Detector, BPSK-Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK and QAM.

Information Theory and Source Coding: Entropy, Information rate, Source coding: Huffman coding, Shannon Fano coding, Mutual information, Channel capacity of discrete channel, Shannon-Hartley law; Trade -off between bandwidth and SNR.

TEXT BOOKS

1. Simon Haykin – Analog and Digital Communications, John Wiley, 2005.
2. George Kennedy and Bernard Davis – Electronics & Communication System, TMH, 2004
3. K. Sam Shanmugam – Analog and Digital Communication, Willey, 2005

REFERENCE BOOKS

1. Herbert Taub, Donald L Schilling, Goutam Saha, -Principles of Communication Systems, 3rdEd., McGraw - Hill, 2008.
2. Wayne Tomasi – Electronics Communication Systems –Fundamentals through Advanced, 5thEd., PHI, 2009.
3. Dennis Roddy and John Coolean- Electronic Communications, 4thEd.,PEA,2004.

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC404PC	**Linear and Digital IC Applications**	3	0	0	3
Prerequisites	Electronics Devices and Circuits Digital Logic Design				

Course Description: This course introduces the basic building blocks of integrated circuits, linear and non-linear applications of operational amplifiers, the concepts of waveform generation and special function ICs. Also, implementation of combinational and sequential digital circuits.

Course Outcomes: After completion of this course, the students will be able to

C404.1	Describe the principles of Op-Amps and derive the applications of the same.
C404.2	Analyse IC 555 timer and its applications
C404.3	Choose the appropriate ADC and DAC in real life applications
C404.4	Design combinational logic circuits for various applications using ICs
C404.5	Design sequential logic circuits for simple applications using ICs
C404.6	Illustrate the architectural features and programming technologies of various FPGAs

Unit – I Operational Amplifier

Introduction and Classification of ICs, Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, Features of 741 Op-Amp, Modes of Operation – Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators.

Unit – II Op-Amp, IC-555 & IC 565 Applications

Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, waveform Generators – Triangular, Saw tooth, square wave, IC555 Timer – Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL – Block Schematic, Description of Individual Blocks, Applications.

Unit – III Data Converters

Introduction, Basic DAC techniques, Different types of DACs-Weighted Resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs – Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

Unit – IV Digital Logic IC's

Decoders, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Parallel Binary Adder/Subtractor, Magnitude Comparators, Flip-flops, Binary Counter, Decade Counter, Universal Shift Register.

Unit – V Field Programmable Gate Arrays

Introduction, FPGA Architectures, SRAM-Based FPGAs: Logic Elements, Interconnection Networks, Configuration, Permanently Programmed FPGAs: Antifuses, Flash Configuration, Logic Blocks, Interconnection Networks, Programming, Chip I/O.

TEXT BOOKS

1. Ramakanth A. Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI, 3rd Edition, 2003.
2. John F. Wakerley, "Digital Design Principles and Practices", Prentice Hall, 3rd Edition, 2009.
3. Wayne Wolf, "FPGA-Based System Design", Prentice Hall, Modern Semicondcutor Design Series, 2004.

REFERENCE BOOKS

1. D. Roy Chowdhury, "Linear Integrated Circuits", Newage international (p) Ltd, 2nd Edition, 2003.
2. Floyd and Jain, "Digital fundamentals", Pearson Education, 8th Edition ,2005.
3. Salivahanan, "Linear Integrated Circuits and Applications", TMH, 1st Edition, 2008.
4. M. Morris Mano, Michael D. Ciletti, "Digital Design", Pearson Education/PHI, 3rd Edition, 2008.

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC405PC	**Electronic Circuit Analysis**	3	0	0	3

Prerequisites Analog Circuits

Course Description: This course is advanced level of Analog Circuits and it contains Tuned Amplifiers, Power Amplifiers, Multivibrators using transistors and Sweep Circuits

Course Outcomes: After completion of this course, the students will be able to

C405.1 Analyze different types of power amplifiers forgiven specifications.
C405.2 Design various types of tuned amplifiers for specific applications.
C405.3 Design different multivibrators using transistors.
C405.4 Optimize time base waveform generators.
C405.5 Apply the concepts of synchronization and frequency division in relaxation and sweep circuits.
C405.6 Illustrate the operation, types, and pedestal removal of sampling gates.

Unit – I Large Signal Amplifiers

Class A Power Amplifier- Series fed and Transformer coupled, Conversion Efficiency, Class B Power Amplifier- Push Pull and Complimentary Symmetry configurations, Conversion Efficiency, Principle of operation of Class AB and Class ‑C and D Amplifiers.

Unit – II Tuned Amplifiers

Introduction, single Tuned Amplifiers ‑ Q-factor, frequency response, Double Tuned Amplifiers ‑ Q-factor, frequency response, Concept of stagger tuning and synchronous tuning.

Unit – III Multivibrators

Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.

Unit – IV Time Base Generators

General features of a Time base Signal, Methods of Generating Time Base Waveform, concepts of Transistor Miller and Bootstrap Time Base Generator, Methods of Linearity improvement.

Unit – V Synchronization and Frequency Division and Sampling Gates

Synchronization and Frequency Division: Pulse Synchronization of Relaxation Devices, Frequency division in Sweep Circuits, Stability of Relaxation Devices, Astable Relaxation Circuits, Monostable Relaxation Circuits, Synchronization of a Sweep Circuit with Symmetrical Signals, Sine wave frequency division with a Sweep Circuit, A Sinusoidal Divider using Regeneration and Modulation.

Sampling Gates: Basic operating principles of Sampling Gates, Unidirectional and Bi-directional Sampling Gates, Four Diode Sampling Gate, Reduction of pedestal in Gate Circuits

TEXT BOOKS

1. Jacob Millman, Christos C Halkias - Integrated Electronics, McGraw Hill Education.
2. J. Millman, H. Taub and Mothiki S. PrakashRao - Pulse, Digital and Switching Waveforms -2nd Ed., TMH, 2008.

REFERENCE BOOKS

1. David A. Bell - Electronic Devices and Circuits, 5th Ed., Oxford.
2. Robert L. Boylestead, Louis Nashelsky - Electronic Devices and Circuits theory, 11th Ed., Pearson, 2009
3. Ronald J. Tocci - Fundamentals of Pulse and Digital Circuits, 3rd Ed., 2008.
4. David A. Bell - Pulse, Switching and Digital Circuits, 5th Ed., Oxford, 2015.
5. A. Anand Kumar - Pulse and Digital Circuits - PHI Learning.

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC406PC	**Analog and Digital Communications Laboratory**	0	0	2	1

Course Description: In this course, students will practically observe the various analog, pulse and digital modulation techniques using the hardware equipment and also analyze by varying the parameters through simulation using MATLAB or any other simulation tools.

Course Outcomes: After completion of this course, the students will be able to

- **C406.1** Analyze the spectrum of various analog modulation/demodulation techniques.
- **C406.2** Understand multiplexing and demultiplexing using FDM.
- **C406.3** Examine various pulse modulation/demodulation techniques.
- **C406.4** Analyze different digital modulation/demodulation schemes

List of Experiments / Programs

Cycle 1:

1. (i) Amplitude modulation and demodulation (ii) Spectrum analysis of AM
2. (i) Frequency modulation and demodulation (ii) Spectrum analysis of FM
3. DSB-SC Modulator & Detector
4. SSB-SC Modulator & Detector (Phase Shift Method)
5. Frequency Division Multiplexing & De multiplexing
6. Pulse Amplitude Modulation & Demodulation
7. Pulse Width Modulation& Demodulation
8. Pulse Position Modulation & Demodulation

Cycle 2:

1. PCM Generation and Detection
2. Delta Modulation
3. DPCM Generation and Detection
4. Frequency Shift Keying: Generation and Detection
5. Binary Phase Shift Keying: Generation and Detection
6. Generation and Detection (i) DPSK (ii) QPSK
7. Generate FSK modulated signal using PLL

Major Equipment required for Laboratories:

1. CROs: 20MHz
2. Function Generators:2MHz
3. Spectrum Analyzer
4. Regulated Power Supplies: 0-30V
5. MATLAB/ Equivalent Simulation Package with Communication tool box.

Note:

1. Minimum of 12 Experiments are to be performed.
2. Any 6 experiments are to be simulated using MATLAB, COMSIM or any other Simulation package.

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC407PC	**Linear and Digital IC Applications Laboratory**	0	0	2	1

Course Description: This course describes about the design and implementation of various analog circuits using 741 ICs, various Multivibrators using 555 timers, ADC, DAC, Voltage regulators and digital ICs.

Course Outcomes: After completion of this course, the students will be able to

C407.1 Design analog circuits for practical applications using Op Amp IC-741.
C407.2 Design multi vibrators using IC555 and Schmitt trigger using IC741
C407.3 Design waveform generators, ADC and DAC.
C407.4 Design combinational and sequential circuits using digital ICs.

List of Experiments / Programs

Cycle 1:

1. Design an Inverting and Non-inverting Amplifier using Op Amp and calculate gain.
2. Design Adder and Subtractor using Op Amp and verify addition and subtraction process.
3. Design a Comparator using Op Amp and draw the comparison results of A=B, A<B, A>B.
4. Design an Integrator and Differentiator Circuits using IC741 and derive the required condition practically.
5. Design an Active LPF, HPF cutoff frequency of 2 KHZ and find the roll off of it.
6. Design a Circuit using IC741 to generate sine/square/triangular wave with period of 1KHZ and draw the output waveform.
7. Construct Mono-stableMultivibratorusingIC555 and draw its output waveform.
8. Construct Astable Multivibrator using IC555 and draw its output waveform and also find its duty cycle.
9. Design a Schmitt Trigger Circuit and find its LTP and UTP.
10. Design Frequency modulator and demodulator circuit and draw the respective waveforms.
11. Design VoltageRegulatorusingIC723, IC 7805/7809/7912 and find its load regulation factor.
12. Design R-2R ladder DAC and find its resolution and write a truth table with respective voltages.
13. Design Parallel comparator type/ counter type/ successive approximation ADC and find its efficiency.

Cycle 2:

14. Design a Gray code converter and verify its truth table.
15. Design priority encoder using IC 74xx and verify its truth table.
16. Design an 8x1 multiplexer using digital ICs.

17. Design a 4-bit Adder/Subtractor using digital ICs
18. Design a Decade counter and verify its truth table and draw respective waveforms.
19. Design a Up/down counter usingIC74163 and draw read/write waveforms.
20. Design a Universal shift register using IC 74194/195 and verify its shifting operation.
21. Design a 16x4 RAM using 74189 and draw its read/write operation.
22. Design an 8x3 encoder/3x8 decoder and verify its truth table.

Note:

1. Minimum 12 experiments should be conducted
2. Verify the functionality of the IC in the given application.

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
EC408PC	**Electronic Circuit Analysis Laboratory**	0	0	2	1

Course Description: Electronic Circuit Analysis lab provides capability to design power amplifiers for efficiency, engineer tuned amplifiers to evaluate Q-factor, create multivibrators and sweep circuits emphasizing linearity, and proficiently design sampling gates with a grasp of frequency division principles.

Course Outcomes: After completion of this course, the students will be able to

C408.1 Design and verify power amplifiers and find efficiency.
C408.2 Design and verify tuned amplifiers and find Q-factor.
C408.3 Design and verify different Multivibrators.
C408.4 Verify the operation of sampling gates and sweep generators

List of Experiments:

Experiments marked with * has to be designed, simulated and verified in hardware. Minimum of 9 experiments to be done in hardware.

1. Design transformer coupled class A power amplifier and draw the input and output waveforms find its efficiency
2. Design class B power amplifier and draw the input and output waveforms, find 2nd order and above harmonics.
3. Prove that the complementary symmetry pushpull amplifier eliminate cross over distortion.
4. Design class C power amplifier and draw the input and output waveforms
5. Design a single tuned amplifier and determine the Q of its tuned circuit practically.
6. Design a Bistable Multivibrator and analyze the effect of commutating capacitors and draw the wave forms at base and collector of transistors.
7. Design an Astable Multivibrator and draw the wave forms at base and collector of transistors.
8. Design a Monostable Multivibrator and draw the input and output waveforms
9. Draw the response of Schmitt trigger for gain of greater than and less than one.
10. Design a Bootstrap sweep circuit using BJT and draw its output time base waveform
11. Design a Miller sweep circuit using BJT and draw its output time base waveform.
12. Design a constant current sweep generator and draw input and output waveforms
13. Design unidirectional and bidirectional sampling gates
14. Prove practically Schmitt Trigger generates square wave
15. Frequency division with sweep circuit

Major Equipment required:

1. Computer System with latest specifications connected
2. Window XP or equivalent
3. Simulation software-Multisim or any equivalent simulation software
4. Regulated Power Suppliers, 0-30V
5. 20 MHz, Dual Channel Cathode Ray Oscilloscopes.
6. Functions Generators-Sine and Square wave signals
7. Multimeters
8. Electronic Components

B.Tech. II Year II Semester

Course Code	Course Title	L	T	P	Credits
MC410	**Gender Sensitization Lab**	0	0	2	0

Course Description: This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

Course Outcomes: After completion of this course, the students will be able to

- **C410.1** sensitized to the 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.
- **C410.2** attain a finer grasp of how gender discrimination works in our society and how to counter it.
- **C410.3** insight into the gendered division of labour and its relation to politics and economics.
- **C410.4** better equipped to work and live together as equals.
- **C410.5** develop a sense of appreciation of women in all walks of life.
- **C410.6** 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

Introduction: Introduction to Gender, what is Gender, why should we study it. Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste: Different Masculinities.

Unit – II GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination- Missing Women-Sex Selection and Its Consequences

Declining Sex Ratio. Demographic Consequences- Gender Spectrum: Beyond the Binary

Unit – III GENDER AND LABOUR

Division & Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work."

"Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

Unit – IV GENDER - BASED VIOLENCE

Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu". Domestic Violence: Speaking Out Is Home a Safe Place? - When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim- "I Fought for my Life…." Additional Reading: The Caste Face of Violence.

Unit – V GENDER AND COEXISTENCE

Gender Issues- Just Relationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks the Brave Heart.

TEXT BOOKS

1. All the five Units in the Textbook, "Towards a World of Equals: A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, AsmaRasheed, Gogu Shyamala, Deepa Sreenivas 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. Abdulali Sohaila. "I Fought for My Life…and Won." Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web References:

- http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

E-Text Books:

- Abdulali Sohaila. "I Fought for My Life…and Won." (Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/)

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC501PC	**Microcontrollers**	3	1	0	4
Prerequisites	Linear & Digital IC Applications				

Course Description: This course familiarizes the architecture of microprocessors and micro controllers, interfacing of bus and memory. Also, the concepts of ARM architecture and advanced ARM Processors.

Course Outcomes: After completion of this course, the students will be able to

C501.1	Differentiate architectural features and modes of operation of 8086 microprocessor and 8051 microcontrollers.
C501.2	Summarize the addressing modes, instruction set and assembler directives of 8086 Microprocessor and 8051 Micro controller.
C501.3	Write assembly language programs for 8086 Microprocessor and 8051 Microcontroller.
C501.4	Explore serial communication standards and interface various peripheral devices, memory with 8051 microcontrollers.
C501.5	Analyze the architectural features and instruction set of ARM processor
C501.6	Describe the architectural feature of CORTEX and OMAP processors

Unit – I 8086 Microprocessor

8086 Architecture: 8086 Architecture-Functional diagrams, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

Unit – II 8051 Microcontroller

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

Unit – III Interfacing

I/O and Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232, USB.

Unit – IV ARM Architecture

ARM Architecture: ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

Unit – V Advanced ARM Processors

Advanced ARM Processors: Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

TEXT BOOKS:

1. A K. Ray and K. M. Bhurchandani -Advanced Microprocessors and Peripherals, TMH, 2nd Edition, 2006.
2. Andrew N SLOSS, Dominic SYMES, Chris WRIGHT -ARM System Developers guide, Elsevier, 2012

REFERENCE BOOKS:

1. Kenneth. J. Ayala-The 8051 Microcontroller, Cengage Learning, 3rd Ed, 2004.
2. D. V. Hall -Microprocessors and Interfacing, TMGH, 2nd Edition, 2006.
3. K. Uma Rao, Andhe Pallavi-The 8051 Microcontrollers, Architecture and Programming and Applications, Pearson, 2009.
4. Donald Reay-Digital Signal Processing and Applications with the OMAP- L138 Experimenter, WILEY 2012.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC502PC	**Antennas and Wave Propagation**	3	0	0	3
Prerequisites	Electromagnetic Fields and Transmission Lines				

Course Description: In this course students will study the Electromagnetic Fields and Waves provides a comprehensive introduction to the fundamental concepts and principles of electromagnetism. It explores the behavior of electromagnetic fields and waves which covering the electric filed, magnetic fields, Maxwell's equations and wave propagation. They will also learn how to apply electromagnetic concepts to practical applications like antennas, electromagnetic compatibility and communication systems.

Course Outcomes: After completion of this course, the students will be able to

C502.1 Understand the fundamental antenna parameters involved in designing antennas.
C502.2 Examine the radiation pattern of linear wire antennas.
C502.3 Analyze the geometric characteristics of different antenna types.
C502.4 Create varied antenna arrays to optimize gain in the desired direction.
C502.5 Evaluate antenna performance by measuring antenna parameters.
C502.6 Investigate the attributes of wave propagation in diverse atmospheric layers.

Unit – I Antenna Basics

Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem.

Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, **Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths**. Loop Antennas - Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances and Directivities of Small Loops (Qualitative Treatment).

Unit – II Antenna Arrays

Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

Unit – III VHF, UHF and Microwave Antennas - I

Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and 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.

Unit – IV VHF, UHF and Microwave Antennas - II

Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas – Geometry and Parameters, Characteristics of Microstrip Antennas. Reflector Antennas – Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features.

Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods)

Unit – V Wave Propagation

Definitions, Categorizations and General Classifications, Different Modes of Wave Propagation, Ray/Mode Concepts

Ground Wave Propagation –Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections.

Space Wave Propagation –Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Troposphere Propagation.

Sky Wave Propagation –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.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. C.A. Balanis - Antenna Theory, 3rd Edition. John Wiley & Sons, 2005.
2. K.D. Prasad, Satya Prakashan - Antennas and Wave Propagation, Tech India Publications, New Delhi, 2001.
3. Keith henney - Radio Engineering Handbook, 3rd edition TMH.
4. John Leonidas Volakis -Antenna Engineering Handbook, 3rd edition, 2007

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC503PC	**Control Systems**	3	1	0	4
Prerequisites	Basic Electrical Engineering				

Course Description: Control systems are a fundamental aspect of engineering that deal with regulating and managing the behavior of dynamic systems to achieve desired outcomes. A control system consists of components that gather information about the system's behavior, process this information to determine appropriate actions, and then execute those actions to influence the system's behavior towards a desired state or trajectory. The primary objective of control systems is to maintain stability, improve performance, and achieve specified objectives, such as tracking a desired trajectory, rejecting disturbances, or optimizing system behavior. In this subject, students learn about the modelling of systems, analysis of their behaviour in time and frequency domains and different stability techniques.

Course Outcomes: After completion of this course, the students will be able to

C503.1	Evaluate the types of control systems for real time applications.
C503.2	Compute transfer function of a system by different techniques.
C503.3	Evaluate the time response of systems for standard input signals.
C503.4	Probe the stability of a system using time and frequency domain approach
C503.5	Examine the performance of systems with compensators and controllers
C503.6	Construct state models for continuous & discrete time systems and Comment on controllability and observability of the system

Unit – I Modeling of Physical Systems and Their Representations

Industrial and domestic Control examples. Mathematical modelling of physical systems: Mechanical and Electrical Systems, Open – loop and Closed loop Systems, Introduction to types of Systems: Transfer function, Block-diagram Techniques, Signal flow graph.

Concept of Feedback Control, Benefits of Feedback and Effects of feedback. Controller Components

Unit – II TIME – Domain Analysis with Input-Output Models

Time response of first order system for standard test inputs, Analysis of standard Second order systems with step input, Types of System, Error Analysis for Linear time Invariant Systems, Design specifications for second-order systems based on the time-response.

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

Unit – III Frequency Response Analysis

Introduction to frequency response, Relationship between time and frequency response, Polar plots, Bode Plot Nyquist stability criterion, Concept of Bode plots and construction. Closed-loop frequency response. Relative stability using Nyquist criterion –gain and phase margin.

Unit – IV Introduction to Design of Classical Controllers and Compensators

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.

Application of Proportional, Integral and Derivative Controllers, Root-loci method of feedback controller design. Design specifications in frequency-domain Lead, Lag and Lag-Lead compensation in designs. Analog and Digital implementation of controllers

Unit – V State Variable Analysis and Design

State Space model, Diagonalization of State Matrix, Solution of State Equation. Eigen Values and stability Analysis, Concept of Controllability and Observability. Pole Placement by state feedback, Discrete time domain. Difference equations. State space model of linear Discrete time system, Stability of linear discrete time systems.

TEXT BOOKS:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
SM504MS	**Business Economics and Financial Analysis**	3	0	0	3

Course Description: The course contains various topics related to forms of Business and the impact of economic variables on the Business. It includes the Demand, Supply, Production, Cost, Market Structure and Pricing aspects in business. The students can study the firm's financial position by analyzing the Financial Statements of a Company which can be used in their engineering career development.

Course Outcomes: After completion of this course, the students will be able to

C504.1 Understand the Economic Concepts in business decision making process.
C504.2 Familiarize with the cost concepts, market structures.
C504.3 Make use of break-even analysis, CVP Analysis, pricing strategies.
C504.4 Examine financial accounting and analyze various financial statements.
C504.5 Interpret various financial statements by applying different types of ratios.
C504.6 Examine the usefulness of Investment decisions of a company.

Unit – I INTRODUCTION TO BUSINESS AND ECONOMICS

Business: Introduction to business, Structure of Business Firm, Types of Business Entities: Sole Proprietorship, Partnership, Limited Liability Company & Co-operatives, Sources of Capital for a Company: Conventional, Non-Conventional Sources of Finance. Theory of Firm.
Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

Unit – II DEMAND AND SUPPLY ANALYSIS

Demand: Demand Determinants, Law of Demand
Elasticity of Demand: Elasticity, Types of Elasticity, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function and Law of Supply.

Unit – III PRODUCTION, COST, MARKET STRUCTURES & PRICING

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

Cost analysis: Types of Costs, Short run and Long run Cost Functions.

Market Structures: Nature of Competition, Perfect competition, Monopoly, Oligopoly, Monopolistic Competition: Features and Price Determination.

Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, and Cost Volume Profit Analysis.

Unit – IV FINANCIAL ACCOUNTING

Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

Unit – V FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Ratio Analysis, Importance, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

TEXT BOOKS:

1. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata Mc Graw Hill Education Pvt. Ltd. 2012.
2. D.D.Chaturvedi, S.L.Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
3. Dhanesh K Khatri, Financial Accounting, Tata Mc –Graw Hill, 2011.

REFERENCE BOOKS:

1. S.N.Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
2. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
3. Managerial Economics: Theory and Applications, D.M. Mithani, Himalaya Publishing House, 2017.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC511PE	**Computer Organization & Operating Systems**	3	0	0	3

Prerequisites Digital Logic Design

Course Description: To understand the structure of a computer and Micro-level operations RTL and control in a computer along with the concepts of I/O and memory organization and operating systems.

Course Outcomes: After completion of this course, the students will be able to

C511.1	Implement Micro-operations in Design, Organization and Architecture of a basic computer.
C511.2	Design a suitable Control unit for a decided set of Instructions
C511.3	Implement data transfer with appropriate IO Interface and Interrupt mechanism
C511.4	Choose suitable type of Memory for a given purpose and appropriately manage it
C511.5	Handle the deadlocks efficiently.
C511.6	Implement efficient File Management techniques through System Calls.

Unit – I

Introduction: Definition of Computer Organization, Computer Design and Computer Architecture and types of architecture- Von-Neumann Architecture, Harvard Architecture.

Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro-operations, shift micro-operations, Arithmetic logic shift unit.

Basic Computer Organization and Design: Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt

Unit – II

Microprogrammed Control: Control memory, Address sequencing, Micro program example, Design of control unit.

Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

Data Representation: Fixed Point Representation, Floating Point Representation.

Unit – III

Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.

Memory Organization: Main Memory, Associate Memory, Cache Memory.

Unit – IV

Introduction: System Structures, Operating System Services, User OS Interface, System Calls and Types, System Programs.

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock

Memory Management: Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation.

Virtual Memory: Demand Paging, Page Replacement, Page Replacement Algorithms.

Unit – V

File System Interface: Access Methods, Directory Structure, Protection, File System Structure, Allocation Methods, Free Space Management.

File Operations: Usage of open, create, read, write, close, lseek, stat, ioctl system calls

TEXT BOOKS:

1. Computer System Architecture – M. Morris Mano, Third Edition, Pearson/PHI.
2. Operating System Principles - Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Sixth Edition, John Wiley.

REFERENCE BOOKS:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, V th Edition, McGraw Hill.
2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
3. Structured Computer Organization – Andrew S. Tanenbaum, 4 th Edition, PHI/Pearson.
4. William Stallings, Operating Systems - Internals and Design Principles, Fifth Edition-2005, Pearson Education/PHI.
5. Crowley, Operating System A Design Approach, TMH.
6. Andrew S. Tanenbaum, Modern Operating Systems, 2nd edition, Pearson/PHI
7. Andrea Arpaci-Dusseau and Remzi Arpaci-Dusseau, Operating Systems: Three Easy Pieces.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC512PE	**Data Communications and Computer Networks**	3	0	0	3

Course Description: This course thoroughly examines essential networking principles and technologies. It also covers the functionalities, design issues and protocols related to the ISO/OSI and TCP/IP models.

Course Outcomes: After completion of this course, the students will be able to

C512.1	Understand the basics of communication and computer networks.
C512.2	Analyze various link and access control mechanisms in the data link layer.
C512.3	Design subnets and calculate the IP addresses to fulfill the network requirements of an organization.
C512.4	Apply various routing algorithms for best effort delivery service.
C512.5	Choose appropriate transport layer protocol for reliable/unreliable communication.
C512.6	Analyze the features and operations of various application layer protocols.

Unit – I Data Communications Concepts and Physical layer

Data Communications Concepts: Components, Data Representation, Data flow, Networks, The Internet, Protocols and Standards, OSI model, Layers in OSI model, TCP/IP protocol suite, addressing.

Physical layer: Transmission modes, Transmission Media, Switching - Datagram Networks, Virtual Circuit Networks.

Unit – II Data link layer

Data link layer: Introduction, Error Detection and Correction - Hamming code, CRC, Framing, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocol. Medium Access sublayer: Random access, Controlled access, Channelization. WiFi (IEEE 802.11), WiFi-6, SDWAN.

Unit – III Network layer

Network layer: Logical Addressing, Internet Protocol: Internetworking, IPv4, IPv6, Translation from IPv4 to IPv6, Address mapping.

Network layer Delivery, Forwarding, Routing Protocols - DVR, OSPF, BGP.

Unit – IV Transport Layer

Transport Layer: Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services.

Unit – V Application Layer

Application Layer: Domain Name Space (DNS), Distribution of Name Space, DNS on the Internet, Electronic Mail, WWW, HTTP(S).

TEXT BOOKS:

1. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition TMH.

REFERENCE BOOKS:

1. Computer Networks, Andrew S Tanenbaum, 6th Edition. Pearson Education.
2. Computer Networking: A Top-Down Approach Featuring the Internet. James F. Kurose & Keith W. Ross, 3 rd Edition, Pearson Education.
3. Data communications and Computer Networks, P.C Gupta, PHI.
4. An Engineering Approach to Computer Networks, S. Keshav, 2nd Edition, Pearson Education.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC513PE	**Electronic Measurements and Instrumentation**	3	0	0	3

Course Description: This course provides an introduction to Measuring Systems, working of different electronic instruments, signal generators, signal analyzers, recorders, concepts of various measuring bridges and their balancing conditions, use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Course Outcomes: After completion of this course, the students will be able to

C513.1	Illustrate the characteristics and operating principles of measuring systems.
C513.2	Summarize the construction and operation of various Wave Analyzers and Signal generators.
C513.3	Analyse the working principles and applications of different types of Oscilloscopes
C513.4	Utilise transducers to compute various electrical parameters.
C513.5	Measure R, L and C values using different bridge circuits.
C513.6	Make use of measuring devices to measure different physical parameters

Unit – I Block Schematics of Measuring Systems

Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

Unit – II Signal Analyzers

AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

Unit – III Oscilloscopes, Special Purpose Oscilloscopes

Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

Unit – IV Transducers

Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes, accelerometers.

Unit – V Bridges, Measurement of Physical Parameters

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

TEXT BOOKS:

1. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W. D. Cooper: PHI 5th Edition 2003.
2. Electronic Instrumentation: H. S. Kalsi – TMH, 2nd Edition 2004.

REFERENCE BOOKS:

1. Electrical and Electronic Measurement and Measuring Instruments – A K Sawhney, Dhanpat Rai & Sons, 2013.
2. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
3. Industrial Instrumentation: T.R. Padmanabham Springer 2009.
4. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC514PE	**Artificial Intelligence**	3	0	0	3

Course Description: This course explains the theory and development of computer systems capable of performing tasks that historically required human intelligence, such as recognizing speech, making decisions, and identifying patterns.

Course Outcomes: After completion of this course, the students will be able to

C514.1	Identify suitable search agents for problem solving.
C514.2	Apply adversarial search techniques on various problem domains.
C514.3	Make use of mathematical logic for knowledge representation and inference mechanism.
C514.4	Construct real knowledge bases in various domains.
C514.5	Define the problem of planning in deterministic, fully observable and static environments.
C514.6	Apply Probabilistic Reasoning under uncertainty.

Unit – I Introduction to Artificial Intelligence

Introduction to AI: Intelligent Agents, problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepening Depth-first search, Bidirectional search, informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Heuristic Functions, Beyond Classical Search: Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces

Unit – II Problem Solving by Search-II and Propositional Logic

Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real -Time Decisions. Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

Propositional Logic: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining, Effective Propositional Model Checking, Agents Based on Propositional Logic.

Unit – III Logic and Knowledge Representation

First-Order Logic: Representation, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

Unit – IV Knowledge Representation

Knowledge Representation: Ontological Engineering, Categories and Objects, Events. Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.

Classical Planning: Definition of Classical Planning, Algorithms for Planning with State-Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches.

Unit – V Uncertain knowledge and Learning Uncertainty

Uncertain knowledge and Learning Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability, Other Approaches to Uncertain Reasoning; Dempster-Shafer theory

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

REFERENCE BOOKS:

1. Artificial Intelligence, 3rd Edn, E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henry Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EN505HS	**Advanced English Communication Skills Laboratory**	0	0	2	1

Course Description: This course will make students to understand the elements of professional update & upgrade through industry exposure in a mini-live project. Understand confidence building strategies and thereby to make effective presentations through PPTs.

Course Outcomes: After completion of this course, the students will be able to

C505.1	Apply personality development principles to enhance their career readiness
C505.2	Understand professional etiquette and confidently partake in professional interactions.
C505.3	Execute English language competencies in various forms of academic and professional reading and writing
C505.4	Differentiate the communication skills of group discussion, presentation, interviews and collaborative projects

Exercise-I

Main Topics: Thinking Skills, Personality Development, self-confidence and assertiveness,
Flipped Sessions: Personal Sensitivity & Professional Sensibility (Reading & Discussion)
Writing Input: Writing to Express - Drafting & Delivering a Speech (Free Writing Exercise)

Exercise-II

Main Topics: Group Discussion: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
Flipped Sessions: Importance of Professional Updating & Upgrading (Reading & Discussions)
Writing Input: Writing with Precision - Writing Abstracts

Exercise-III

Main Topics: Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews. Resume' writing – structure and presentation, planning, defining the career objective, projecting one's strengths and skills.
Flipped Sessions: Mock Interviews (Video Sessions & Practice)
Writing Input: Writing to Reflect - Resume Writing

Exercise-IV

Main Topic: Corporate Culture – Grooming and etiquette, communication media, academic ethics and integrity
Flipped Sessions: Corporate Culture, Etiquette & Grooming (Video Sessions & Practice through Role-play)
Writing Input: Writing to Define - Writing an effective SOP.

Exercise-V

Main Topic: Mini Project – General/Technical. Research, developing a questionnaire, data collection, analysis, written report and project seminar. Elements & Structure of effective presentation. Presentation tools – Body language, Eye-contact, Props & PPT.

Flipped Sessions: Effective Presentations (Video & Writing Sessions, Practice through Emulation)

Writing Input: Writing to Record - Writing minutes of meeting.

Reference Books:

1. Madhavi Apte, "**A Course in English communication**", Prentice-Hall of India, 2007
2. Dr. Shalini Verma, **"Body Language- Your Success Mantra**", S Chand, 2006
3. Ramesh, Gopalswamy, and Mahadevan Ramesh, "**The ACE of Soft Skills",** New Delhi: Pearson, 2010
4. Van Emden, Joan, and Lucinda Becker, "**Presentation Skills for Students**", New York: Palgrave Macmillan, 2004

Web sources:

1. https://www.goskills.com/Soft-Skills
2. https://www.trainerbubble.com
3. https://www.skillsconverged.com

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC506PC	**Advanced Communication Laboratory**	0	0	2	1

Course Description: To develop students advanced skills in communication system analysis and design through practical experiments involving network analyzers, antenna simulations, signal generation, and modulation techniques using software and hardware tools.

Course Outcomes: After completion of this course, the students will be able to

C506.1 Analyze the radiation patterns of different antennas.
C506.2 Generate different types of signals.
C506.3 Analyze different digital modulation and demodulation schemes.
C506.4 Examine various coding techniques

List of Experiments:

1. Study the features of Network and spectrum analyser
2. Simulate the Radiation pattern for different antennas using HFSS/ ADS/MATLAB and compare the measurement using Network analyzer.
   i. Dipole Antenna
   ii. Horn antenna
   iii. Micro-strip Antenna etc.
3. Simulate the Radiation resistance for different antennas using HFSS/ ADS/ MATLAB and compare the measurement using Network analyser.
   i. Dipole Antenna
   ii. Horn antenna
   iii. Micro-strip Antenna etc.
4. Plotting eye diagram for baseband signal using MATLAB and verifying using Network analyser.
5. Plotting Constellation Diagram of QAM using MATLAB and verify using kit.
6. OFDM generation and detection using Simulink and verify using kit.
7. Generation of different types of signals using Vector Signal Generator
8. Modulation analysis on digital modulated single carrier signals using MATLAB.
9. Binary cyclic encoder and decoder (CRC)
10. Convolutional encoder and decoder
11. Linear Block encoder and decoder (Hamming code)
12. Source encoder and decoder (Huffman code)

Major Equipment Required:

1. Network Analyser
2. MATLAB.

B.Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
EC507PC	**Microcontrollers Laboratory**	0	0	2	1

Course Description: In this course operations and programming of microprocessors and microcontrollers will be studied. Also, interfacing of I/O devices to 8051 and Cortex M3 processor using development board and GNU toolchain.

Course Outcomes: After completion of this course, the students will be able to

C507.1 Develop 8086 assembly language programs using macro assembler.

C507.2 Build 8051 assembly language programs for simple arithmetic and logical operations and verify using Keil IDE.

C507.3 Write assembly language programs to configure various peripheral devices using 8051 kits.

C507.4 Interface various input/output devices to ARM Cortex M3 processor using development board and GNU toolchain.

Cycle 1: Using 8086 Processor Kits and/or Assembler

- Assembly Language Programs to 8086 to Perform
  1. Arithmetic, Logical, String Operations on 16 Bit and 32-Bit Data.
  2. Bit level Logical Operations, Rotate, Shift, Swap and Branch Operations.

Cycle 2: Using 8051 Microcontroller Kit

- Introduction to IDE
  1. Assembly Language Programs to Perform Arithmetic (Both Signed and Unsigned) 16 Bit Data Operations, Logical Operations (Byte and Bit Level Operations), Rotate, Shift, Swap and Branch Instructions
  2. Time delay Generation Using Timers of 8051.
  3. Serial Communication from / to 8051 to / from I/O devices.
  4. Program Using Interrupts to Generate Square Wave 10 KHZ Frequency on P2.1 Using Timer 0 8051 in 8 bit Auto reload Mode and Connect a 1 HZ Pulse to INT1 pin and Display on Port 0. Assume Crystal Frequency as 11.0592 MHZ

Cycle 3: Interfacing I/O Devices to 8051

1. 7 Segment Display to 8051.
2. Matrix Keypad to 8051.
3. Sequence Generator Using Serial Interface in 8051.
4. 8-bit ADC Interface to 8051.
5. Triangular Wave Generator through DAC interfaces to 8051.

Cycle 4: Experiments to be carried out on Cortex-M3 development boards and using GNU toolchain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.

B. Tech. III Year I Semester

Course Code	Course Title	L	T	P	Credits
MC508	**Intellectual Property Rights**	3	0	0	0

Course Description: To provide the students with the concepts of IPR.

Course Outcomes: After completion of this course, the students will be able to

- **C508.1** Understand the fundamental aspects of Intellectual property Rights who are going to play a major role in development and management of innovative projects in industries.
- **C508.2** Examine Trademarks, Acquisition of Trade Mark Rights and its registration processes.
- **C508.3** Evaluate various aspects relating to copyrights and its procedure for registration processes.
- **C508.4** Evaluate with the Trade Secret Law, protection for submission, Unfair Competition.
- **C508.5** Evaluate on the International Developments in Intellectual Property Rights.
- **C508.6** Interpret about current trends in IPR and the steps taken by the Government of India in fostering IPR.

Unit – I Introduction to Intellectual property

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Unit – II Trade Marks

Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

Unit – III Law of copy rights

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Unit – IV Trade Secrets

Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation. Unfair competition: Misappropriation right of publicity, false advertising.

Unit – V New development of intellectual property

New developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS:

1. Intellectual property Right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual Property Right – Unleashing the knowledge economy, Prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC601PC	**IoT Architectures and Protocols**	3	0	0	3

Course Description: This course provides the basic knowledge on IoT, Architectures from M2M to IoT, different protocols of IoT and implementation.

Course Outcomes: After completion of this course, the students will be able to

C601.1	Articulate the concept of IoT, its architectures and functional stacks
C601.2	Explore different sensing and actuation elements in IoT.
C601.3	Interpret the transition from Machine-to-Machine (M2M) to IoT
C601.4	Understand the data link and network layer protocols for diverse IoT networks.
C601.5	Understand the Transport, Session and service layer protocols for diverse IoT networks.
C601.6	Acquire knowledge on the role of Security in IoT protocols.

Unit – I IoT Introduction

Introduction and definition of IoT, Evolution of IoT, IoT growth, Application areas of IoT, Characteristics of IoT, IoT stack, enabling technologies, IoT levels, IoT sensing and actuation, Sensing types, Actuator types.

Unit – II IoT, M2M and IoT Architecture

IOT and M2M: M2M to IoT – A Basic Perspective– Introduction, Differences and similarities between M2M and IoT, SDN and NFV for IoT, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, international driven global value chain and global information monopolies.

IoT Architecture: IoT Architecture components, Comparing IoT Architectures, A simplified IoT Architecture, core IoT functional stack, IoT data management and compute stack

Unit – III IoT Data link layer and Network layer protocols

PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP.

Unit – IV Transport and Session layer protocols

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)- (TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT.

Unit – V Service layer protocols and Security

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 6LoWPAN, RPL, Application Layer.

TEXT BOOKS:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy -Introduction to IOT, Cambridge University Press.
2. David Hanes, Gonzalo salgueiro, Patrick Grossetete, Rob barton, Jerome henry-IoT Fundamentals Networking Technologies, Protocols and Use cases for IoT", Cisco Press.

REFERENCE BOOKS:

1. Cunopfister-Getting started with the internet of things, O Reilly Media, 2011
2. Francis daCosta, -Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications.
3. Arshdeep Bahga, Vijay Madisetti -Internet of Things A Hands-on approach, Universities Press
4. Shriram K Vasudevan, RMD Sundaram, Abhishek S Nagarajan-Internet of things, John Wiley and Sons.
5. Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC602PC	**Digital Signal Processing**	3	0	0	3
Prerequisites	Signals & Systems				

Course Description: This course is to comprehend digital signal analysis and processing, covering key concepts such as signal representation, sampling, analog-to-digital conversion, efficient computation of the Discrete Fourier Transform (DFT) through the Fast Fourier Transform (FFT) algorithm, studying the design and structure of digital filters (IIR and FIR), emphasizing analysis and synthesis for specific specifications, as well as familiarization with multi-rate signal processing techniques and addressing finite word length effects for system robustness and accuracy.

Course Outcomes: After completion of this course, the students will be able to

C602.1 Determine the behavior of LTI systems by solving difference equation
C602.2 Analyze digital signals in frequency domain using DFS and DFT
C602.3 Compute DFT using FFT algorithms
C602.4 Design and implement IIR and FIR digital filters
C602.5 Understand the concepts of multi rate digital signal processing
C602.6 Analyze the effects of finite word length representation

Unit – I

Introduction to Digital Signal Processing: Block diagram, Advantages and applications, Discrete Time Signals & Sequences, Normalized Frequency, Linear Shift Invariant Systems, Linear Constant Coefficient Difference Equations, System Function, Solution of Difference Equations of Digital Filters using Z-transforms.

Unit – II

Discrete Fourier Series and Transform: DFS Representation of Periodic Sequences, Properties of Discrete Fourier Series, Discrete Fourier Transforms: Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method.

Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT.

Unit – III IIR Digital Filters

IIR Digital Filters: Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations. Realization of Digital Filters – Direct, Canonic, Cascade and Parallel Forms.

Unit – IV FIR Digital Filters

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters. Realization of FIR Digital Filters – Direct, Cascade, Parallel and Linear phase forms

Unit – V

Multirate Digital Signal Processing: Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion.

Finite Word Length Effects: Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round Off Noise, Methods to Prevent Overflow, Trade Off Between Round Off and Overflow Noise, Measurement of Coefficient Quantization Effects through Pole-Zero Movement, Dead Band Effects.

TEXT BOOKS:

1. A. V. Oppenheim and R.W. Schaffer - Discrete Time Signal Processing, PHI, 2009
2. John G. Proakis, Dimitris G. Manolakis - Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education / PHI, 2007.

REFERENCE BOOKS:

1. Li Tan - Digital Signal Processing – Fundamentals and Applications, Elsevier, 2008
2. Robert J. Schilling, Sandra L. Harris - Fundamentals of Digital Signal Processing using MATLAB, Thomson, 2007
3. S. Salivahanan, A. Vallavaraj and C. Gnanapriya - Digital Signal Processing, TMH, 2009
4. Emmanuel C. Ifeachor and Barrie W. Jervis - Digital Signal Processing - A Practical approach, 2nd Edition, Pearson Education, 2009

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC603PC	**CMOS VLSI Design**	3	0	0	3
Prerequisites	Analog Circuits, Digital ICs				

Course Description: This course give exposure to different steps involved in the fabrication of ICs, electrical properties, design rules and layout. Also, concepts to design building blocks of subsystems, programmable logic devices and testing of CMOS circuits

Course Outcomes: After completion of this course, the students will be able to

C603.1 Summarize the steps in VLSI fabrication process of different MOS Technologies
C603.2 Examine the electrical properties and models of CMOS circuits.
C603.3 Construct layouts using stick diagrams in accordance with the design rules.
C603.4 Implement complex digital logic circuits using switch logic.
C603.5 Build different VLSI subsystems using CMOS logic.
C603.6 Apply the concept of testing in fault tolerant system design.

Unit – I Introduction

Introduction to IC Technology: MOS, PMOS, NMOS, CMOS & BiCMOS
Basic Electrical Properties: Basic Electrical Properties of MOS and BiCMOS Circuits: I_{DS}-V_{DS} relationships, MOS transistor threshold Voltage, g_m, g_{ds}, Figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit – II VLSI Circuit Design Processes

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

Unit – III Gate Level Design

Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out.

Unit – IV Subsystems Design

Data Path Subsystems: 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

Manufacturing Test Principles: Fault Models, Observability, Controllability, Repeatability, Survivability, Fault Coverage, ATPG;
Design for Testability: Ad Hoc testing, Scan design, Built in Self-Test (BIST), IDDQ Testing, Design for Manufacturability, Boundary Scan.

TEXT BOOKS:

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell - Essentials of VLSI circuits and systems, PHI, 2005.
2. Weste, Neil H. E. & Harris, David Money, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson, 2010, 4ed.

REFERENCE BOOKS:

1. Ming-BO Lin - Introduction to VLSI Systems: A Logic, Circuit and System Perspective, CRC Press, 2011.
2. John. P. Uyemura - CMOS logic circuit Design, Springer, 2007.
3. Wayne Wolf - Modern VLSI Design, 3rd Edition, Pearson Education, 1997.
4. K. Lal Kishore, V. S. V. Prabhakar -VLSI Design, I.K International, 2009.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC611PE	**Digital Design through Verilog HDL**	3	0	0	3
Prerequisites	Digital Logic Design				

Course Description: In this course Verilog HDL Programming, structural level of abstraction for modeling digital hardware systems functional Bifurcation, various construct models, and design using behavioral level will be studied.

Course Outcomes: After completion of this course, the students will be able to

C611.1 Understand concepts of verilog HDL for designing of digital circuits
C611.2 Design low level modules as a primitive gate for higher level abstraction like RTL
C611.3 Design digital logic circuits with the use of flow charts, algorithms and truth tables
C611.4 Model the data flow level circuits and write switch level circuits
C611.5 Analyse the sequential and combinational circuits
C611.6 Enhance the concepts of sequential and concurrent statements

Unit – I Introduction

Introduction To Verilog: Verilog as HDL, Levels of design description, concurrency, simulation and synthesis, functional verification, system tasks, programming language interface (PLI), module.

Language Constructs and Conventions: Introduction, keywords, identifiers, whitespace characters, comments, numbers, strings, logic values, data types, scalars and vectors, parameters, memory, operators, system tasks.

Unit – II 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, delays, strengths and contention resolution, net types, design of basic circuits

Unit – III Behavioral Modelling

Introduction, operations and assignments, functional Bifurcation, initial construct, always construct, examples, assignments with delays, wait construct, multiple always blocks, designs at behavioral level, blocking and non-blocking assignments, the case statement, simulation flow, if and if else constructs, assign-Deassign construct, repeat construct, FOR loop, the disable construct, While loop, forever loop, parallel blocks, force-release construct, event.

Unit – IV Dataflow Level and Switch Level Modelling

Introduction, continuous assignment structures, delays and continuous assignments, assignment to vectors, basic transistor switches, CMOS switch, Bidirectional gates and time delays with switch primitives, instantiations with strengths and delays, strength contention with triregnets.

Unit – V Verilog Models

Synthesis of Combinational and Sequential Logic Using Verilog: Synthesis of combinational logic: Net list of structured primitives, a set of continuous assignment statements and level sensitive cyclic behavior with examples, Synthesis of priority structures. Synthesis of sequential logic with latches: Accidental synthesis of latches and Intentional synthesis of latches, Synthesis of sequential logic with flip-flops, Synthesis of explicit state machines.

Verilog Models: Static RAM Memory, Interfacing Memory to a Microprocessor Bus, UART Design and Design of Microcontroller CPU

TEXT BOOKS:

1. Fundamentals of Logic Design with Verilog – Stephen. Brown and Zvonko Vranesic, TMH,2005.
2. A Verilog Premier – J. Bhasker, BSP,2003.

REFERENCE BOOKS:

1. Advanced Digital Design with Verilog HDL – Michael D. Ciletti, PHI, 2005.
2. Design through Verilog HDL – T.R. Padmanabhan and B. Bala Tripura Sundari, WSE, IEEE Press,2004.
3. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC612PE	**Cellular and Mobile Communications**	3	0	0	3

Course Description: In this course, students will study various concepts related to Cellular Communications like generations of cellular system, techniques to improve the spectral efficiency, types of interferences and minimization techniques, effective signal coverage on various contours, managing the frequency and assigning the channels effectively to minimize interference, Importance of Handoffs and its types, evaluation of dropped call rate, need of Intelligent cell and basics of 5G

Course Outcomes: After completion of this course, the students will be able to

C612.1	Understand various techniques that improves the efficiency of cellular communication system
C612.2	Design an effective cellular system considering the effects of co-channel and non-co-channel interferences
C612.3	Explore the factors that affect signal coverage in various contours
C612.4	Illustrate the concepts of effective frequency management and channel assignment
C612.5	Assimilate the concept of handoff mechanism and dropped call
C612.6	Understand the Concepts of Intelligent Cell

Unit – I Introduction to Cellular System

Introduction to Cellular Mobile Radio Systems: Limitations of Conventional Mobile Telephone Systems. Basic Cellular Mobile System, Comparison of various Wireless Generations (1G to 6G) Systems. Uniqueness of Mobile Radio Environment-Fading-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time.

Fundamentals of Cellular Radio System Design: Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I from a Normal Case in an Omni Directional Antenna System, System Capacity Improving Coverage and Capacity in Cellular Systems- Cell Splitting, Sectoring.

Unit – II Interference and Its Types

Co-Channel Interference: Measurement of Real Time Co-Channel Interference, Design of Antenna System, Antenna Parameters and their effects, diversity techniques-space diversity, polarization diversity, frequency diversity, time diversity.

Non-Co-Channel Interference: Adjacent Channel Interference, Near end far end interference, cross talk, effects on coverage and interference by power decrease, antenna height decrease, effects of cell Site components.

Unit – III Cell Coverage, Frequency Management and Channel Assignment

Cell Coverage for Signal and Traffic: Signal Reflections in flat and Hilly Terrain, effects of Human Made Structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation, path loss from a point-to-point prediction model in different conditions, merits of lee model.

Frequency Management and Channel Assignment: Numbering and Grouping, Setup Access and Paging Channels, Channel Assignments to Cell Sites and Mobile Units.

Unit – IV Handoffs and Dropped Calls

Handoffs and Dropped Calls: Handoff Initiation, types of Handoff, Delaying Handoff, advantages of Handoff, Power Difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoff, Intersystem handoff, Introduction to Dropped Call Rates and their Evaluation.

Unit – V Intelligent Cell Concept and Basics of 5G

Microcell Zone Concept, Intelligent cell concept, Applications of intelligent microcell Systems, CDMA Cellular Radio Network and MIMO.

TEXT BOOKS:

1. Mobile Cellular Telecommunications-W.C.Y. Lee, Mc Graw Hill, 2nd Edn., 1989.
2. Wireless Communications-Theodore. S. Rapport, Pearson Education, 2nd Edn., 2002.

REFERENCE BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols-C. Siva ram Murthy and B.S. Manoj, 2004, PHI.
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.
4. Wireless Communications-Andrea Goldsmith, Cambridge University Press, 2005.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC613PE	**Machine Learning**	3	0	0	3

Course Description: The course introduces the basic concepts and techniques of Machine Learning with thorough understanding of the Supervised and Unsupervised learning techniques and its differences. The course elucidates the principles of evolutionary computing algorithms, ensembling techniques for increased prediction accuracy, and enlightens the principles of Reinforcement learning.

Course Outcomes: After completion of this course, the students will be able to

C613.1	Understand the basic concepts of Machine Learning Techniques.
C613.2	Evaluate various supervised, unsupervised learning algorithms with ensemble techniques.
C613.3	Apply the neural network concepts with Perceptron and Back Propagation.
C613.4	Make use of Dimensionality Reduction concepts for model building.
C613.5	Apply evolutionary computing algorithms approach for search and optimization.
C613.6	Analyze the concepts of Reinforcement Learning for building autonomous systems.

Unit – I Introduction to Learning

Learning- Types of Machine Learning, Design a Learning System, Perspectives and Issues in Machine Learning, Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination Algorithm, Linear Discriminants, Perceptron, Linear Separability.

Unit – II Supervised and Unsupervised Learning

Linear Regression, Support Vector Machines, Learning with Trees, Decision Trees, Constructing Decision Trees Classification and Regression Trees, Ensemble Learning, Boosting, Bagging, Different ways to Combine Classifiers, Basic Statistics, Gaussian Mixture Models, Nearest Neighbor Methods, Unsupervised Learning, K means Algorithms.

Unit – III Multi-layer Perceptron– Going Forwards – Going Backwards

The Brain and the Neuron, Multilayer Perceptron– Going Forwards, Going Backwards: Back Propagation Error, Multilayer Perceptron in Practice, Examples of using the MLP, Overview, Deriving Back Propagation, Radial Basis Functions and Splines, Concepts, RBF Network, Interpolations and Basis Functions

Unit – IV Dimensionality Reduction and Evolutionary Learning

Curse of Dimensionality, Dimensionality Reduction, Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear

Embedding, Isomap, Least Squares Optimization Evolutionary Learning, Genetic algorithms, Genetic Offspring: Genetic Operators, Using Genetic Algorithms.

Unit – V Reinforcement Learning

Reinforcement Learning, Overview, Getting Lost Example Markov Chain Monte Carlo Methods, Sampling, Proposal Distribution, Markov Chain Monte Carlo, Graphical Models, Bayesian Networks, Markov Random Fields, Hidden Markov Models, Tracking Methods.

TEXT BOOKS:

1. Stephen Marsland — Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series.

REFERENCE BOOKS:

1. Tom M Mitchell — Machine Learning, First Edition, McGraw Hill Education, 2017.
2. Marco Gori, Alessandro Betti, Stefano Melacci, Machine Learning A Constraint-Based Approach, 2023.
3. Peter Flach — Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
4. Jason Bell — Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.
5. Ethem Alpaydin — Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC614PE	**Electronic Sensors**	3	0	0	3

Course Description: This course provides an introduction to characterization of sensors, knowledge on working of Electromechanical, Thermal, Magnetic and radiation sensors, basic Understanding of Electro analytic and smart sensors and different applications of sensors.

Course Outcomes: After completion of this course, the students will be able to

C614.1	Illustrate the characteristics and operating principles of Sensors
C614.2	Summarize the construction and operation of various Electro Mechanical Sensors.
C614.3	Analyze the working principles and applications of different Thermal Sensors
C614.4	Explore the working principles of different Magnetic Sensors
C614.5	Utilize Radiation and Electro Analytical Sensors to compute radiation and various electrical parameters.
C614.6	Make use of smart sensors to measure different physical parameters and apply them in various Fields

Unit – I Sensors / Transducers

Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization Electromechanical 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

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 Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors

Unit – III Magnetic sensors

Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magneto resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros.

Unit – IV Radiation Sensors

Introduction, Basic Characteristics, Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors, Fibre Optic Sensors Electro analytical Sensors: 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 – V Smart Sensors

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

TEXT BOOKS:

1. "Sensors and Transducers - D. Patranabis" –PHI Learning Private Limited., 2003.
2. Introduction to sensors- John veteline, Aravind Raghu, CRC press, 2011

REFERENCE BOOKS:

1. Sensors and Actuators, D. Patranabis, 2nd Ed., PHI, 2013.
2. Make sensors: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.
3. Sensor's handbook- Sabriesoloman, 2nd Ed. TMH, 2009.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC604PC	**Digital Signal Processing Laboratory**	0	0	2	1

Course Description: The objective of this course is to validate diverse digital signal processing (DSP) algorithms through thorough simulation and subsequently implement them in hardware for real-world applications.

Course Outcomes: After completion of this course, the students will be able to

C604.1 Generate sinusoidal and noise waveforms using different approaches.
C604.2 Analyze Impulse and frequency response of various digital filters.
C604.3 Verify different algorithms of DSP through simulation.
C604.4 Implement various DSP algorithms in hardware.

The Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/ Equivalent) and Hardware (Using TI / Analog Devices / Motorola / Equivalent DSP processors).

List of Experiments

1. Generation of Sinusoidal Waveform / Signal based on Recursive Difference Equations
2. Histogram of White Gaussian Noise and Uniformly Distributed Noise.
3. To find DFT / IDFT of given DT Signal
4. To find Frequency Response of a given System given in Transfer Function/ Differential equation form.
5. Obtain Fourier series coefficients by formula and using FFT and compare for half sine wave.
6. Implementation of FFT of given Sequence
7. Determination of Power Spectrum of a given Signal(s).
8. Implementation of LP FIR Filter for a given Sequence/Signal.
9. Implementation of HP IIR Filter for a given Sequence/Signal
10. To find the roundoff noise in IIR digital filters
11. Generation of DTMF Signals
12. Implementation of Decimation Process
13. Implementation of Interpolation Process
14. Implementation of I/D Sampling Rate Converters
15. Impulse Response of First order and Second Order Systems.

Note: - Minimum of 12 experiments has to be conducted.

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC605PC	**CMOS VLSI Design Laboratory**	0	0	2	1

Course Description: This course enhances the knowledge in HDL programming, layout, physical verification, timing and power analysis.

Course Outcomes: After completion of this course, the students will be able to

C605.1 Verify the functionality of digital circuits using Xilinx ISIM simulator
C605.2 Implement digital circuits on various FPGA boards using Xilinx tools
C605.3 Design layout for digital circuits and perform physical verification
C605.4 Analyze static timing, IR drop and crosstalk in digital circuit layouts

List of Experiments

Part - I

All the following experiments have to be implemented using HDL

1. Realize all the logic gates
2. Design of 8-to-3 encoder (without and with priority) and 2-to-4 decoder
3. Design of 8-to-1 multiplexer and 1-to-8 demultiplexer
4. Design of 4 bit binary to gray code converter
5. Design of 4-bit comparator
6. Design of Full adder using 3 modeling styles
7. Design of flip flops: SR, D, JK, T
8. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter.
9. Finite State Machine Design

Part - II

Layout, physical verification, placement & route for complex design, static timing analysis, IR drop analysis and crosstalk analysis for the following:

1. Basic logic gates
2. CMOS inverter
3. CMOS NOR/ NAND gates
4. CMOS XOR and MUX gates
5. Static / Dynamic logic circuit (register cell)
6. Latch
7. Pass transistor
8. Layout of any combinational circuit (complex CMOS logic gate).

Note: Any SIX of the following experiments from each part are to be conducted (Total 12)

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC606PC	**IoT Architectures and Protocols Laboratory**	0	0	2	1

Course Description: This course explores the knowledge on operation of different sensors, interface between the sensors and processor for transmission of data. Also, about the utilization of various protocols like I2c, UART communication etc.,

Course Outcomes: After completion of this course, the students will be able to

C606.1 Analyze integration of sensors and actuators with IoT boards.

C606.2 Establish interfaces between the sensors and processor to facilitate data transmission.

C606.3 Perform automation and processing of images using Arduino, NodeMCU, or Raspberry Pi

C606.4 Understand the application of SPI, I2C and UART communication Protocols.

List of Experiments:

1. Demonstrate blinking of an LED at every 5 seconds and to control the brightness of an LED.
2. Read Humidity and Room Temperature using DHT sensor and display the readings.
3. Send the recorded values of Temperature/Humidity to the Internet via GSM module using Arduino/NodeMCU/Raspberry Pi.
4. Demonstrate Interfacing NodeMCU/Raspberry Pi with the Cloud using REST API and MQTT protocol.
5. Demonstrate Switching lights on/off remotely using Arduino/NodeMCU/Raspberry Pi.
6. Voice-based Home Automation for switching lights on/off using Google Assistant, IFTTT and MQTT.
7. Interfacing DHT11 sensor with Raspberry pi/equivalent and upload temperature and humidity values to the cloud.
8. Design an obstacle detection unit using ultrasonic sensor.
9. Capture images from web camera using Raspberry Pi/equivalent and apply filters in increase image quality.
10. Access a remote computer from Raspberry Pi and display the remote screen.
11. Design an automatic water sprinkler based on soil moisture using Arduino/NodeMCU/Raspberry Pi.
12. Design an RFID based attendance system using Arduino/NodeMCU/Raspberry Pi.
13. Write an arduino program to demonstrate interrupts
14. Write an arduino program to demonstrate UART communication protocol
15. Write an arduino program to demonstrate I2C communication protocol
16. Write an arduino program to demonstrate SPI communication protocol

B. Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
MC608	**Constitution of India**	3	0	0	0

Course Description: The students will be able to understand the history of Indian Constitution, and to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. It is to address the role of socialism in India after the commencement of the Bolshevik Revolution and develops the spirit of nationalism.

Course Outcomes: After completion of this course, the students will be able to

- **C608.1** Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- **C608.2** Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- **C608.3** Discuss the circumstances surrounding the foundation of the Congress Socialist Party (CSP) under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- **C608.4** Discuss the passage of the Hindu Code Bill of 1956.
- **C608.5** Understand the Parliamentary form of Government in India.
- **C608.6** Discuss the role and importance of Local Administration.

Unit – I History and Philosophy of the Indian Constitution

History of Drafting Committee, Preamble and Salient Features of the Indian Constitution.

Unit – II 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.

Unit – III Organs of Governance

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Unit – IV Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Unit – V Election Commission

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.

SUGGESTED READING:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Mahendra Pal Singh, V.N.Shukla's Constitution of India, Eastern Book Company, 2017.
3. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
4. J.N. Pandey, Constitutional Law of India, Central Law Agency, 2018.

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC701PC	**Microwave and Optical Communications**	3	1	0	4

Course Description: This course provides a comprehensive study of microwave tubes, microwave solid-state devices, waveguide components, scattering matrix concepts, and optical fiber transmission media. The subject is designed to give students a deep understanding of the principles and applications of microwave and optical technologies, focusing on their structures, operation, and performance characteristics.

Course Outcomes: After completion of this course, the students will be able to

- **C701.1** Analyze the characteristics of O-type and M-type tubes
- **C701.2** Illustrate the operation of various solid-state devices
- **C701.3** Explain various waveguide components and their applications.
- **C701.4** Estimate S-parameters of multiport junction devices
- **C701.5** Measure various parameters using microwave bench
- **C701.6** Understand an optical fiber communication system

Unit – I

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications, O-type Tubes: 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes, and O/P Characteristics.

Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

Unit – II

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling 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 Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

Unit – III

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators;

Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator and Circulator.

Unit – IV

Scattering matrix: Scattering Matrix Definition, Properties and Derive S-matrix for Directional Couplers and its classifications, E plane Tee, H plane Tee, Magic Tee and Circulator.

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation- Power Ratio and RF substitution methods, Frequency, Standing Wave Measurements, measurement of Low and High VSWR-(S<10 and S>10), Cavity Q-Transmission method, Impedance Measurement-Slotted line and reflectometer.

Unit – V

Optical Fiber Transmission Media: Optical Fiber types, Light Propagation, Optical fiber classifications, Losses in Optical Fiber cables, Optical Sources, Optical Detectors, WDM Concepts, Optical Fiber System link budget.

TEXT BOOKS

1. "Microwave Devices and Circuits", Samuel Y. Liao, 3rd Edition, Pearson, 2003.
2. "Electronic Communications Systems", Wayne Tomasi, 5th Edition, Pearson

REFERENCE BOOKS

1. "Optical Fiber Communication", Gerd Keiser, 4th Edition, TMH, 2008.
2. "Microwave Engineering", David M. Pozar, 3rd edition, John Wiley & Sons (Asia) Pvt Ltd., 2011 Reprint.
3. "Microwave Engineering", G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. "Electronic Communication System", George Kennedy, 6th Edition, McGraw Hill

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC711PE	Embedded System Design	3	0	0	3

Course Description: This course provides an overview of design principles of embedded system, role of firmware, necessity of operating systems in correlation with hardware systems and the methods of interfacing and synchronization for tasking.

Course Outcomes: After completion of this course, the students will be able to

- **C711.1** Distinguish the embedded systems from general purpose processing systems.
- **C711.2** Recommend suitable hardware for different applications of embedded systems.
- **C711.3** Select different types and amount of memory based on embedded system specifications.
- **C711.4** Explain the Embedded firmware design approaches, development languages and device drivers
- **C711.5** Analyze the issues and techniques of Task synchronization and communication in embedded firmware.
- **C711.6** Differentiate between general purpose operating systems and RTOS.

Unit – I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit – II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces

Unit – III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit – IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Unit – V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, **Task Synchronization:** Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

TEXT BOOKS

1. "Introduction to Embedded Systems", Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS

1. "Embedded Systems", Raj Kamal, TMH.
2. "Embedded System Design", Frank Vahid, Tony Givargis, John Wiley.
3. "Embedded Systems", Lyla, Pearson,2013
4. "An Embedded Software Primer", David E.Simon, Pearson Education.

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC712PE	CMOS Analog IC Design	3	0	0	3

Course Description: This course emphasizes design techniques and layout, focusing on modern CMOS analog integrated circuits.

Course Outcomes: After completion of this course, the students will be able to

C712.1	Analyse and model MOS transistors and passive components in integrated circuits, utilizing large-signal, small-signal, and sub-threshold models.
C712.2	Design and analyse analog CMOS sub-circuits, including MOS switches, diodes, active resistors, current sources and sinks and implement current mirrors and stable voltage/current references.
C712.3	Design various CMOS amplifiers, such as differential amplifiers, Cascode amplifiers, and high-gain amplifier architectures, and understand how to optimize these designs for specific applications.
C712.4	Design CMOS operational amplifiers, including two-stage and Cascode op-amps, and apply compensation techniques to enhance stability and performance.
C712.5	Characterise and design different types of comparators, and will understand methods to enhance comparator performance and design discrete-time comparators.
C712.6	Apply theoretical knowledge to real-world design and troubleshooting scenarios, ensuring that their designs meet performance specifications and operational requirements.

Unit – I MOS Devices and Modeling

The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

Unit – II Analog CMOS Sub-Circuits

MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode Current Mirror and Wilson Current Mirror, Current and Voltage References, and Bandgap Reference.

Unit – III CMOS Amplifiers

Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

Unit – IV CMOS Operational Amplifiers

Design of CMOS Op-Amps, Compensation of Op-Amps, Design of Two-Stage Op-Amps, Power- Supply, Rejection Ratio of Two-Stage Op-Amps, Cascode Op-Amps, Measurement Techniques of OP-Amp.

Unit – V Comparators

Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

TEXT BOOKS

1. "CMOS Analog Circuit Design", Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. "Analysis and Design of Analog Integrated Circuits", Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

REFERENCE BOOKS

1. "Analog Integrated Circuit Design", David A. Johns, Ken Martin, Wiley Student Edn, 2013.
2. "Design of Analog CMOS Integrated Circuits", Behzad Razavi, TMH Edition.
3. "CMOS: Circuit Design, Layout and Simulation", Baker, Li

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC713PE	System Verilog for Verification	3	0	0	3

Course Description: This course provides a comprehensive understanding of the System Verilog language, specifically focusing on its features and capabilities used for effective hardware design verification

Course Outcomes: After completion of this course, the students will be able to

C713.1	Understand and apply verification processes, testbench functionality, and constrained-random stimulus generation.
C713.2	Efficiently handle built-in data types, arrays, user-defined structures, and type conversion.
C713.3	Write and execute procedural statements, tasks, functions, and manage local data storage in System Verilog.
C713.4	Separate testbench and design, control synchronous signals, and implement System Verilog assertions.
C713.5	Apply OOP principles in System Verilog, including class definition, object management, and method implementation.
C713.6	Build and optimize layered testbenches, maximize code reuse, and enhance testbench performance in simulation environments.

Unit – I Verification Guidelines

The Verification Process, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance

Unit – II Data Types

Built-In Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Array Methods, choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Packages, Type Conversion, Streaming Operators, Enumerated Types, Constants, Strings, Expression Width.

Unit – III Procedural Programming in System Verilog

Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values

Unit – IV Connecting the Testbench and Design

Separating the Testbench and Design, The Interface Construct, Controlling Timing of Synchronous Signals with a Clocking Block, Interface Driving and Sampling, Program Block Considerations, Connecting It All Together, Top-Level Scope, Program–Module Interactions, System Verilog Assertions

Unit – V Basic OOP

Introduction, Think of Nouns, not Verbs, Your First Class, Where to Define a Class, OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Class Methods, Defining Methods Outside of the Class, Static Variables vs. Global Variables, Scoping Rules

TEXT BOOKS

1. "System Verilog for Verification: A Guide to Learning the Testbench Language Features", Chris Spear and Greg Tumbush.

REFERENCE BOOKS

1. "System Verilog Assertions and Functional Coverage: Guide to Language, Methodology, and Applications", Ashok B. Mehta
2. "Writing Testbenches Using System Verilog", Janick Bergeron.
3. IEEE 1800 System Verilog Language Reference Manual

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC714PE	Speech Signal Processing	3	0	0	3

Course Description: This course describes the fundamentals of speech processing, losses, effects, timing models, predictive coding analysis. Also, learn the concepts of homomorphic considerations and HMM recognition, algorithms, testing, verification systems and identification systems.

Course Outcomes: After completion of this course, the students will be able to

C714.1	Model an electrical equivalent of Speech Production system and Extract the Pitch period estimation using the autocorrelation function.
C714.2	Extract the LPC coefficients that can be used to Synthesize or compress the speech.
C714.3	Design a Homomorphic Vocoder for coding and decoding of speech.
C714.4	Enhance the speech and can design an Isolated word recognition system using HMM.
C714.5	Extract the features for Automatic speaker recognition system which can used for classification.
C714.6	Enhance of the deep learning techniques for the speech processing

Unit – I Fundamentals of Digital Speech Processing and Time Domain Models for Speech Processing

Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production – Uniform lossless tube model, effect of losses in vocal tract, effects of radiation at lips, Digital models for speech signals.

Introduction- Window considerations, short time energy and average magnitude short time average zero crossing rate, Speech vs Silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach. The short time autocorrelation function, the short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Unit – II Linear predictive Coding (LPC) Analysis

Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equation, comparison between the Method of Solution of the LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

Unit – III Homomorphic Speech Processing

Introduction Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, pitch Detection, Formant Estimation, and The Homomorphic Vocoder.

Speech Enhancement-Nature of interfering sounds, Speech enhancement techniques: Single microphone Approach: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach.

Unit – IV Automatic Speech & Speaker Recognition

Basic pattern recognition approaches, parametric representation of speech, evaluating the similarity of speech patterns, isolated digit Recognition System, Continuous digit Recognition System Hidden Markov Model (HMM) for Speech Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS. Speaker Recognition Recognition techniques, features that distinguish speakers, Speaker Recognition Systems: Speaker Verification Systems, Speaker identification Systems.

Unit – V Introduction to Deep Learning for Speech Signal Processing

Basic of Deep Learning (DL), Introduction, perception algorithm, Multilayer perception, Deep learning, Model Training, Unsupervised DL, basic building blocks of RNN and its Properties, Deep RNN Architecture, Applications of RNNs in NLP

TEXT BOOKS

1. "Digital Processing of Speech Signals", L.R. Rabiner, S. W. Schafer. Pearson Education.
2. "Speech Communication: Human & Machine", Douglas O' Shaughnessy, 2nd Ed., IEEE Press.

REFERENCE BOOKS

1. "Discrete Time Speech Signal Processing: Principles and Practice", Thomas F. Quateri, 1st Ed., PE.
2. "Speech & Audio Signal Processing", Ben Gold & Nelson Morgan, 1st Ed., Wiley.
3. "Deep Learning for NLP and Speech Recognition", Kamath U., Liu, J., Whitaker, J. (2019), Germany: Springer International Publishing.

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC721PE	Image and Video Processing	3	0	0	3

Course Description: This course introduces the principles of digital image and video processing, discusses current image and video processing technology, and provides hands-on experience with image/video processing and communication methods. The course includes topics on image filtering and restoration, image transform algorithms, multiresolution image processing, image matching and segmentation techniques, as well as image and video compression.

Course Outcomes: After completion of this course, the students will be able to

C721.1	Explain the fundamentals of digital image processing and analyze the digital image using different image transforms.
C721.2	Apply spatial and frequency domain filtering techniques for image enhancement.
C721.3	Estimate the original image from a noisy one using different approaches in image restoration.
C721.4	Examine different types of discontinuities using image segmentation algorithms.
C721.5	Apply morphological operations, compression techniques, and basic video processing concepts on different images and videos.
C721.6	Apply deep learning techniques, including Convolutional Neural Networks (CNNs) for image processing tasks

Unit – I Digital Image Fundamentals & Image Transforms

Digital Image Fundamentals: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels.

Image Transforms: 2-D FFT, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform

Unit – II Image Enhancement and Restoration

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering.

Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

Image Restoration: Degradation Model, Inverse Filtering, Least Mean Square Filters

Unit – III Image Segmentation and Compression

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation. Dilation, Structuring Element Decomposition, Erosion, Opening and Closing, Hit or Miss Transformation

Image Compression: Redundancies and Their Removal, Huffman and Arithmetic Coding, Lossy and Lossless Compression, JPEG Standards.

Unit – IV Basics of Video Processing

Basics Of Video Processing: Analog video, Digital Video, Time varying Image Formation models- 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.

Unit – V Deep Learning Models for Image Processing

Role of Deep Learning in Image Analysis, Convolutional Neural Networks (CNNs), Architecture of CNNs (Convolution, Pooling, Fully Connected Layers), Overview of Popular Models (VGG, ResNet)

TEXT BOOKS

1. "Digital Image Processing", Rafael C. Gonzalez, Richard E. Woods, Pearson, Third Edition, 2010.
2. "Fundamentals of Digital Image Processing", Anil K. Jain, Pearson, 2002.
3. "Video processing and communication", Yao wang, Joem Ostarmann and Ya quin Zhang, 1st edition, PHI.
4. "Computer Vision: Algorithms and Applications", Richard Szeliski,2nd Edition, 2022, Springer.

REFERENCE BOOKS

1. "Digital Image Processing", Kenneth R. Castleman, Pearson, 2006.
2. "Digital Image Processing using MATLAB", Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Pearson Education, Inc., 2011.
3. "Multidimensional Digital Signal Processing", D. E. Dudgeon and RM. Mersereau, Prentice Hall Professional Technical Reference, 1990.
4. "Digital Image Processing'", William K. Pratt, John Wiley, New York, 2002.
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
6. "Digital video Processing", M. Tekalp, Prentice Hall International, 2015.
7. "Foundations of Computer Vision",Torralba, Isola, Freeman, MIT Press, 2024

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC722PE	Coding theory and Techniques	3	0	0	3

Course Description: This course explores the mathematical principles and algorithms for encoding, error detection, and error correction to ensure reliable data transmission and storage.

Course Outcomes: After completion of this course, the students will be able to

C722.1	Develop the ability to analyze and design error-detecting and error-correcting codes for reliable data communication and storage.
C722.2	Understand the principles of constructing and decoding linear block codes for efficient error detection and correction in digital communication systems.
C722.3	Gain knowledge to construct and implement cyclic redundancy checks and polynomial-based error-correcting codes.
C722.4	Understand the design and decoding techniques for Convolutional codes to improve transmission reliability in communication systems.
C722.5	Learn to apply iterative decoding methods and construct turbo codes for high-performance error correction.
C722.6	Acquire the skills to design and evaluate space-time coding techniques for improving reliability in wireless communication systems.

Unit – I Coding for Reliable Digital Transmission and storage

Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies. Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

Unit – II Cyclic Codes

Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

Unit – III Convolutional Codes

Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

Unit – IV Turbo Codes

LDPC Codes- Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes-Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding

Unit – V Space-Time Codes

Introduction, Digital modulation schemes, Diversity, Orthogonal space-Time Block codes, Alamouti's schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial Multiplexing: General Concept, Iterative APP Preprocessing and Per-layer Decoding, Linear Multilayer Detection, Original BLAST Detection, QL Decomposition and Interface Cancellation, Performance of Multi–Layer Detection Schemes, Unified Description by Linear Dispersion Codes.

TEXT BOOKS

1. "Error Control Coding- Fundamentals and Applications", Shu Lin, Daniel J.Costello, Jr, Prentice Hall, Inc.
2. "Error Correcting Coding Theory", Man Young Rhee, 1989, McGraw-Hill

REFERENCE BOOKS

1. "Digital Communications", Fundamental and Application, Bernard Sklar, PE.
2. "Digital Communications", John G. Proakis, 5th Edition, 2008, TMH.
3. "Introduction to Error Control Codes", Salvatore Gravano, Oxford.
4. "Error Correction Coding: Mathematical Methods and Algorithms", Todd K.Moon, 2006, Wiley India.
5. "Information Theory, Coding and Cryptography", Ranjan Bose, 2nd Edition, 2009, TMH.

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC723PE	VLSI Physical Design	3	0	0	3

Course Description: This course deals the basic concepts of VLSI physical design, fabrication process, basic algorithms and physical design like partitioning, floor planning.

Course Outcomes: After completion of this course, the students will be able to

- **C723.1** apply the concepts of trade-offs, methodologies and tools to optimize physical design.
- **C723.2** analyze scaling methods and fabrication process challenges.
- **C723.3** understand innovations in interconnect technology and aggressive process projections.
- **C723.4** analyze fundamental graph algorithms like spanning tree, shortest path and matching.
- **C723.5** formulate partitioning problems for specific design styles
- **C723.6** analyze design-specific floorplanning problems by considering design constraints

Unit – I VLSI Physical Design

VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle Design Styles, System Packaging Styles, Existing Design Tools

Unit – II Fabrication Process and its Impact

Scaling Methods, Issues of Fabrication Process - Parasitic Effects, Interconnect Delay, Noise and Crosstalk, Future of Fabrication Process - SIA Roadmap, Innovations in Interconnect, Aggressive Projections for the Process, Tools

Unit – III Data Structures and Basic Algorithms

Basic Algorithms - Graph Search Algorithms, Spanning Tree Algorithms, Shortest Path Algorithms, Matching Algorithms.

Basic Data Structures- Linked List of Blocks, Neighbor Pointers, Multi-layer Operations.

Graph Algorithms for Physical Design - Classes of Graphs, Algorithms for Interval Graphs, Permutation Graphs, Circle Graphs

Unit – IV Partitioning

Problem Formulation, Design Style Specific Partitioning Problems, Classification of Partitioning Algorithms, Group Migration Algorithms - Kernighan-Lin Algorithm, Extensions of Kernighan-Lin Algorithm, Performance Driven Partitioning

Unit – V Floorplanning

Floorplanning, Problem Formulation - Design Style Specific Floorplanning Problems Classification of Floorplanning Algorithms- Constraint Based Floorplanning, Integer Programming Based Floorplanning, Timing Driven Floorplanning

TEXT BOOKS

1. "Algorithms for VLSI Physical Design Automation", Naveed Sherwani, 3rd Edition, 2005.
2. "Algorithms for VLSI Design Automation", Sabih H. Gerez, Wiley, 2008, 2nd Edition.

REFERENCE BOOKS

1. "VLSI Physical Design Automation", Sait, Sadiq M., IEEE, 1995.
2. "Computer Aided Logical Design with Emphasis on VLSI", Hill & Peterson, Wiley, 1993.
3. "VLSI Physical Design Automation-Theory and Practice", Sadiq M Sait, Habib Youssef, World Scientific.

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC724PE	Satellite Communications	3	0	0	3

Course Description: This course provides a comprehensive understanding of the principles and applications of satellite communications.

Course Outcomes: After completion of this course, the students will be able to

- **C724.1** Describe the basic concepts of satellite communication and orbital mechanics.
- **C724.2** Analyze the functionality of various satellite subsystems.
- **C724.3** Design a satellite link for specified C/N
- **C724.4** Understand and analyze various multiple access techniques used.
- **C724.5** Explore about the earth station and its design.
- **C724.6** Analyze various parameters of LEO and GEO satellites.

Unit – I Introduction

Introduction:

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, Orbit determination, Launches and Launch vehicles, Orbital Effects in Communication Systems Performance.

Unit – II Satellite Subsystems

Attitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification.

Unit – III Satellite Link Design

Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design of Satellite Links For Specified C/N, System Design Examples.

Unit – IV Multiple Access

Frequency Division Multiple Access (FDMA), Inter modulation, 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.

Unit – V

Earth Station Technology:

Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods.

Non-Geostationary Satellite Systems:

Orbit Considerations, Coverage and Frequency Consideration, Delay & Throughput Considerations, System Considerations, Operational NGSO Constellation Designs.

TEXT BOOKS

1. "Satellite Communications", Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. "Satellite Communications Systems 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, 2nd Edition, BS Publications, 2003.
2. "Satellite Communication", D.C Agarwal, 7th Edition, Khanna Publications, 2019.
3. "Fundamentals of Satellite Communications", N. Raja Rao, PHI, 2004.
4. "Satellite Communications", Dennis Roddy, 4th Edition, McGraw Hill, 2009.
5. "Digital Satellite Communications", Tri T. Ha, 2nd Edition, McGraw Hill, 2009.

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
SM702MS	Professional Practice, Law & Ethics	2	0	0	2

Course Description: This Course provides the students with a comprehensive understanding of the legal and ethical frameworks that govern various professional fields. It explores the ethical principles and standards that guide professional conduct and decision-making processes.

Course Outcomes: After completion of this course, the students will be able to

- **C702.1** Understand the Professional Practice and Ethics needed for Engineering Professionals.
- **C702.2** Familiarize the various concepts in Law of Contract.
- **C702.3** Analyse the challenges of Law and its judicial interventions.
- **C702.4** Asses the regulatory aspects of negotiable instruments.
- **C702.5** Evaluate the Law relating to different types of Intellectual Property.
- **C702.6** Apply the various issues relating to the professional practice, law and ethics aimed for overall development.

Unit – I

Professional Practice and Ethics: Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Introduction to GST- Various Roles of Various Stake holders

Unit – II

Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and discharge of Contracts, Remedies for breach of contract. Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

Unit – III

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Distinction

between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

Unit – IV

Negotiable Instruments Act - 1881: Negotiable Instruments- Promissory Note, Bills of Exchange, & Cheque, Parties to negotiable instruments, Types of endorsements, Holder-Holder in due course, Dishonour and discharge of negotiable Instruments, Offences by the companies.

Unit – V

Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970.

Formation of Company, Composition of Board of Directors, Roles and Responsibilities of Directors.

TEXT BOOKS

1. "Professional Ethics", R. Subramanian, Oxford University Press, 2015.
2. "Legal Aspects of Business", Ravinder Kaur, 4e, Cengage Learning, 2016.
3. "Elements of Mercantile Law", N.D. Kapoor, Sultan Chand & Sons, 38th e, 2020

REFERENCE BOOKS

1. "Intellectual Property Rights", Wadhera (2004), Universal Law Publishing Co.
2. "Intellectual Property Rights Law in India", T. Ramappa (2010), Asia Law House.
3. "Law of Industrial Disputes", O.P. Malhotra, N.M. Tripathi Publishers

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC703PC	Microwave and Optical Communications Laboratory	0	0	4	2

Course Description: This course provides a hands-on exploration of key characteristics and measurement techniques in both microwave and optical communication systems. It is designed to give students practical knowledge in analysing and characterizing microwave devices, components, and optical fibers, as well as the measurement of essential system parameters.

Course Outcomes: After completion of this course, the students will be able to

C703.1 Analyse the characterizes of microwave sources
C703.2 Measure the parameters of the various microwave components
C703.3 Analyse the characterizes of optical sources
C703.4 Measure the various parameters of the optical communication system

List of Experiments:

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation measurement
4. Directional coupler Characteristics.
5. Scattering parameters of wave guide components.
6. Frequency measurement.
7. Impedance measurement.
8. VSWR measurement.
9. Characterization of LED.
10. Characterization of Laser Diode.
11. Intensity modulation of Laser output through an optical fiber.
12. Measurement of Data rate for Digital Optical link.
13. Measurement of Numerical Aperture of fiber cable.
14. Measurement of losses for Optical link

Note: - Minimum of 12 experiments has to be conducted.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC811PE	System on Chip Architecture	3	0	0	3

Course Description: This course discusses the fundamentals and advanced concepts of System-on-Chip (SoC) design. It begins with system architecture, components, hardware-software integration, and memory addressing.

Course Outcomes: After completion of this course, the students will be able to

- **C811.1** understand basic building blocks of SoC like processor architecture and memory interface
- **C811.2** explore design aspects of processor's working and selection criteria for SoC architectures
- **C811.3** Comprehend variations in advanced processor architectures
- **C811.4** Gain the knowledge on various memory subsystem designs employed in an SoC scenario
- **C811.5** Perceive the optimal interconnection strategies and their customization on SoC platform
- **C811.6** Identify the issues related to reconfigurable processor designs

Unit – I Introduction to the System Approach

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Unit – II Processors

Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Unit – III Memory Design for SOC

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

Unit – IV Interconnect Customization

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization.

Unit – V Configuration

An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism

TEXT BOOKS

1. "Computer System Design System-on-Chip", Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.

REFERENCE BOOKS

1. "Design of System on a Chip: Devices and Components", Ricardo Reis, 1st Ed., 2004, Springer.
2. "Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)", Jason Andrews, Newnes, BK and CDROM
3. "System on Chip Verification Methodologies and Techniques", Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC812PE	FPGA Architectures	3	0	0	3

Course Description: The purpose of studying FPGA Architectures give the knowledge on creation of custom hardware circuits. Understanding FPGA architecture helps in leverage the flexibility to design tailored solutions for specific applications, such as signal processing, encryption, or custom algorithms. Also, provides the knowledge on implementing the hardware functionality specific to the application needs rather than relying on general-purpose processors.

Course Outcomes: After completion of this course, the students will be able to

C812.1	understand various types of FPGAs to be used in complex digital system designs.
C812.2	understand various technology mapping corresponding to the type of FPGAs
C812.3	understand logic block functionality and impact on the design style.
C812.4	understand various routing architectures corresponding to the type of FPGAs
C812.5	create logic functions that realize using specific FPGA device.
C812.6	build logic models with appropriate block selection and routing flexibility for the selected FPGA devices.

Unit – I

Introduction to FPGAs: Evolution of Programmable Devices, what is an FPGA? Logic Blocks, Interconnection Resources, Economics of FPGAs, Applications of FPGAs, Implementation Process.

Commercially Available FPGAs: Programming Technologies, Static RAM Programming Technology, Anti-fuse Programming Technology, EPROM and EEPROM Programming Technology, Summary of Programming Technologies, Commercially Available FPGAs, Field-Programmable Gate Arrays, Xilinx FPGAs, Actel FPGAs, Altera FPGAs, Plessey FPGA, Plus Logic FPGA, Advanced Micro Devices (AMD) FPGA, QuickLogic FPGA, Algotronix FPGA, Concurrent Logic FPGA, Cross point Solutions FPGA, FPGA Design Flow Example, Initial Design Entry, Translation to XNF Format, Partition, Place and Route, Performance Calculation and Design Verification.

Unit – II Technology Mapping for FPGAs

Logic Synthesis, Logic Optimization, Technology Mapping, Lookup Table Technology Mapping, The Chortle-crf Technology Mapper, The Chortle-d Technology Mapper, Lookup Table Technology Mapping in mis-pga, Lookup Table Technology Mapping in Asyl, The Hydra Technology Mapper, The Xmap Technology Mapper, The VISMAP Technology Mapper, Multiplexer Technology Mapping, The Proserpine Technology Mapper, Multiplexer Technology Mapping in mis-pga, The Amap and XAmap Technology Mappers

Unit – III Logic Block Architecture

Logic Block Functionality versus Area-Efficiency, Logic Block Selection, Experimental Procedure, Logic Block Area and Routing Model, Experimental Results and Conclusions, Impact of Logic Block Functionality on FPGA Performance, Logic Block Selection, Logic Synthesis Procedure, Model for Measuring Delay

Unit – IV Routing for FPGAs

Routing Terminology, General Strategy for Routing in FPGAs, Routing for Row-Based FPGAs, Introduction to Segmented Channel Routing, Definitions for Segmented Channel Routing, An Algorithm for I-Segment Routing, An Algorithm for K-Segment Routing, Results for Segmented Channel Routing, Final Remarks for Row-Based FPGAs, Routing for Symmetrical FPGAs, Example of Routing in a Symmetrical FPGA, General Approach to Routing in Symmetrical FPGAs, The CGE Detailed Router Algorithm.

Flexibility of FPGA Routing Architectures: FPGA Architectural Assumptions, The Logic Block The Connection Block, The Switch Block Experimental Procedure, Limitations of the Study Experimental Results, Effect of Connection Block Flexibility on Routability, Effect of Switch Block Flexibility on Routability, Tradeoffs in the Flexibilities of the S and C Blocks, Track Count Requirements, Architectural Choices

Unit – V Theoretical Model for FPGA Routing

Architectural Assumptions for the FPGA, Overview of the Stochastic Model, Model of Global Routing and Detailed Routing, Previous Research for Predicting Channel Densities, Predicting Channel Densities in FPGAs, The Probability of Successfully Routing a Connection, The Logic Block to C Block Event, the S Block Events, The C Block to Logic Block Event, The Probability of Rci, Using the Stochastic Model to Predict Routability, Routability Predictions

TEXT BOOKS

1. "Field-Programmable Gate Arrays", Stephen D. Brown, Robert J. Francis, Jonathan Rose , Zvonko G. Vranesic, University o/ Toronto, The Kluwer International Series In Engineering and Computer Science, Springer Science-Business Media LLC, ISBN 978-1-4613-6587-7 ISBN 978-1-4615-3572-0 (eBook) DOI 10.1007/978-1-4615-3572-0, II Series.
2. "Field-Programmable Gate Array Technology", Stephen M. Trimberger Xilinx with contributions by Stephen M. Trimberger Xilinx, Dennis McCarty Telle Whitney Actel and The Technical Staff of Altera Corporation edited by Robert Hartmann, Springer. Science-Business Media, LLC, ISBN 978-1-4613-6183-1 ISBN 978-1-4615-2742-8 (eBook) DOI 10.1007/978-1-4615-2742-8

REFERENCE BOOKS

1. **"**Advanced FPGA Design Architecture, Implementation, and Optimization", Steve Kilts Spectrum Design Solutions Minneapolis, Minnesota, Wiely Interscience, A johny Wiely & Sons, INC, Publications.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC813PE	Wireless Sensor Networks	3	0	0	3

Course Description: This course provides a comprehensive understanding of the fundamental principles, design considerations, and applications of wireless sensor networks (WSNs), including sensor hardware, communication protocols, data aggregation, routing algorithms, deployment strategies, and security mechanisms,

Course Outcomes: After completion of this course, the students will be able to

- **C813.1** Explore various applications of wireless sensor networks.
- **C813.2** Understand various challenges in designing mobile Ad-hoc networks and sensor networks.
- **C813.3** Analyse various network and datalink layer protocols developed for sensor networks.
- **C813.4** Analyse and compare various data gathering and data dissemination methods.
- **C813.5** Understand wireless sensor network design principles and operating systems
- **C813.6** Design a sensor network environment for different types of applications

Unit – I

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Unit – II

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit – III

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee

Unit – IV

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Unit – V

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

TEXT BOOKS

1. "Ad-Hoc Wireless Sensor Networks", C. Siva Ram Murthy, B. S. Manoj, Pearson
2. "Principles of Wireless Networks", Kaveh Pah Laven and P. Krishna Murthy, 2002, PE

REFERENCE BOOKS

1. "Wireless Digital Communications", Kamilo Feher, 1999, PHI.
2. "Wireless Communications", Andrea Goldsmith, 2005 Cambridge University Press.
3. "Mobile Cellular Communication", Gottapu Sasibhushana Rao, Pearson Education, 2012.
4. "Wireless Communication and Networking", William Stallings, 2003, PHI.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC814PE	Radar Systems	3	0	0	3

Course Description: The Radar Systems course encompasses the fundamental principles of Radar, various types of Radar, tracking mechanisms, receiver systems, signal detection in noise using matched filter

Course Outcomes: After completion of this course, the students will be able to

- **C814.1** Understand Basic Operation Principles of Radar and Radar equation
- **C814.2** Determination of Radar Range Equation and prediction of its performance
- **C814.3** Understand the Principle and working mechanism of different types of RADAR (CW, FM-CW, Pulse Doppler, MTI, SAR)
- **C814.4** Understand and analyze Various Tracking mechanisms
- **C814.5** Understand phase array antennas used at the Receiver, its parameters and types of displays
- **C814.6** Detection of Noisy signals using matched filter and concept of non-Matched filter

Unit – I Basics of Radar and Radar Equation

Basics of Radar: Introduction - Maximum Unambiguous Range, Radar Frequencies, Radar Block Diagram and Operation, Applications, , Simple form of Radar Equation, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise – Modified Radar Range Equation

Radar Equation: SNR: Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (Simple targets), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment).

Unit – II CW and FMCW Radar

CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, CW Doppler Radar with Non-zero IF Receiver, Receiver Bandwidth – IF Doppler Filter Bank, Applications of CW radar.

FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW Altimeter.

Unit – III MTI, Pulse Doppler Radar, SAR

Pulse Doppler Radar – Block Diagram and Operation

Introduction to MTI Radar, MTI Radar - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. MTI Radar Parameters, Limitations of MTI

SAR- Introduction, Radar Equation for SAR

Unit – IV Tracking Radar

Tracking with Radar - Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Phase Comparison, Tracking in Range, Acquisition, Comparison of Trackers.

Unit – V Radar Receivers and Detection of Radar Signals in Noise

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

Detection of Radar Signals in Noise Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

TEXT BOOKS

1. "Introduction to Radar Systems", Merrill I. Skolnik, 2nd Edition, Mc Graw Hill Education, Special Indian Edition 2007.

REFERENCE BOOKS

1. "Radar Principles", Peyton Z. Peebles, Jr., Wiley Student Edition.
2. "Principles of Modern Radar: Basic Principles", Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC821PE	Testing and Testability	3	0	0	3

Course Description: This course will provide broad understanding of faults, defects in the digital designs, and their diagnosis. It gives understanding of fault model, and test methods using test pattern generation. It provides the understanding of importance in design for testability in Digital Design perspective.

Course Outcomes: After completion of this course, the students will be able to

C821.1	Identify the need for testing and categorize the different problems involved in testing.
C821.2	Summarize types of faults and choose appropriate fault models
C821.3	Illustrate the methods for test generation in combinational circuits
C821.4	Analyze the pseudo random test pattern generation techniques using Linear Feedback Shift Registers and Cellular Automata
C821.5	Categorize DFT techniques for combinational circuits
C821.6	Illustrate the methods for test generation in sequential circuits

Unit – I

Need for testing, the problems in digital Design testing, the problems in Analog Design testing, the problems in mixed analog/digital design testing, design for test, printed-circuit board (PCB) testing, software testing, Fault in Digital Circuits: General Introduction, Controllability and Observability.

Unit – II

General Introduction, to test pattern generation, Test Pattern generation for combinational logic circuits, Manual test pattern generation, automatic test pattern generation, Boolean difference method, Roth's D-algorithm, Developments following Roth's D-algorithm, Pseudorandom test pattern generation.

Unit – III

Pseudo-random test pattern generators, Design of test pattern generator using Linear feedback shift registers (LFSRs) and cellular automata (CAs).

Unit – IV

Design for Testability for combinational circuits: Basic Concepts of testability, controllability and observability, the Reed Muller's expansion techniques, use of control logic and syndrome testable designs.

Unit – V

Making sequential circuits testable, testability insertion, full scan DFT technique-Full scan insertion, flipflop structures, Full scan design and test, scan architectures-full scan design, shadow register DFT, partial scan methods, multiple scan design, other scan designs.

TEXT BOOKS

1. "Fault Tolerant and Fault Testable Hardware Design", Parag K. Lala, 1984, PHI.
2. "VLSI Testing digital and Mixed analogue/digital techniques", Stanley L. Hurst, IEE Circuits, Devices and Systems series 9, 1998.

REFERENCE BOOKS

1. "Digital Systems Testing and Testable Design", Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Jaico Books.
2. "Essentials of Electronic Testing", Bushnell and Vishwani D.Agarwal, Springers.
3. "Design for test for Digital IC's and Embedded Core Systems", Alfred L. Crouch, 2008, Pearson Education.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC822PE	Navigational Systems	3	0	0	3

Course Description: This course provides a comprehensive understanding of the principles and applications of Navigational Systems.

Course Outcomes: After completion of this course, the students will be able to

C822.1	Understand the basic forms, principles, and history of navigation
C822.2	Analyze the fundamentals of GPS systems
C822.3	Explore the IRNSS/NAVIC system and compare global navigation satellite systems
C822.4	Evaluate receiver architectures and the role of antennas in navigation systems
C822.5	Explain the principles of inertial navigation
C822.6	Integrate knowledge of navigation systems for real-world applications

Unit – I Introduction

Basic forms of Navigation: Pilotage, Dead reckoning, Celestial navigation, Radio navigation and Inertial navigation; History of navigation, Classification: land, sea, air, and space navigation; Principles of Navigation: Positioning, guidance, and timing; Coordinate Systems and Geodesy: Geodetic coordinates, earth-centered systems, and map projections.

Unit – II Satellite Navigation & 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 C/A Code Accuracy, Differential GPS.

Unit – III IRNSS/NAVIC & Other GNSS

History of Indian Navigation Systems, IRNSS/NAVIC Constellation, Space segment, Ground segment, User segment, Signal configuration: Navigation message, Frame structure, PRN Codes, Composite signal generation; IRNSS Performance Specifications, Comparison of GNSS (GPS, GALILEO, GLONASS, IRNSS) in terms of constellation and services provided.

Unit – IV Receiver and Antennas

Receiver architecture: GPS & IRNSS, Receiver design choices: number of channels and sequencing rate, L2 capability, code selections – C/A, P, or codeless, access to SA signals; Different antenna used: passive antenna, active antenna, smart antenna, military antennas, Antenna noise.

Unit – V Inertial Navigation

Background, Inertial Sensors, Navigation Coordinates, System Implementations, System level error models, Problems

TEXT BOOKS

1. "Satellite Communications", Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. "Understanding GPS/GNSS: Principles and Applications", Kaplan, E. D., & Hegarty, C. J., Artech House, 2017.
3. "Global Positioning Systems", Grewal, M. S., Weill, L. R., & Andrews, A. P., Inertial Navigation, and Integration, Wiley, 2013.
4. "GNSS – Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and more", Hofmann-Wellenhof, B., Lichtenegger, H., & Wasle, E., Springer, 2008.

REFERENCE BOOKS

1. "Global Navigation Satellite Systems", G S RAO, McGraw-Hill Publications, New Delhi, 2010.
2. "Global Positioning System: Signals, Measurements, and Performance", Misra, P., & Enge, P., Ganga-Jamuna Press, 2011.
3. "Inertial Navigation Technology", Titterton, D. H., & Weston, J. L., Strapdown, The Institution of Engineering and Technology, 2004.
4. "Global Positioning System: Theory and Applications", Parkinson, B. W., Spilker, J. J., & Enge, P. K., American Institute of Aeronautics and Astronautics, 1996.
5. Springer handbook of "global navigation satellite systems", Teunissen, Peter JG, and Oliver Montenbruck, eds. Vol. 10. Cham, Switzerland: Springer International Publishing, 2017.
6. "Position, navigation, and timing technologies in the 21st century: Integrated satellite navigation, sensor systems and civil applications", Morton, Y. Jade, Frank van Diggelen, James J. Spilker Jr, Bradford W. Parkinson, Sherman Lo, and Grace Gao, eds., volume 1. John Wiley & Sons, 2021.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC823PE	5G and Beyond Communications	3	0	0	3

Course Description: This course provides an in-depth understanding of 5G and beyond communication technologies, focusing on multiple input multiple output (MIMO) systems, mobile wireless technology generations, millimeter-wave (mm-Wave) propagation, higher-layer design considerations, and future challenges in mobile communications.

Course Outcomes: After completion of this course, the students will be able to

C823.1	Outline the concept of MIMO communication system related to 5G technology.
C823.2	Illustrate the Concepts, Challenges and Standards of 5G
C823.3	Analyze the SMNAT architecture and Implementation
C823.4	Explain the radio wave propagation of mm waves, channel effects and Channel models
C823.5	Understand the higher layer design considerations for mm Wave
C823.6	Explore Security issues and challenges of future mobile technologies

Unit – I Multiple Input Multiple Output (MIMO) Communications

Spatial Multiplexing, Spatial Diversity, Beamforming in MIMO systems, Hybrid Precoding, 5G Communication Landscape, Related work on 5G.

Unit – II Introduction to Mobile Wireless Technology Generations

5G, Wireless Innovative System for Dynamically Operating Mega Communication (WISDOM), GIMVC, Requirements of 5G, standardization of WISDOM, Vision of 5G, WISDOM Concept and Challenges, Cellular D2D Communication, D2D Using Physical Layer Network Coding, Using FFR and Using Cognitive Radio.

Unit – III Radio Wave Propagation for mm Wave

Introduction, Large-scale Propagation Channel Effects, Small-Scale Channel Effects, Spatial Characterization of Multipath and Beam Combing, Outdoor Channel Models, Indoor Channel Models.

Unit – IV Higher layer Design Considerations for mm Wave

Challenges when Networking Mm Wave Devices, Beam Adaptation Protocols, Relaying for Coverage Extension, Support for Multimedia Transmission, Multiband considerations, Performance of Cellular networks, Mm Wave Standardization: ECMA-387, IEEE 802.11ad.

Unit – V BEYOND 2020

Major Challenges Surrounding Future Cyber Security, Users Awareness, Spectrum Related Security Issues in CRNs. Challenges for 2020 and beyond, Future Mobile Technologies, High

Altitude Stratospheric Platform Station Systems, Human Bond Communications, CONASENSE

TEXT BOOKS

1. "5G: 2020 and Beyond", Ramjee Prasad, River Publishers.
2. "Millimeter Wave Wireless Communication", S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Pearson Education, 2015.

REFERENCE BOOKS

1. "5G and Beyond Wireless Systems PHY Layer Perspective", M. Manish, G. Devendra, P. Pattanayak, and N. Ha, Springer Series in Wireless Technology.
2. "Multiple Access techniques for 5G Wireless Networks and Beyond", M. Vaezi, Z. Ding, and H. V. Poor, Springer Nature, Switzerland, 2019.

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC824PE	Low Power VLSI Design	3	0	0	3

Course Description: This course emphasizes on the need and methodologies of Low Power VLSI Design in various levels of abstraction. It also introduces various architectures for low power adders, multipliers and memory elements.

Course Outcomes: After completion of this course, the students will be able to

C824.1	Summarize various sources of power dissipation in low power circuits
C824.2	Illustrate the need for low power circuit design and analyze the effects of short channel
C824.3	Categorize the special techniques to mitigate the power consumption in VLSI circuits
C824.4	Analyze the architectural approaches to design low power, low voltage adder and multiplier circuits
C824.5	Interpret the performance of low power, low voltage memory architectures
C824.6	Compare different technology trends for low voltage low power logic styles

Unit – I Fundamentals

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

Unit – II

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches.

Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, and Mask level Measures.

Unit – III

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look- Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

Unit – IV

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

Unit – V

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TEXT BOOKS

1. "CMOS Digital Integrated Circuits – Analysis and Design", Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. "Low-Voltage, Low-Power VLSI Subsystems", Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

REFERENCE BOOKS

1. "Low Power VLSI Circuits and Systems", Ajit Pal, Springer, 2015.
2. "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", Ming-BO Lin, CRC Press, 2011.
3. "Low Power CMOS VLSI Circuit Design", Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
4. "Practical Low Power Digital VLSI Design", Gary K. Yeap, Kluwer Academic Press, 2002.
5. "Leakage in Nanometer CMOS Technologies,", Siva G. Narendran, Anatha Chandrakasan, Springer, 2005.

Open Elective-I

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC600OE	**Microcontrollers**	3	0	0	3

Course Description: This course describes about the operations of microprocessors and micro controllers, machine language programming, interfacing techniques, input output and memory systems.

Course Outcomes: After completion of this course, the students will be able to

C600OE.1	Differentiate between microprocessors and microcontrollers in terms of architecture and functionality.
C600OE.2	Summarize the addressing modes, instruction set and assembler directives of 8086 Microprocessor and 8051 Micro controller.
C600OE.3	Develop programming skills in assembly language for 8086 microprocessor and 8051 microcontrollers.
C600OE.4	Interface peripheral devices and memory with 8086 using 8255, 8257 and 8259
C600OE.5	Implement basic hardware interfaces and connections with 8051 microcontrollers.
C600OE.6	Interface microprocessors and microcontrollers with external devices using different communication protocols.

Unit - I 8086 Microprocessor

8086 Architecture-Pin diagram, Register Organization, Memory Segmentation, Programming Model, Modes of operation, Timing diagrams, Memory addresses, Physical Memory Organization, interrupts of 8086.

Instruction Set and Assembly Language Programming Of 8086: Instruction formats, addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations, Software Debugging tools, MDS.

Unit - II 8086 Interfacing

I/O Interface: 8255 PPI, Various modes of operations and interface of I/O devices to 8086, A/D, D/A Converter Interfacing.

Interfacing With Advanced Devices: 8086 System bus structure, Memory and I/O Interfacing with 8086, Interfacing through various IC Peripheral Chips, 8257 (DMA Controller), 8259 (Interrupt Priority Control).

Unit – III Communication Interface

Serial Communication Standards, USART Interfacing RS-232, IEEE-488, 20mA Current Loop, Prototyping and Troubleshooting.

Unit – IV 8051 Microcontrollers

Introduction To Micro Controllers: Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, addressing modes and Instruction set of 8051, Simple Programs using Stack Pointer, Assembly language programming of 8051 Interrupts Communication: Interrupts - Timer/Counter and Serial Communication, Interrupt Priority in the 8051, Programming of 8051- Timers, Counters and Interrupts.

Unit - V Interfacing And Industrial Applications

Applications of Micro Controllers, interfacing 8051 to LED's, Keyboard Interfacing, Interfacing Seven Segment Display, ADC and DAC Interfacing, Stepper Motor Interfacing

TEXT BOOKS

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.

REFERENCE BOOKS

1. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012
2. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
3. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
4. The 8051 Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, Andhe Pallavi, Pearson, 2009.

Open Elective-I

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC601OE	**Fundamentals of IoT**	3	0	0	3

Course Description: The objectives of the course are to understand the concepts of Internet of Things to build applications, programming and use of Arduino and Raspberry Pi boards and to provide Knowledge about data handling and analytics in SDN.

Course Outcomes: After completion of this course, the students will be able to

C601OE.1 Develop a clear comprehension of IoT and M2M concepts, facilitating the construction of IoT applications.

C601OE.2 Gain expertise in programming to configure Arduino boards for various designs.

C601OE.3 Effectively deploy python programs into Raspberry Pi boards in diverse scenarios.

C601OE.4 Demonstrate an understanding of data handling and analytics within Software-Defined Networking (SDN).

C601OE.5 Apply IoT concepts effectively for practical application development.

C601OE.6 Understand the role of cloud-computing in a typical IoT system with case studies.

Unit - I Introduction to Internet of Things

Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

Unit - II Machine-to-Machine Communications

Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

Unit – III Introduction to Python programming

Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi.

Unit – IV Implementation of IoT with Raspberry Pi

Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics.

Unit - V Cloud Computing

Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT.

Case Study: Agriculture, Healthcare, Activity Monitoring

TEXT BOOKS:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. “Make sensors”: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.
3. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti

REFERENCE BOOKS:

1. “Internet of Things: A Hands-On Approach”, Vijay Madisetti, Arshdeep Bahga.
2. “Fundamentals of Wireless Sensor Networks: Theory and Practice”, Waltenegus Dargie, Christian Poellabauer.
3. “Beginning Sensor networks with Arduino and Raspberry Pi”, Charles Bell, Apress, 2013.

Open Elective-I

B.Tech. III Year II Semester

Course Code	Course Title	L	T	P	Credits
EC602OE	**VLSI Design**	3	0	0	3

Course Description: This course gives the exposure to different steps involved in the fabrication of ICs and explain electrical properties of MOS devices. Also, describes about the design rules to be followed to draw the layout and concepts to design building blocks of data path of any system using gates.

Course Outcomes: After completion of this course, the students will be able to

C602OE.1 Study the steps in VLSI fabrication process for different MOS Technologies

C602OE.2 Examine the electrical properties and models of CMOS circuits

C602OE.3 Construct layouts using stick diagrams in accordance with the design rules.

C602OE.4 Implement complex digital logic circuits with switch logic and CMOS dynamic logic

C602OE.5 Build different VLSI subsystems using CMOS logic.

C602OE.6 Explore the construction of various semiconductor memories.

Unit - I Introduction

Introduction to IC Technology – Silicon Wafer Preparation, Ion Implantation, Diffusion, Photolithography, Oxidation, Chemical-Vapor Deposition, Metallization, Packaging, NMOS and CMOS Fabrication, Latch-up in CMOS

Unit - II Basic Electrical Properties of MOS circuits

I_{DS}-V_{DS} relationships, MOS transistor threshold, Voltage, gm, gds, Figure of merit, MOS transistor circuit model, Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis, Power Dissipation components in CMOS circuits

Unit – III VLSI Circuit Design Processes

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters, NAND, NOR Gates.

Unit – IV Gate Level Design

Logic Gates and Other complex gates, Switch logic, Pseudo-NMOS logic, CMOS Dynamic Logic, clocked CMOS logic, CMOS Domino logic, n-p CMOS logic, Time delays, Fan–in, Fan–out.

Unit - V Subsystems

Data Path Subsystems: Subsystem Design, Shifters, Adders, ALUs, Parity generators, Comparators, Zero/One Detectors.

Array Subsystems: SRAM, DRAM, ROM, Serial Access Memories

TEXT BOOKS:

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition.
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.

REFERENCE BOOKS:

1. VLSI Fabrication Principles: Silicon and Gallium Arsenide, 2ed, January 2008 by Sorab K. Ghandhi.
2. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
3. CMOS logic circuit Design - John. P. Uyemura, Springer, 2007.
4. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.
5. VLSI Design- K. Lal Kishore, V. S. V. Prabhakar, I.K International, 2009.

Open Elective-II

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC700OE	Electronic Sensors	3	0	0	3

Course Description: This course provides knowledge on working of Electromechanical, Thermal, Magnetic and radiation sensors and provide basic Understanding of Electro analytic and smart sensors

Course Outcomes: After completion of this course, the students will be able to

C700OE.1 Illustrate the characteristics and operating principles of Sensors

C700OE.2 Summarize the construction and operation of various Electro Mechanical Sensors.

C700OE.3 Analyze the working principles and applications of different Thermal Sensors

C700OE.4 Explore the working principles of different Magnetic Sensors

C700OE.5 Utilize Radiation and Electro Analytical Sensors to compute radiation and various electrical parameters.

C700OE.6 Make use of smart sensors to measure different physical parameters and apply them in various Fields

Unit – I Sensors / Transducers

Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization Electromechanical 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

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 Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors

Unit – III Magnetic sensors

Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magneto resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros

Unit – IV Radiation Sensors

Introduction, Basic Characteristics, Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors, Fibre Optic Sensors Electro analytical Sensors: 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 – V Smart Sensors

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

TEXT BOOKS

1. "Sensors and Transducers", D. Patranabis, PHI Learning Private Limited., 2003.
2. "Introduction to sensors", John veteline, Aravind Raghu, CRC press, 2011

REFERENCE BOOKS

1. "Sensors and Actuators", D. Patranabis, 2nd Ed., PHI, 2013.
2. "Make sensors by Terokarvinen, kemo, karvinen and villeyvaltokari", 1st edition, maker media, 2014.
3. "Sensors handbook", Sabrie soloman, 2nd Ed. TMH, 2009

Open Elective-II

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC701OE	Digital Image Processing	3	0	0	3

Course Description: This course covers fundamental concepts of digital image processing, including image transforms, enhancement, restoration, segmentation, and compression. It explores both spatial and frequency domain techniques, along with morphological processing and advanced compression standards like JPEG 2000.

Course Outcomes: After completion of this course, the students will be able to

C701OE.1 Explain the fundamentals of digital image processing
C701OE.2 Analyze the digital image using different image transforms
C701OE.3 Apply spatial and frequency domain filtering techniques for image enhancement
C701OE.4 Estimate the original image from a noisy one using different approaches in image restoration
C701OE.5 Examine different types of discontinuities using image segmentation algorithms
C701OE.6 Apply Morphological operations and compression techniques on different images

Unit – I Digital Image Fundamentals & Image Transforms

Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels.
Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

Unit – II Image Enhancement

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering.
Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

Unit – III Image Restoration

Degradation Model, Noise Models, Mean Filters, Order-Statistic Filters, Estimating the Degradation Function, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration.

Unit – IV Image Segmentation and Morphological Image Processing

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation.

Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

Unit – V Image Compression

Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

TEXT BOOKS

1. "Digital Image Processing", Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008.
2. "Digital Image Processing", S Jayaraman, S Esakkirajan, T Veerakumar, TMH, 2010.

REFERENCE BOOKS

1. "Digital Image Processing using MATLAB", Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, TMH, 2010.
2. "Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools", Scott E Umbaugh, 2nd Ed, CRC Press, 2011.
3. "Digital Image Processing and Computer Vision", Milan Sonka, Vaclav Hlavac, Roger Boyle, Cengage Learning (Indian edition) 2008.

Open Elective-II

B.Tech. IV Year I Semester

Course Code	Course Title	L	T	P	Credits
EC702OE	Principles of Communications	3	0	0	3

Course Description: This course provides a comprehensive understanding of the fundamental concepts and techniques used in communication systems, and the various components of communication systems such as transmitters, receivers, and communication channels.

Course Outcomes: After completion of this course, the students will be able to

C702OE.1	Understand the need of modulation and distinguish various modulation techniques.
C702OE.2	Analyze the performance of modulation schemes in time and frequency domains.
C702OE.3	Demonstrate the principles of satellite communication systems.
C702OE.4	Understand the principles and components of optical communication and real-world applications.
C702OE.5	Understand telecommunication systems and networking.
C702OE.6	Gain knowledge of cellular and mobile communication systems.

Unit – I

Simple description on Modulation Need for Modulation, Electromagnetic spectrum, Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

Unit – II

Satellite Communication Satellite Orbits, Ground Stations, Satellite Applications, basics of Global Positioning systems.

Unit – III

Optical Communication Propagation mechanism, Types of optical fiber, LED source, PIN detector.

Unit – IV

Telecommunication Systems Telephone system, Paging systems, Internet Telephony. Networking and Local Area Networks Network fundamentals, Ethernet LANs, Token Ring LAN.

Unit – V

Cellular and Mobile Communications Basic concepts of Cellular telephone systems, Evolution and standard - AMPS, GSM, CDMA, and WCDMA. Wireless Technologies Fundamentals - Wireless LANs, PANs and MANs.

TEXT BOOKS

1. "Principles of Electronic Communication Systems", Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. "Electronic Communications systems", Kennedy, Davis, 4e, TMH, 1999.

REFERENCE BOOKS

1. "Introduction to Telecommunications Network Engineering", Tarmo Anttalainen, Artech House Telecommunications Library.
2. "Wireless Communications-Principles and practice", Theodore Rappaport, Printice Hall, 2002.
3. "Fundamentals of Telecommunications", Roger L. Freeman, 2e, Wiley publications.
4. "Introduction to data communications and networking", Wayne Tomasi, Pearson Education, 2005.

Open Elective-III

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC800OE	Electronic Measurements & Instrumentation	3	0	0	3

Course Description: This course provides an introduction to Measuring Systems, working of different electronic instruments, signal generators, signal analyzers, recorders, concepts of various measuring bridges and their balancing conditions, use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Course Outcomes: After completion of this course, the students will be able to

C800OE.1 Illustrate the characteristics and operating principles of measuring systems.

C800OE.2 Summarize the construction and operation of various Wave Analysers and Signal generators.

C800OE.3 Analyse the working principles and applications of different types of Oscilloscopes

C800OE.4 Utilise transducers to compute various electrical parameters.

C800OE.5 Measure R, L and C values using different bridge circuits.

C800OE.6 Make use of measuring devices to measure different physical parameters

Unit – I Block Schematics of Measuring Systems

Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

Unit – II Signal Analyzers

AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

Unit – III Oscilloscopes, Special Purpose Oscilloscopes

Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

Unit – IV Transducers

Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes, accelerometers.

Unit – V Bridges, Measurement of Physical Parameters

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

TEXT BOOKS

1. "Modern Electronic Instrumentation and Measurement Techniques", A.D. Helbincs, W. D. Cooper: PHI 5th Edition 2003.
2. "Electronic Instrumentation", H. S. Kalsi, TMH, 2nd Edition 2004.

REFERENCE BOOKS

1. "Electrical and Electronic Measurement and Measuring Instruments", A K Sawhney, Dhanpat Rai & Sons, 2013.
2. "Electronic Instrumentation and Measurements", David A. Bell, Oxford Univ. Press, 1997.
3. "Industrial Instrumentation", T.R. Padmanabham Springer 2009.
4. "Electronic Measurements and Instrumentation", K. Lal Kishore, Pearson Education 2010.

Open Elective-III

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC801OE	Embedded System Design	3	0	0	3

Course Description: To provide an overview of Design Principles of Embedded System, the role of firmware, the necessity of operating systems in correlation with hardware systems.

Course Outcomes: After completion of this course, the students will be able to

C801OE.1 Distinguish the embedded systems from general purpose processing systems.

C801OE.2 Recommend suitable hardware for different applications of embedded systems.

C801OE.3 Select different types and amount of memory based on embedded system specifications.

C801OE.4 Explain the Embedded firmware design approaches, development languages and device drivers

C801OE.5 Analyze the issues and techniques of Task synchronization and communication in embedded firmware.

C801OE.6 Differentiate between general purpose operating systems and RTOS.

Unit – I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit – II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces

Unit – III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit – IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Unit – V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, **Task Synchronization:** Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

TEXT BOOKS

1. "Introduction to Embedded Systems", Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS

1. "Embedded Systems", Raj Kamal-, TMH.
2. "Embedded System Design", Frank Vahid, Tony Givargis, John Wiley.
3. "Embedded Systems", Lyla, Pearson,2013
4. "An Embedded Software Primer", David E.Simon, Pearson Education.

Open Elective-III

B.Tech. IV Year II Semester

Course Code	Course Title	L	T	P	Credits
EC802OE	FPGA based System Design	3	0	0	3

Course Description: This course describes design and implement digital systems using Field Programmable Gate Arrays (FPGAs), architectures, methodologies for different logic design, power and energy optimization concepts.

Course Outcomes: After completion of this course, the students will be able to

C802OE.1	Understand and apply FPGA-based system design concepts and VLSI technology.
C802OE.2	Analyze and compare different FPGA architectures and circuit designs.
C802OE.3	Design and implement combinational logic using HDLs for FPGA applications.
C802OE.4	Develop and optimize sequential circuits with clocking and performance analysis.
C802OE.5	Design FPGA-based architectures using pipelining, scheduling, and power optimization.
C802OE.6	Apply FPGA design methodologies for verification and implementation in real-world applications.

Unit – I FPGA BASED SYSTEMS

Introduction - Basic Concepts - Digital Design and FPGAs - FPGA Based System Design - VLSI Technology Behind FPGAs - Manufacturing Processes - CMOS Logic Gates - Registers and RAM -Packages and Pads.

Unit – II FPGA FABRICS

FPGA Fabrics - FPGA Architectures -SRAM Based FPGAs - Permanently Programmed FPGAs-Chip I/O-Circuit Design of FPGA Fabrics - Architecture of FPGA Fabrics.

Unit – III COMBINATIONAL LOGIC

The Logic Design Process - Hardware Description Languages - Combinational Network Delay - Power and Energy Optimization -Arithmetic Logic - Logic Implementation for FPGAs - Physical Design of FPGAs.

Unit – IV SEQUENTIAL MACHINES

Sequential Machine Design Process - Sequential Design Styles- Rules for Clocking-Performance Analysis - Power Optimization.

Unit – V ARCHITECTURE

Behavioral Design: Data Path-Controller architectures, Scheduling and allocation, Power, Pipelining - Design Methodologies: Design processes, Design standards, Design Verification- Design Example: Digital Signal Processor.

TEXT BOOKS

1. "FPGA Based System Design", Wayne Wolf,1st Edition, Prentice Hall PTR, 2004.

REFERENCE BOOKS

1. "Fundamentals of Digital Logic with Verilog Design", Stephen D. Brown, and Zvonko Vranesic,2nd Edition, McGraw Hill, June, 2007.
2. "Digital System Design with FPGA: Implementation Using Verilog and VHDL", Cem Unsalan and Bora Tar, McGraw Hill, October, 2017
3. "Modern VLSI Design: System-on-Chip Design", Wayne Wolf, 4th Edition, Prentice Hall, 2008.
4. "Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar, Pearson Education,2003.

SUSTAINABLE DEVELOPMENT GOALS

01 NO POVERTY

02 ZERO HUNGER

03 GOOD HEALTH AND WELL-BEING

04 QUALITY EDUCATION

05 GENDER EQUALITY

06 CLEAN WATER AND SANITATION

07 AFFORDABLE AND CLEAN ENERGY

08 DECENT WORK AND ECONOMIC GROWTH

09 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS