Department of Electronics
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SYLLABUS for FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP) in ELECTRONICS of Digboi College (Autonomous) as per NEP-2020 Guidelines

ESTD 1965

Meeting of the Board of Studies in Electronics held on 24th May, 2025

Preamble

The FYUGP in Electronics, aligned with NEP 2020 guidelines, is crafted to equip graduates with skills that meet current industry demands and adhere to national and global standards. The program's primary goal is to prepare students to contribute meaningfully to society.

This outcome-focused undergraduate curriculum emphasizes student-centric teaching and learning, fostering an engaging and personalized educational experience. It empowers students to pursue their chosen field with confidence, preparing them for both academic advancement and career opportunities.

The revamped FYUGP Electronics curriculum provides a comprehensive foundation, guiding students from fundamental concepts to advanced electronics skills that align with industry expectations. It enables graduates to pursue higher education or excel in the competitive job market.

The program is designed to support students in making informed choices about their future academic and professional aspirations, ensuring they are well-prepared for their chosen paths.

Introduction

The FYUGP Electronics curriculum is structured to prepare graduates to meet contemporary industry demands while equipping them with skills aligned with national and global benchmarks. It aims to foster students' ability to analyze, comprehend, and critically engage with the subject, enhancing the learning experience for all stakeholders. Beyond delivering disciplinary knowledge, the curriculum emphasizes competencies such as problem-solving and analytical reasoning to ensure high professional proficiency. The University is encouraged to support its faculty in adopting innovative pedagogical approaches, alongside the model curriculum's teaching-learning methods, to achieve the intended course and program outcomes. The FYUGP is developed based on the CBCS framework outlined by the UGC.

Programme Duration

The FYUGP in Electronics spans four years, with each academic year divided into two semesters, resulting in a total of eight semesters.

The program offers a flexible multiple-exit system. Students who exit after the first year, upon earning 40 credits in Semesters I and II, will receive an Undergraduate Certificate. Those exiting after completing Semesters III and IV with 80 credits will be awarded an Undergraduate Diploma. Students who complete Semesters V and VI, securing 120 credits, will earn a 3-Year Bachelor’s Degree with Honours. Upon completing Semesters VII and VIII with 160 credits, students will be awarded a 4-Year Bachelor’s Degree with Honours or Honours with Research.

Design of Programme

The teaching-learning process in the FYUGP Electronics program includes theory classes (L) lasting one hour, tutorials (T), and practical (P) sessions. The curriculum will be delivered using diverse methods such as traditional chalk-and-talk, PowerPoint presentations, audio-visual tools, e-learning resources, laboratory sessions, virtual labs, simulations, experiments, field trips, industry visits, seminars, workshops, projects, models, class discussions, and other recommended approaches.

Assessment will consist of Internal Assessment (Continuous Evaluation) and End Semester Examinations. Each theory paper carries 60 marks, with 40 marks allocated to Internal Assessment. Internal Assessment will be based on methods such as sessional tests, assignments, oral presentations, short projects, group discussion, group activity and other suggested evaluation techniques.

Programme Structure

The FYUGP in Electronics offers courses with either four or three credits. Four-credit courses without practical components consist solely of theory classes. For theory or tutorial classes, one credit corresponds to one hour of instruction per week, while for practical sessions, one credit equates to a two-hour session per week.

The program comprises Core Courses (CC) and Elective Courses (EC). Core Courses are mandatory for all students. Elective Courses include three types: Discipline Specific Elective (DSE), Multidisciplinary Generic Elective (MDC), and Skill Enhancement Course (SEC). Additionally, the program includes two mandatory Ability Enhancement Courses (AEC).

Aim

The FYUGP in Electronics seeks to deliver learning experiences that foster a deep understanding of fundamental electronic science concepts and equip students with advanced scientific and technological skills to address challenges in the electronics field. It aims to enable students to apply their acquired knowledge and skills to solve specific theoretical and practical problems in electronics. The program cultivates students' abilities to design and create innovative solutions for societal benefit through diligence, leadership, teamwork, and lifelong learning. Additionally, it equips students with the skills needed to secure employment in industries, pursue advanced studies, undertake research, or become entrepreneurs.

Graduate Attributes

Graduate Attributes represent individually measurable outcomes that reflect a graduate’s potential to achieve competence at an appropriate level. The Graduate Attributes for the FYUGP in Electronics are outlined below:

- **Disciplinary Knowledge**: Develop comprehensive knowledge in electronics or related professional fields, adopting a broad and global perspective. Graduates will be capable of discerning, evaluating, analyzing, and synthesizing existing and new knowledge to advance their understanding.
- **Communication Skills**: Effectively communicate complex scientific and technological concepts to the scientific community and society, through clear reports, well-designed documentation, impactful presentations, and precise instructions.

- **Problem Solving and Critical Thinking**: Think creatively and critically to conceptualize and address scientific/technological challenges, assessing multiple solutions while considering public health, safety, cultural, societal, and environmental factors. Graduates will apply independent judgment to drive intellectual or creative advancements in research across theoretical, practical, and policy contexts.
- **Use of Modern Tools**: Select, adapt, and apply advanced techniques, resources, and modern engineering/IT tools, including predictive and modeling software, to tackle complex scientific/technological tasks while understanding their limitations.
- **Collaborative and Multidisciplinary Work**: Understand group dynamics, contribute to collaborative, multidisciplinary research, and demonstrate self-management, teamwork, and decision-making skills based on open-mindedness and rational analysis to achieve shared goals and foster learning.
- **Lifelong Learning**: Recognize the importance of continuous learning and possess the preparation and enthusiasm to independently enhance knowledge and skills throughout their careers.
- **Ethical and Moral Practices**: Uphold professional integrity, adhere to ethical research practices, and consider the societal and environmental impacts of research outcomes to contribute to sustainable community development.

Programme Learning Outcomes

The FYUGP in Electronics is designed to cultivate specialized skills to meet industry demands, responding to the rapid advancements in electronic science, including new technologies, ideas, and principles. The program addresses the need for highly skilled, scientifically oriented professionals through adaptable, progressive training and collaboration among research organizations, academia, and industry. Key study areas include Semiconductor Devices, Analog and Digital Circuit Design, Microprocessors and Microcontroller Systems, Communication Techniques, IoT, Computational Techniques, Programming in High-Level Languages, and applied fields such as Embedded Systems, Advanced Computing, Data Communication, Robotics, Control Systems, VLSI Design, Nanoelectronics, Artificial Intelligence, and IoT.

The curriculum, based on a learning outcomes model, enhances graduates' learning experiences by imparting disciplinary knowledge and fostering competencies like problem-solving, analytical reasoning, and leadership for high professional competence. The program outcomes include:

- Applying mathematical and scientific knowledge to address electronics-related challenges.
- Designing and conducting experiments in electronics, analyzing, and interpreting data.
- Developing and managing electronic systems or processes within ethical and economic constraints.
- Identifying, formulating, solving, and analyzing problems across various electronics disciplines.
- Collaborating effectively in multidisciplinary teams with a commitment to ethics, integrity, and social responsibility.
- Communicating effectively through oral and written mediums.
- Engaging in lifelong learning to stay updated with evolving knowledge.
- Utilizing modern technological, scientific, and engineering tools and techniques for professional practice.

Teaching-Learning Process

The FYUGP in Electronics encourages the acquisition of electronics knowledge, understanding, and professional skills essential for industrial and professional roles. Practical and experimental skill development is a critical component of the teaching-learning process. Interactive methods that engage students' thoughts and motivation are prioritized over traditional lectures to foster critical thinking and deeper understanding.

Suggested approaches for outcome-oriented and participatory learning include:

a) **Lectures**: Designed to offer fresh perspectives, lectures should be interactive, allowing students to collaborate with instructors to gain insights and build pathways to advanced learning. Faculty should outline lecture outcomes at the start and summarize key points at the end to ensure clarity.

b) **Case Studies**: Incorporate real-world case studies to challenge students to devise creative solutions to complex electronics industry problems, encouraging them to present findings through reports and seminars.

c) **SWAYAM Portal**: Leverage the SWAYAM platform's e-resources, including video lectures, downloadable reading materials, self-assessment tests, and online discussion forums, to enrich students' learning experiences with multimedia and advanced pedagogy.

d) **Lab Sessions**: Traditional labs involve following procedures to achieve predetermined outcomes, enabling students to handle equipment, master techniques, collect data, and write reports. To enhance lab experiences:

- **Simulations**: Use simulation tools like MATLAB, Scilab, MULTISIM/PSPICE, or LabVIEW as pre-lab exercises to prepare students for experiments.
- **Optional Experiments**: Offer a variety of experiments, allowing students to choose additional ones aligned with their interests after completing mandatory tasks.
- **Problem Solving**: Encourage students to design their own approaches to scientific problems rather than following set procedures, increasing engagement.
- **Mini Projects**: Assign circuit/system design projects to develop project management and teamwork skills.
- **Virtual Remote Laboratories**: Promote virtual and remote labs to enhance accessibility and support lifelong learning alongside experimental skills.
- **Lab Reports**: Require reports that clearly connect theoretical concepts to experimental findings, including introductions, procedures, data, results, and conclusions.

e) **Project-Based Learning**: Foster critical thinking, problem-solving, creativity, collaboration, and project management through projects. Assessments should evaluate both the process and the final product via practical tests, presentations, and seminar papers.

f) **Summer Training/Internship**: Provide industrial training to expose students to professional environments, enhancing employability skills and enabling them to:

- Understand professional duties, responsibilities, and ethics.
- Communicate effectively in work settings.
- Learn general and specific industry procedures.

- Gain practical experience in relevant fields.
- Prepare technical reports.
- Apply knowledge to solve industry challenges.

g) **Industrial/Field Visits**: Organize visits to bridge the gap between academia and industry, allowing students to observe advanced technologies, gain hands-on experience, and understand societal and technological challenges.

h) **Invited Talks and Workshops**: Regularly host subject experts to discuss technological advancements, research, and industry needs, boosting students' confidence and self-learning abilities.

Assessment Methods

The assessment methods for the Four-Year Undergraduate Programme (FYUGP) ensure continuous evaluation aligned with the National Education Policy (NEP) 2020. The evaluation comprises In-Semester Assessments and End-Semester Examinations, with a 40:60-mark distribution per course. In-Semester Assessments (40% of total marks) include: Sessional Exam 1 (10 marks), Sessional Exam 2 (10 marks), Group Discussions (GD) or Activities (10marks), Seminars/ Assignments/ Projects/ Field Studies (10marks), and Other Academic Activities (10 marks). Students must appear for both Sessional Exams and any two remaining sub-components to complete In-Semester Assessment. These components use tools like objective tests, written tests, and practical assignments for skill development, with mandatory participation; non-compliance bars students from End-Semester Examinations. End-Semester Examinations (60%of total marks) have two types: courses without practical have 60-mark exams covering the syllabus through written tests focusing on problem-solving questions; courses with practical have 45-marks exams plus 15-marks practical evaluation by a Board of Examiners (internal course teacher and external examiner).

Assessment	Sub-Components	Marks	Details
In-Semester Assessment (40% of total,40 marks)	Sessional Exam1	10 marks (Mandatory)	First written/objective test to assess ongoing learning.
	Sessional Exam2	10 marks (Mandatory)	Second written/objective test to evaluate progress.
	GD/Group Activities	10 marks (Choose any2 of these)	Collaborative tasks fostering critical thinking, communication, and application skills.
	Seminars/Assignments/ Projects/ Field Studies		Collaborative/Individual tasks but individual reports/presentations
	Other Academic Activities		Flexible tasks assigned by the course teacher, e.g., quizzes, presentations, or case studies, tailored to course needs.

End-Semester Examination (60% of total)	Courses without Practical	60 marks	Written exam covering full course, emphasizing problem-solving and application-based questions (2-hour duration for 3/4-credit courses).
	Courses with Practical	Theory: 45 marks and Practical:15 marks	Theory exam (45 marks) covering full course; practical exam (15 marks) assessed by internal and External examiners, to be conducted before theory exams.

NB: For VAC (Value Added Course) *students are required to appear 1 Sessional Exam and any 1 activity among Group Discussions (GD) or Group Activities, Seminars/Assignments/Projects/Field Studies, and Other Academic Activities assigned by the course teacher.*

Programme Outcomes (POs)

The FYUGP in Electronics aims to achieve the following outcomes:

PO1: Disciplinary Knowledge: Graduates will build a strong foundation in theoretical concepts and experimental techniques in electronics.

PO2: Problem Solving Capacity: Graduates will apply electronics knowledge to identify, formulate, and solve complex problems using principles of mathematics, science, and engineering, supported by experimentation, data analysis, and interpretation.

PO3: Communication and Presentation Skills: Graduates will effectively convey technical information, ideas, and results through written, oral, and graphical communication.

PO4: Analytical and Critical Thinking: Graduates will critically evaluate information, assess methodologies and tools, and analyze diverse scenarios to advance knowledge.

PO5: Digital and ICT Efficiency: Graduates will proficiently use modern ICT tools in various learning and professional contexts to enhance capability and efficiency.

PO6: Teamwork and Leadership: Graduates will demonstrate teamwork and leadership skills, working collaboratively in diverse teams with coordination and cooperation.

PO7: Research and Inquiry: Graduates will develop observation, inquiry, and problem-identification skills to articulate issues effectively.

PO8: Multidisciplinary Learning: Graduates will adopt a multidisciplinary approach to solve real-world problems.

PO9: Ethics and Values: Graduates will adhere to ethical conduct and professional standards in their academic and professional endeavors.

PO10: Employability: Graduates will acquire the skills and knowledge necessary for employment in research, academia, industry, administration, and other sectors.

Curriculum Components and Structure

The Four-Year Undergraduate Programme (FYUGP) features a structured course categorization designed to foster multidisciplinary learning and holistic development, as outlined in the National Education Policy (NEP) 2020. The curriculum includes Major (Core) courses, which form the foundation of the chosen discipline, and Minor courses that complement the major by broadening knowledge in a secondary field. Multi-Disciplinary Courses (MDC) expose students to diverse domains, while Ability Enhancement Courses (AEC) develops essential language and communication skills. Skill Enhancement Courses (SEC) focuses on practical, industry-relevant competencies and Value-Added Courses (VAC) instill ethical and cultural values. Additionally, Internships, Apprenticeships, Projects, or Community Outreach (IAPC) provide hands-on experience, ensuring a balanced blend of theoretical and practical learning across the programme's 160 credits.

Curriculum Components

S.N.	Components	Description
1	Major Discipline(Core)	The main subject of study in which a student will earn their degree.
2	Minor Discipline (2nd Major, if opted)	A secondary subject that complements the major, providing broader knowledge.
3	Multi-Disciplinary Generic Elective (MDC)	Three introductory-level courses from other disciplines to broaden intellectual exposure.
4	Ability Enhancement Courses (AEC)	Courses to develop core skills like language proficiency, communication, and analytical thinking.
5	Value-Added Courses (VACs)	Courses focused on personal development, ethics, and sustainability.
6	Skill Enhancement Courses (SEC)	Practical and soft skills training for better employability.
7	Community Engagement	Real-world exposure through social service and outreach programs.
8	Field-Based Learning/Project	Practical learning through field visits and research-based activities.
9	Internship	Hands-on experience through industry exposure and training.
10	Research/Dissertation (For Honors with Research)	Advanced research work in a specific area for students opting for a research degree.
11	MOOCs (SWAYAM, Infosys Springboard, etc.)	Online certification courses that count for credit (up to 40% of total).
12	Value-Added Add-on Courses	Additional courses for skill enhancement that appears on the grade sheet but do not affect GPA.

General structure and distribution of number of Courses in the FYUGP in Electronics

Sem.	Major (Core)	Minor	MDC	AEC	VAC	SEC	Others	Total Credit
I	C101 (4)	MIN101 (4)	MDC101 (3)	AEC101 (4)	VAC101 (2)	SEC101 (3)	--	20
II	C202 (4)	MIN202 (4)	MDC202 (3)	AEC202 (4)	VAC202 (2)	SEC202 (3)	--	20
III	C303 C304 (4x2)	MIN303 (4)	MDC303 (3)	--	VAC303 (2)	SEC303 (3)	--	20
IV	C405, C406, C407, C408 (4x4)	MIN404 (4)	--	--	--	--	--	20
V	C509 C510 C511 (4x3)	MIN505 (4)	--	--	--	--	IAPC500 (4)	20
VI	C612 C613 C614 C615 (4x4)	MIN606 (4)	--	--	--	--	--	20
VII	C716 C717 C718 (4x3)	MIN707 (4)	--	--	--	--	RM700 (4)	20
VIII	C819 C820 (4x2)	MIN808 (4)	--	--	--	--	8 (Dissertation)/2DSE (4+4)	20
Total	80	32	9	8	6	9	16	160

Exit Options and Degree Structure for UG Programme

The Four-Year Undergraduate Programme (FYUGP), aligned with the NEP 2020, offers a flexible exit option structure for its UG programmes, catering to diverse student needs and ensuring academic and professional mobility. Students can exit after completing one year (40credits, including a 4-credit IAPC within1year of last Even End-Sem exam) to earn an Undergraduate Certificate. After two years (80 credits, including another 4-credit IAPC), they can exit with an Undergraduate Diploma. Completion of three years (120 credits) grants a 3-Year UG Degree, provided all credit requirements are met. For those pursuing the full four years (160credits), a 4-Year UG Degree (Honours) is awarded upon satisfying major credit requirements. Additionally, students achieving a minimum of 75% marks or a CGPA of 7.5 across the first three years can opt for a 4-Year UG Degree (Honours with Research), which includes 12 research credits and a mandatory research project or dissertation. This multi-exit framework, supported by the Academic Bank of Credits (ABC), allows students to accumulate and transfer credits, facilitating lifelong learning and seamless re-entry into the program within specified timeframes, such as three years for re-entry after obtaining a certificate or diploma, and upto seven years to complete the Honours or Honours with Research degrees.

Exit Level	Duration	Credits Earned	Additional Requirement/Remarks
UG Certificate	1 Year	40 Credits	1IAPC(4credits)within 1 year of last Even End-Sem exam
UG Diploma	2 Years	80 Credits	1IAPC(4credits)within 1 year of last Even End-Sem exam
3-YearUGDegree	3 Years	120 Credits	Must satisfy major credit requirements. IAPC in Summer Break
4-Year UG Degree (Honours)	4 Years	160 Credits	Must satisfy major credit requirements
4-Year UG Degree (Honours with Research)	4 Years	160 Credits (including 12 research credits)	75%+ marks in first 3 years + Research Project

Abbreviations used:

- ✓ **ABC**-Academic Bank of Credits
- ✓ **AEC**-Ability Enhancement Course
- ✓ **C**- Core Course

- ✓ **CBCS**-Choice Based Credit System
- ✓ **CGPA**-Cumulative Grade Point Average
- ✓ **DSE**-Discipline Specific Elective
- ✓ **ESE**-End-Semester Examination
- ✓ **FYUGP**-Four-Year Under graduate Programme
- ✓ **IA**-In-Semester Assessment
- ✓ **IAPC-Internship/Apprenticeship/Project/Community Outreach**
- ✓ **IKS**-Indian Knowledge System
- ✓ **MDC**-Multi-Disciplinary(Generic Elective)Course
- ✓ **MIL**-Modern Indian Language
- ✓ **MOOCs**-Massive Open Online Courses
- ✓ **NEP**-National Education Policy
- ✓ **NSQF**-National Skills Qualifications Framework
- ✓ **OJT**-On-the-Job Training
- ✓ **SEC**-Skill Enhancement Course
- ✓ **SGPA**-Semester Grade Point Average
- ✓ **SWAYAM**-Study Webs of Active-Learning for Young Aspiring Minds
- ✓ **UG**- Undergraduate
- ✓ **VAC**- Value Added Course

Semester	**Course Code**	**Course Title (Major)**	**Credits**
I	C-ELT-101-T	Basic Circuit Theory and Network	3
	C-ELT-101-P	Basic Circuit Theory and Network Lab	1
II	C-ELT-202	Mathematical Foundation and Quantum Mechanics	4
III	C-ELT-303-T	Semiconductor Devices	3
	C-ELT-303-P	Semiconductor Devices Lab	1
	C-ELT-304-T	Electronic Circuits	3
	C-ELT-304-P	Electronic Circuits Lab	1
IV	C-ELT-405-T	Operational Amplifiers and Applications	3
	C-ELT-405-P	Operational Amplifiers and Applications Lab	1
	C-ELT-406-T	Digital Electronics	3
	C-ELT-406-P	Digital Electronics Lab	1
	C-ELT-407-T	Electronic Instrumentation	3
	C-ELT-407-P	Electronic Instrumentation Lab	1
	C-ELT-408-T	C Programming and Data Structures	3
	C-ELT-408-P	C Programming and Data Structures Lab	1

V	C-ELT-509-T	Analog Communication	3
	C-ELT-509-P	Analog Communication Lab	1
	C-ELT-510-T	Signals and Systems	3
	C-ELT-510-P	Signals and Systems Lab	1
	C-ELT-511-T	Power Electronics	3
	C-ELT-511-P	Power Electronics Lab	1
VI	C-ELT-612-T	Advanced Communication System	3
	C-ELT-612-P	Advanced Communication System Lab	1
	C-ELT-613-T	Microprocessors and Microcontrollers	3
	C-ELT-613-P	Microprocessors and Microcontrollers lab	1
	C-ELT-614-T	Robotics	3
	C-ELT-614-P	Robotics Lab	1
	C-ELT-615-T	Electromagnetics	3
	C-ELT-615-P	Electromagnetics Lab	1
VII	C-ELT-716-T	Embedded Systems	3
	C-ELT-716-P	Embedded Systems Lab	1
	C-ELT-717-T	Digital Signal Processing	3
	C-ELT-717-P	Digital Signal Processing Lab	1
	C-ELT-718-T	Photonics	3
	C-ELT-718-P	Photonics Lab	1
VIII	C-ELT-819-T	VLSI Designing	3
	C-ELT-819-P	VLSI Designing Lab	1
	C-ELT-820-T	Nano Electronics	3
	C-ELT-820-P	Nano Electronics Lab	1

List of Discipline Specific Elective Courses (For 8th Semester): DSE Group I (in lieu of dissertation, any one)

Semester	Course Code	Course Title	Credits
VIII	DSE-ELT-601A-T	Machine Learning	3
	DSE-ELT-601A-P	Machine Learning Lab	1
	DSE-ELT-601B-T	Control Systems	3
	DSE-ELT-601B-P	Control Systems Lab	1
	DSE-ELT-601C-T	Internet of Things	3
	DSE-ELT-601C-P	Internet of Things Lab	1
	DSE-ELT-601D-T	Computer Networks	3
	DSE-ELT-601D-P	Computer Networks Lab	1

DSE Group II (in lieu of dissertation, any one)

Semester	Course Code	Course Title	Credits
VIII	DSE-ELT-602A-T	Fundamentals of Applied Physics	3
	DSE-ELT-602A-P	Fundamentals of Applied Physics Lab	1
	DSE-ELT-602B-T	Transmission Lines, Antenna and Wave	3
	DSE-ELT-602B-P	Transmission Lines, Antenna and Wave Lab	1
	DSE-ELT-602C-T	Digital System Design with Verilog/VHDL	3
	DSE-ELT-602C-P	Digital System Design with Verilog/VHDL Lab	1
	DSE-ELT-602D-T	Digital Image Processing	3
	DSE-ELT-602D-P	Digital Image Processing Lab	1

List of Skill Enhancement Courses:

Semester	Course Code	Course Title	Credits
I	SEC- ELT-101	Electrical Wiring and Maintenance	3
II	SEC- ELT-202A **OR** SEC- ELT-202B	Analytics / Computing With Python **OR** Basic Instrumentation Skills	3
III	SEC- ELT-303	APP Development using Flutter	3

List of Multi Disciplinary Generic Elective Courses:

Semester	Course Code	Course Title	Credits
I	MDC-ELT-101	Circuit Theory	3
II	MDC-ELT-202A Or MDC-ELT-202B	Medical Electronics Or Electronic Devices and Circuits	3
III	MDC-ELT-303	Digital Logic Circuits	3

List of Minor Courses:

Semester	Course Code	Course Title	Credits
I	MIN-ELT-101-T	Basic Circuit Theory and Network Analysis	3
	MIN-ELT-101-P	Basic Circuit Theory and Network Analysis Lab	1
II	MIN-ELT-202-T	Mathematical Foundation and Quantum Mechanics	4
III	MIN-ELT-303-T	Semiconductor Devices	3
	MIN-ELT-303-P	Semiconductor Devices Lab	1
IV	MIN-ELT-404-T	Electronics Circuits	3
	MIN-ELT-404-P	Electronics Circuits Lab	1
V	MIN-ELT-505-T	Digital Electronics	3
	MIN-ELT-505-P	Digital Electronics Lab	1
VI	MIN-ELT-606-T	Communication Electronics	3
	MIN-ELT-606-P	Communication Electronics Lab	1
VII	MIN-ELT-707-T	Microprocessors and Microcontrollers	3
	MIN-ELT-707-P	Microprocessors and Microcontrollers Lab	1
VIII	MIN-ELT-808-T	Signals and Systems	3
	MIN-ELT-808-P	Signals and Systems Lab	1

DETAILED SYLLABUS OF CORE COURSES

SEMESTER I

Course title: Basic Circuit Theory and Network Analysis
Course code: C-ELT-101-T
Nature of the course: Core
Total credits: 3
Distribution of marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course provides a comprehensive introduction to the fundamental concepts and techniques used in the analysis and design of electrical circuits and networks. It covers the basic principles governing electrical circuits, methods for analyzing complex circuits, and the use of network theorems to simplify circuit analysis. The course is essential for students pursuing a degree in electronics, laying the groundwork for advanced studies in circuit design, signal processing, and system analysis.

Course Objectives: The course objectives are designed to equip students with comprehensive knowledge and practical skills in electrical circuit analysis. Students will delve into fundamental concepts such as voltage, current, resistance, capacitance, and inductance, both in DC and AC circuits. They will learn to apply Kirchhoff's laws, mesh and node analysis, and various network theorems (such as Thevenin's and Norton's) to analyze and solve complex circuits. Practical aspects include understanding transient responses, resonance in RLC circuits, and the behavior of passive filters. The course also emphasizes phasor analysis for evaluating AC circuit characteristics and introduces students to impedance and transmission parameters in two-port networks.

Prerequisites:

- Fundamentals of mathematics
- Basic electricity and magnetism
- Basic electronic components

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

- **Demonstrate Knowledge of Circuit Components:** Accurately describe the construction, characteristics, and applications of voltage/current sources, resistors, inductors, and capacitors, including resistor color coding and source transformation techniques.
- **Analyze Electrical Networks:** Effectively apply Kirchhoff's laws, node analysis, mesh analysis, and star-delta conversions to determine voltages, currents, and power in complex network configurations.
- **Apply Network Theorems:** Solve DC and AC circuit problems using theorems such as Superposition, Thevenin's, Norton's, Reciprocity, Millman's, and Maximum Power Transfer, demonstrating proficiency in circuit simplification and analysis.
- **Characterize Two-Port Networks:** Compute and interpret impedance (Z), admittance (Y), hybrid (h), and transmission (ABCD) parameters to analyze and design two-port network systems.
- **Evaluate DC Transient Behavior:** Predict and analyze transient responses in RC, RL, and RLC circuits, including time constants, charging/discharging processes, and responses to DC sources.

- **Perform Comprehensive AC Analysis:** Analyze AC circuits to determine instantaneous, peak, RMS, and average values, and compute power (instantaneous, average, reactive) and power factor in RL, RC, and RLC circuits using phasor and complex impedance methods.
- **Design and Analyze Resonant Circuits and Filters:** Evaluate resonance in series and parallel RLC circuits, determine frequency response, quality factor, and bandwidth, and design passive filters (low-pass, high-pass, band-pass, and band-stop) for specific applications.
- **Solve Practical Circuit Problems:** Integrate theoretical knowledge and analytical skills to design, simulate, and troubleshoot electrical circuits, demonstrating competence in real-world circuit applications.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit I: Basic Circuit Concepts	Basic Circuit Concepts: Voltage and Current Sources. Source transformation, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors. Inductor and Capacitor: Constructions, working principles and types.	**8**	**0**	**0**	**8**
Unit-II: Network and Circuit Analysis	Elements of a Network, Network geometry; Graph and Tree of a network. Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion, Star-Delta Conversion. **Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. **Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Hybrid (h) Parameters, Transmission (ABCD) Parameters.	**15**	**0**	**0**	**15**

Unit-III: DC and AC Circuit Analysis	**DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits. **AC Circuit Analysis** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and **RLC Circuits.** Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.	**22**	**0**	**0**	**22**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examination **(20 Marks)**
2. GD/group activity/Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Electric Circuits, *S. A. Nasar*, Schaum's outline series, Tata McGraw Hill.
2. Electrical Circuits, *M. Nahvi and J. Edminister*, Schaum's Outline Series, Tata McGraw-Hill.
3. Essentials of Circuit Analysis, *Robert L. Boylestad*, Pearson Education.
4. Engineering Circuit Analysis, *W. H. Hayt, J. E. Kemmerly, S. M. Durbin*, Tata McGraw Hill.
5. Fundamentals of Electric Circuits, *Alexander and M. Sadiku*, McGraw Hill.

6. Network Analysis, G.K. Mithal, Khanna Publication
7. Circuit Theory (Analysis and Synthesis), Abhijit Chakrabarti, Dhanpat Rai and Co. (2018)
8. Electric Circuit Analysis, P. Ramesh Babu, Scitech-2010
9. Electrical Circuits, Schaum's Outline Series, M. Nahvi and J. Edminister, Tata McGraw Hill.(2005)

Course title: Basic Circuit Theory and Network Analysis
Course code: C-ELT-101-P
Nature of the course: Core
Total credits: 1
Distribution of marks: 15 (End sem)

List of Experiments
1. Verification of Thevenin's theorem
2. Verification of Norton's theorem.
3. Verification of Superposition Theorem
4. Verification of Reciprocity Theorem.
5. Verification of the Maximum Power Transfer Theorem
6. Design and study of first & second order passive low pass RC filter circuits
7. Design and study of first & second order passive high pass RC filter circuits
8. Design and study of first & second order passive band pass RC filter circuits
9. Design and study of first & second order passive band elimination RC filter circuits

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Course title: Basic Circuit Theory and Network Analysis
Course code: MIN-ELT-101-T
Nature of the course: Minor
Total credits: 3
Distribution of marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course provides a comprehensive introduction to the fundamental concepts and techniques used in the analysis and design of electrical circuits and networks. It covers the basic principles governing electrical circuits, methods for analyzing complex circuits, and the use of network theorems to simplify circuit analysis. The course is essential for students pursuing a degree in electronics, laying the groundwork for advanced studies in circuit design, signal processing, and system analysis.

Course Objectives: The course objectives are designed to equip students with comprehensive knowledge and practical skills in electrical circuit analysis. Students will delve into fundamental concepts such as voltage, current, resistance, capacitance, and inductance, both in DC and AC circuits. They will learn to apply Kirchhoff's laws, mesh and node analysis, and various network theorems (such as Thevenin's and Norton's) to analyze and solve complex circuits. Practical aspects include understanding transient responses, resonance in RLC circuits, and the behavior of passive filters. The course also emphasizes phasor analysis for evaluating AC circuit characteristics and introduces students to impedance and transmission parameters in two-port networks.

Prerequisites:

- Fundamentals of mathematics
- Basic electricity and magnetism
- Basic electronic components

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

- **Demonstrate Knowledge of Circuit Components:** Accurately describe the construction, characteristics, and applications of voltage/current sources, resistors, inductors, and capacitors, including resistor color coding and source transformation techniques.
- **Analyze Electrical Networks:** Effectively apply Kirchhoff's laws, node analysis, mesh analysis, and star-delta conversions to determine voltages, currents, and power in complex network configurations.
- **Apply Network Theorems:** Solve DC and AC circuit problems using theorems such as Superposition, Thevenin's, Norton's, Reciprocity, Millman's, and Maximum Power Transfer, demonstrating proficiency in circuit simplification and analysis.
- **Characterize Two-Port Networks:** Compute and interpret impedance (Z), admittance (Y), hybrid (h), and transmission (ABCD) parameters to analyze and design two-port network systems.
- **Evaluate DC Transient Behavior:** Predict and analyze transient responses in RC, RL, and RLC circuits, including time constants, charging/discharging processes, and responses to DC sources.
- **Perform Comprehensive AC Analysis:** Analyze AC circuits to determine instantaneous, peak, RMS, and average values, and compute power (instantaneous, average, reactive) and power factor in RL, RC, and RLC circuits using phasor and complex impedance methods.
- **Design and Analyze Resonant Circuits and Filters:** Evaluate resonance in series and parallel RLC circuits, determine frequency response, quality factor, and bandwidth, and design passive filters (low-pass, high-pass, band-pass, and band-stop) for specific applications.
- **Solve Practical Circuit Problems:** Integrate theoretical knowledge and analytical skills to design, simulate, and troubleshoot electrical circuits, demonstrating competence in real-world circuit applications.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit I: Basic Circuit Concepts	Basic Circuit Concepts: Voltage and Current Sources. Source transformation, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors. Inductor and Capacitor: Constructions, working principles and types.	**8**	**0**	**0**	**8**
Unit-II: Network and Circuit Analysis	Elements of a Network, Network geometry; Graph and Tree of a network. Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion, Star-Delta Conversion. **Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. **Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Hybrid (h) Parameters, Transmission (ABCD) Parameters.	**15**	**0**	**0**	**15**
Unit-III: DC and AC Circuit Analysis	**DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits. **AC Circuit Analysis** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and **RLC Circuits.**	**22**	**0**	**0**	**22**

	Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.				

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examination **(20 Marks)**
2. GD/group activity/Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Electric Circuits, *S. A. Nasar*, Schaum's outline series, Tata McGraw Hill.
2. Electrical Circuits, *M. Nahvi and J. Edminister*, Schaum's Outline Series, Tata McGraw-Hill.
3. Essentials of Circuit Analysis, *Robert L. Boylestad*, Pearson Education.
4. Engineering Circuit Analysis, *W. H. Hayt, J. E. Kemmerly, S. M. Durbin*, Tata McGraw Hill.
5. Fundamentals of Electric Circuits, *Alexander and M. Sadiku*, McGraw Hill.
6. Network Analysis, G.K. Mithal, Khanna Publication
7. Circuit Theory (Analysis and Synthesis), Abhijit Chakrabarti, Dhanpat Rai and Co. (2018)
8. Electric Circuit Analysis, P. Ramesh Babu, Scitech-2010
9. Electrical Circuits, Schaum's Outline Series, M. Nahvi and J. Edminister, Tata McGraw Hill.(2005)

Course title: Basic Circuit Theory and Network Analysis

Course code: MIN- ELT-101-P

Nature of the course: Minor

Total credits: 1

Distribution of marks: 15 (End sem)

List of Experiments

1. Verification of Thevenin's theorem
2. Verification of Norton's theorem.
3. Verification of Superposition Theorem
4. Verification of Reciprocity Theorem.
5. Verification of the Maximum Power Transfer Theorem
6. Design and study of first & second order passive low pass RC filter circuits
7. Design and study of first & second order passive high pass RC filter circuits
8. Design and study of first & second order passive band pass RC filter circuits
9. Design and study of first & second order passive band elimination RC filter circuits

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Course title: Circuit Theory
Course code: MDC-ELT-101
Nature of the course: Multi Disciplinary Generic Elective Course
Total credits: 3
Distribution of marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course provides a comprehensive introduction to basic circuit analysis, covering both DC and AC circuits. Topics include resistive elements, Kirchhoff's laws, mesh current and node voltage analysis, network theorems, and transient response analysis using Laplace transforms. Students will explore AC circuits, phasor diagrams, power factor, and three-phase circuit analysis. The course also delves into resonance and coupled circuits, examining their frequency response, quality factor, and bandwidth. Emphasis is placed on practical applications and problem-solving techniques to prepare students for more advanced studies in electrical engineering.

Course Objectives: This course aims to equip students with the fundamental principles and analytical techniques needed to understand and analyze electrical circuits. Students will learn to apply Ohm's Law, Kirchhoff's laws, and various network theorems to both DC and AC circuits. They will develop skills in transient response analysis and explore the behavior of resonant and coupled circuits. The course prepares students to tackle complex electrical engineering problems and provides a solid foundation for future studies in the field, emphasizing practical applications and critical thinking.

Prerequisites:

- Basic understanding of physics and mathematics.
- Familiarity with algebra and trigonometry.
- Introductory knowledge of calculus.
- General background in electrical concepts.

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

Analyze Basic Circuit Configurations: Apply Ohm's Law, Kirchhoff's laws, and techniques such as mesh current, node voltage, and star-delta conversion to analyze resistive circuits, including series and parallel resistor networks.

Apply Network Theorems: Utilize Thevenin's, Norton's, Superposition, Maximum Power Transfer, Reciprocity, and Millman's theorems to simplify and solve DC and AC circuits, demonstrating proficiency in circuit analysis and optimization.

Evaluate Transient Responses: Analyze the transient behavior of RL, RC, and RLC circuits under DC and AC sinusoidal inputs, using Laplace transform methods to determine charging/discharging characteristics and time-domain responses.

Perform AC Circuit Analysis: Calculate and interpret instantaneous, peak, peak-to-peak, RMS, and average values of sinusoidal signals, and analyze RL, RC, and RLC circuits using phasor diagrams, complex impedance, and power concepts (instantaneous, average, reactive, and power factor).

Investigate Resonance and Coupled Circuits: Evaluate series and parallel resonant circuits, determine their frequency response, quality factor, and bandwidth, and analyze coupled circuits, including self and mutual inductance, coefficient of coupling, and the behavior of tuned and single-tuned circuits.

Solve Practical Circuit Problems: Integrate theoretical concepts and analytical methods to design, analyze, and troubleshoot basic electrical circuits, demonstrating competence in applying circuit theory to real-world applications.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: Basic Circuits Analysis	Resistive elements, Ohm's Law, Resistors in series and parallel circuits, Kirchhoff's laws, Mesh current and node voltage - methods of analysis, Star-Delta Conversion.	**5**	**0**	**0**	**5**
Unit-II: Network Theorems	Thevenin's and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.	**9**	**0**	**0**	**9**
Unit-III: Transient Response Analysis	Circuit- Charging and discharging, Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.	**10**	**0**	**0**	**10**
Unit-V: Practicals	1 Familiarization with I. Resistance: Types and color codes II. Bread Board connection III. Resistance in series, parallel and series – Parallel. IV. Capacitors &	**0**	**0**	**16**	**16**

	Inductors in series & Parallel. V. Multimeter – Checking of components. VI. Voltage sources in series, parallel and series – Parallel 2 Voltage and Current divider circuit 3 Measurement of Amplitude, Frequency & Phase difference using CRO. 4 Verification of Kirchhoff's Law. 5 Verification of Norton's theorem. 6 Verification of Thevenin's Theorem. 7 Verification of Superposition Theorem. 8 Verification of the Maximum Power Transfer Theorem.				

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examinations: **(20 Marks)**
2. GD/group activity/Assignment / Presentation / Classroom interaction / Quiz etc.: **(20 Marks)**

Recommended Readings:

1. Engineering Circuits Analysis, *William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin*, McGraw Hill.
2. Fundamentals of Electric Circuits, Charles *K. Alexander, Mathew N. O. Sadiku*, McGraw Hill.

Course title: Electrical Wiring and Maintenance

Course code: SEC- ELT-101

Nature of the course: Skill Enhancement Course

Total credits: 3
Distribution of credits: Theory – 1, Practical - 2
Distribution of marks: 60 (End sem) **+ 40** (In-sem)

Course Description: This course provides a comprehensive overview of electrical circuits, focusing on both theoretical principles and practical applications. Students will learn about electric current, resistance, potential difference, and various voltage sources. The course covers different types of wiring, electrical symbols, and schematic drawings, emphasizing the design and implementation of domestic electrical systems. It also includes important safety protocols and protective devices. Through hands-on experience with tools and wiring accessories, students will develop practical skills essential for electrical installations and maintenance in residential and commercial environments.

Course Objectives: The primary objectives of this course are to equip students with a solid understanding of fundamental electrical concepts and practical wiring techniques. Students will learn to identify and use various electrical components and wiring systems, design and interpret electrical schematics, and implement safe and efficient electrical installations. The course aims to develop proficiency in handling tools and wiring accessories, understanding electrical protection devices, and adhering to safety standards. By the end of the course, students will be able to design, install, and maintain domestic and small-scale electrical systems, ensuring reliability and safety in all their electrical projects.

Prerequisites:

- Basic understanding of physics and mathematics, particularly concepts related to electricity and magnetism.
- Familiarity with fundamental electronic components and their functions.
- Ability to read and interpret simple electrical schematics.
- Basic hands-on experience with electrical tools and safety practices.
- Awareness of different types of electrical circuits and their applications.

Course Outcomes (COs): The students will able to
Gain foundational knowledge of electric circuits and components.
Understand various types of wiring systems and accessories.
Develop skills in reading and creating electrical drawings and schematics.
Understand the importance of electrical protection and safety measures.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: Basics of Electrical Circuits	Introductory concepts and basic circuit elements: Concept of Electric current and its unit, Conductors, Insulators, Resistance, potential and potential	**4**	**0**	**0**	**4**

	difference, different voltage sources (AC and DC), Ohm's law, electric power, electric energy, Series circuit, parallel circuit, combination circuit, AC current and voltage, single-phase and three-phase alternating current sources, Transformers, Unit of power and energy, kWh, KVA. Different types of light sources like filament bulb, tube (fluorescent) light, CFL, LED and Neon light, Different types of switches, two-way, three-way, four-way switches, fan regulators, dimmer, different types of domestic electrical appliances and their power.				
Unit-II: Types of wiring	Various types of tools and wiring accessories, Basics of wiring: casing-capping, PVC conduit wiring, concealed wiring (PVC/MS), comparison of different wire joint (flat and straight), types of wiring systems; selection and design of wiring schemes for particular situation (domestic), selection of wire, cables, wiring accessories and use of protective devices i.e., MCB, ELCB etc.; rating and current carrying capacity of wires, cables, fuse, switches, socket, MCBs, ELCBs and other electrical accessories.	**3**	**0**	**0**	**3**
Unit-III: Electrical Drawing and Symbols	Different types of electrical symbols used in domestic installation and power systems as per BIS code. Electrical Schematics. Reading of circuit schematics. Understanding the connections of elements and identifying current flow and voltage drop. Wiring diagram of light, fan, bell and alarm circuit, staircase wiring, schematic diagram of lighting system of small room, hall and conference room, circuit breakers, inverter connections, Design and drawing of panels, distribution board using MCB, ELCB, main switches and change over switches for domestic installations, Estimation of electrical materials for domestic wiring.	**4**	**0**	**0**	**4**
Unit-IV: Electrical	Earthing: Concept and purpose of earthing, different types and	**4**	**0**	**0**	**4**

Protection and Safety	procedure of earthing, drawing of plate and pipe earthing, test material and costing and estimating. Safety precautions: Effect of electric shock on human body, first aid for electric shock, rules and standards in house wiring, Introduction to Lightning Arresters–Types, Electrical Hazards and its effects- Basic, safety introduction-Personal protection and PPE, Basic injury prevention, Basic first aid.				

(Total Lectures 15, Total Contact Hours 15, Total Marks 20)

2-credits practical

Demonstration and Laboratory:

1. Safety use in electricity, shock treatment methods, safety precautions.
2. To study & find the specifications of various types of wires and cables.
3. To measure the gauge of a given wire with the help of a wire gauge.
4. Prepare a chart of wattage of different electrical items/ appliances like CFL bulb, LED bulb, Tube light, Ceiling Fan, Table Fan, Gyger, Mixer-grinder, Refrigerator, Water pump, Iron, Xerox Machine, Inverter, TV, Hanging/ pendant Light, Microwave oven etc.
5. Measurements of ac voltage with multimeter.
6. To connect the wires with different electrical accessories.
8. Skinning the cable and joint practice on single and multi-strand wire.
9. To make a main switch board for house wiring
10. Installation of common electrical accessories such as switch, holder, plug on board
11. Installation and wiring connection of ceiling fan, exhaust fan, geyser, and water purifier.
12. Preparation of extension board with switches, sockets and indicator.
13. Demonstrate electrical circuit diagrams related to electrical house hold appliances.
14. Carry out the earthing of the installed electrical circuit as per standard practice
15. Practice on different types of House Wiring installation and testing
16. House wiring circuits using fuse, switches, sockets, ceiling fan etc.in P. V. C. casing- capping.
17. Prepare one estimate of materials required for CTS wiring for small domestic installation of one room and one verandah within 25 m^2 with given light, fan & plug points.

(Total Practical Classes 30, Total Contact Hours 60, Total Marks 40)

Mode of In-semester Assessment:

1. Internal exam / Viva-voce: (Marks 20)
2. Laboratory performance / Notebook: (Marks 20)

Mode of End-semester Assessment:

1. Examination for 1 credit theory (Marks 20)
2. Examination for 2 credit practical (Marks 40)

Recommended Readings:

1. Elementary Electrical Engineering, *M. L. Gupta*, New Heights.
2. Electrical Installation and Estimating, *Surjit Singh*, Dhanpat Rai and Sons.
3. A Course in Electrical Installation, Estimating and Costing, *J B Gupta*, S K Kataria and Sons.
4. A Text Book in Electrical Technology, *B. L. Theraja*, S Chand & Co.
5. A Text Book of Electrical Technology, *A K Theraja,* S Chand & Co.

Semester II

Course title: Mathematical foundation and Quantum Mechanics

Course code: C-ELT-202-T

Nature of the course: Core

Total credits: 4

Distribution of Marks: 60 (End sem) **+ 40** (In-sem)

Course Description: This course offers undergraduate electronics students a comprehensive foundation in mathematical physics and quantum mechanics, equipping them with essential analytical and theoretical tools for success in electronics and related fields. Through a blend of vector calculus, matrix algebra, differential equations, complex variables, and probability, students will develop problem-solving skills critical for modeling and analyzing electronic systems. The course introduces core quantum mechanics concepts, including wave-particle duality, Schrödinger equations, quantum tunneling, and energy band theory, providing insights into the behavior of electrons in semiconductors and nanostructures like quantum dots and wells. By bridging mathematical rigor with practical applications, the course prepares students to tackle advanced topics in circuit design, solid-state electronics, and nanotechnology, fostering a deep understanding of the principles underlying modern electronic devices and technologies.

Course outcome (CO): Upon successful completion of this course, students will be able to:

1. **Apply Vector Calculus and Matrix Methods**: Perform vector operations, including scalar and vector products, and utilize vector calculus concepts such as gradient, divergence, curl, and theorems (Green, Gauss, Stokes) to solve physical problems. Solve systems of linear equations using matrix methods, and analyze properties of

matrices, including transpose, singular, diagonal, symmetric, skew-symmetric, and orthogonal matrices.

2. **Solve Differential Equations and Analyze Complex Variables**: Solve first- and second-order ordinary differential equations (separable, exact, linear, homogeneous, and non-homogeneous) and analyze complex functions for continuity, differentiability, and analyticity, applying these concepts to physical systems.
3. **Understand Probability Concepts**: Apply probability principles, including continuous and random variables, conditional probability, Bayes' theorem, laws of large numbers, and the central limit theorem, to model and analyze stochastic processes in physical systems.
4. **Explain Foundations of Quantum Mechanics**: Describe the origins of quantum mechanics, including wave-particle duality, De Broglie's hypothesis, wave packets, Heisenberg's uncertainty principle, Pauli's exclusion principle, and the general postulates of quantum mechanics, including wave functions and Schrödinger equations.
5. **Analyze Quantum Systems and Applications**: Solve time-dependent and time-independent Schrödinger equations for free and confined electrons, analyze potential well problems, quantization of energy, quantum tunneling, and apply the Kronig-Penney model to understand energy band theory, E-k band diagrams, density of states, and nanostructures like quantum dots, wires, and wells.
6. **Integrate Mathematical Tools with Quantum Concepts**: Synthesize vector calculus, matrix methods, differential equations, complex analysis, and probability to formulate and solve problems in quantum mechanics, demonstrating proficiency in applying mathematical techniques to model and interpret quantum phenomena.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I	Vector: Operations with vectors. Scalar and vector product; Vector Calculus. Scalar-valued functions, Vector function of a scalar variable: Vector differentiation & integration; gradient, divergence, and curl. Green, Gauss, Stokes Theorem. Matrices: Addition & multiplication of Matrices. Transpose of matrix, singular matrix, diagonal matrix, Symmetric and Skew – Symmetric matrices. Orthogonal matrix, solution of a system of linear equations by matrix method.	**15**	**0**	**0**	**15**
Unit-II	Differential Equations: First Order	**15**	**0**	**0**	**15**

	Ordinary Differential Equations, Separable Ordinary Differential Equations, Exact Ordinary Differential Equations, Linear Ordinary Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations. Complex Variables: Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Probability: continuous & random variables, Conditional probability, Bayes Theorem, Sum of random variables, the laws of large numbers, central limit theorem.				
Unit-III	Origin of quantum mechanics, wave particle duality, De Broglie's hypothesis, Wave packet, Heisenberg Uncertainty Principle, Pauli's exclusion principle, Wave function. General postulates of quantum mechanics, Time dependent & Time independent Schrödinger equation.	**15**	**0**	**0**	**15**
Unit-IV	Schrödinger equations of Free and confined electrons, potential well problems & Quantization of energy, Quantum tunneling, Kronig-penny model & energy band theory of solids, E-k band diagrams, density of states, basics of quantum dots, quantum wires and quantum wells.	**15**	**0**	**0**	**15**

(Total Lectures 60, Total Contact Hours 60, Total Marks 60)

Mode of In-semester Assessment:

1. Two internal examination **(20 Marks)**
2. GD/Group Activity/Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Advanced Engineering Mathematics, Erwin Kryszig, Wiley India

2. Introduction to Quantum Mechanics, D. J. Griffiths & D. F. Schroeter, Cambridge University

3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House(2007)

4. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)

Course title: Mathematical foundation and Quantum Mechanics
Course code: MIN-ELT-202-T
Nature of the course: Minor
Total credits: 4
Distribution of Marks: 60 (End sem) **+ 40** (In-sem)

Course Description: This course offers undergraduate electronics students a comprehensive foundation in mathematical physics and quantum mechanics, equipping them with essential analytical and theoretical tools for success in electronics and related fields. Through a blend of vector calculus, matrix algebra, differential equations, complex variables, and probability, students will develop problem-solving skills critical for modeling and analyzing electronic systems. The course introduces core quantum mechanics concepts, including wave-particle duality, Schrödinger equations, quantum tunneling, and energy band theory, providing insights into the behavior of electrons in semiconductors and nanostructures like quantum dots and wells. By bridging mathematical rigor with practical applications, the course prepares students to tackle advanced topics in circuit design, solid-state electronics, and nanotechnology, fostering a deep understanding of the principles underlying modern electronic devices and technologies.

Course outcome (CO): Upon successful completion of this course, students will be able to:

7. **Apply Vector Calculus and Matrix Methods**: Perform vector operations, including scalar and vector products, and utilize vector calculus concepts such as gradient, divergence, curl, and theorems (Green, Gauss, Stokes) to solve physical problems. Solve systems of linear equations using matrix methods, and analyze properties of matrices, including transpose, singular, diagonal, symmetric, skew-symmetric, and orthogonal matrices.
8. **Solve Differential Equations and Analyze Complex Variables**: Solve first- and second-order ordinary differential equations (separable, exact, linear, homogeneous, and non-homogeneous) and analyze complex functions for continuity, differentiability, and analyticity, applying these concepts to physical systems.
9. **Understand Probability Concepts**: Apply probability principles, including continuous and random variables, conditional probability, Bayes' theorem, laws of large numbers, and the central limit theorem, to model and analyze stochastic processes in physical systems.
10. **Explain Foundations of Quantum Mechanics**: Describe the origins of quantum mechanics, including wave-particle duality, De Broglie's hypothesis, wave packets, Heisenberg's uncertainty principle, Pauli's exclusion principle, and the general postulates of quantum mechanics, including wave functions and Schrödinger equations.
11. **Analyze Quantum Systems and Applications**: Solve time-dependent and time-independent Schrödinger equations for free and confined electrons, analyze potential well problems, quantization of energy, quantum tunneling, and apply the Kronig-Penney model to understand energy band theory, E-k band diagrams, density of states, and nanostructures like quantum dots, wires, and wells.
12. **Integrate Mathematical Tools with Quantum Concepts**: Synthesize vector calculus, matrix methods, differential equations, complex analysis, and probability to formulate

and solve problems in quantum mechanics, demonstrating proficiency in applying mathematical techniques to model and interpret quantum phenomena.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I	Vector: Operations with vectors. Scalar and vector product; Vector Calculus. Scalar-valued functions, Vector function of a scalar variable: Vector differentiation & integration; gradient, divergence, and curl. Green, Gauss, Stokes Theorem. Matrices: Addition & multiplication of Matrices. Transpose of matrix, singular matrix, diagonal matrix, Symmetric and Skew – Symmetric matrices. Orthogonal matrix, solution of a system of linear equations by matrix method.	**15**	**0**	**0**	**15**
Unit-II	Differential Equations: First Order Ordinary Differential Equations, Separable Ordinary Differential Equations, Exact Ordinary Differential Equations, Linear Ordinary Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations. Complex Variables: Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Probability: continuous & random variables, Conditional probability, Bayes Theorem, Sum of random variables, the laws of large numbers, central limit theorem.	**15**	**0**	**0**	**15**
Unit-III	Origin of quantum mechanics, wave particle duality, De Broglie's hypothesis, Wave packet, Heisenberg Uncertainty Principle, Pauli's exclusion principle, Wave function. General postulates of quantum mechanics, Time dependent & Time independent Schrödinger equation.	**15**	**0**	**0**	**15**
Unit-IV	Schrödinger equations of Free and confined electrons, potential well problems & Quantization of energy, Quantum tunneling, Kronig-penny	**15**	**0**	**0**	**15**

	model & energy band theory of solids, E-k band diagrams, density of states, basics of quantum dots, quantum wires and quantum wells.				

(Total Lectures 60, Total Contact Hours 60, Total Marks 60)

Mode of In-semester Assessment:

3. Two internal examination **(20 Marks)**
4. GD/Group Activity/Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Advanced Engineering Mathematics, Erwin Kryszig, Wiley India
2. Introduction to Quantum Mechanics, D. J. Griffiths & D. F. Schroeter, Cambridge University
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House(2007)
4. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)

Course title: Medical Electronics

Course code: MDC-ELT-202 A

Nature of the course: Multidisciplinary Generic Elective Course

Total credits: 3

Distribution of marks: 60 (End sem) **+ 40** (In-sem)

Unit	Content	L	T	P	Total Hours
Unit-I	Fundamental Electronics: Amplifiers, Frequency response, signal generation. Different types of transducers & their selection for biomedical applications. Electrode theory, selection criteria of electrodes & different types of electrodes Bio electric amplifiers	**10**	**0**	**0**	**10**
Unit-II	Introduction to Bio-medical instruments: Origin of bio-electric signals, active & passive transducer for medical application – Electrocardiography-waveform-standard lead systems, typical ECG amplifier, EEG electrode, recording systems, EMG basic principle-block diagram of a recorder	**12**	**0**	**0**	**12**
Unit-III	Medical Imaging: Nature and production of X-rays, Improving X-ray	**13**	**0**	**0**	**13**

	images, Computerised axial tomography, Using ultrasound in medicine, Ultrasound scanning, Magnetic resonance imaging PET and SPECT Imaging				
Unit-IV	Biomedical Signal Processing: Fundamentals of signal processing, digital image, transforming image, image enhancement, image Segmentation, image compression, image restoration and reconstruction of medical images. Demonstration using MATLAB	**10**	**0**	**0**	**10**

(Total Lectures 45, Total Contact Hours 45, Total Marks 60)

Mode of In-semester assessment:

1. Two internal examinations: **(20 Marks)**
2. GD/ Group Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. L Cromwell, F J Weibell, Eapfeiffer, Biomedical Instrumentation and measurements, PHI Publications.
2. Shakti Chatterjee, "Textbook of Biomedical Instrumentation System", Cengage Learning
3. Khandpur R. S. - Handbook of Biomedical Instrumentation, TMH
4. Prof. S.K.VenkataRam-Bio-Medical Electronics and Instrumentation, Galgotia Publications

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Course title: Electronic Devices and Circuits

Course code: MDC-ELT-202B

Nature of the course: Multidisciplinary Generic Elective Course

Total credits: 3

Distribution of marks: 60 (End sem) **+ 40** (In-sem)

Course Description: This course offers an in-depth study of electronic devices and circuits, focusing on PN junction devices, transistors, thyristors, and various amplifier configurations. Students will explore the structure, operation, and characteristics of diodes, BJTs, JFETs, MOSFETs, and other semiconductor devices. The course covers amplifier analysis, including small signal models and frequency response. Additionally, students will learn about multistage and differential amplifiers, power amplifiers, and feedback principles. The course also includes a comprehensive study of oscillators, their conditions for oscillation, and different types such as phase shift, Wien bridge, Hartley, Colpitts, and crystal oscillators.

Course Objectives: This course aims to provide students with a thorough understanding of electronic devices and circuit principles. Students will learn to analyze and design rectifiers, amplifiers, and oscillators. The course will enhance their knowledge of the operational characteristics and applications of PN junction diodes, transistors, and thyristors. Emphasis is placed on developing the ability to perform frequency response analysis and understand the impact of feedback in amplifier circuits. By the end of the course, students will be equipped with the skills needed to design and analyze complex electronic circuits.

Prerequisites:

- Basic understanding of physics and mathematics
- Familiarity with semiconductor physics
- Introductory knowledge of electrical circuits and components
- General background in electronics concepts

Course Outcomes (COs): The students will able to

Understand the principles and characteristics of PN junction devices.

Study the structure, operation, and characteristics of transistors and thyristors.

Analyze small-signal models and frequency response of amplifiers.

Study multistage amplifiers, differential amplifiers, and power amplifiers.

Understand feedback amplifiers and oscillator circuits.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: PN Junction Devices	PN junction diode, structure, operation and V-I characteristics, diffusion and transition capacitance, Rectifiers – Half Wave and Full Wave Rectifier, Display devices-LED, Laser diodes, Zener diode characteristics, Zener and Avalanche Breakdown Mechanism, Zener as regulator.	**9**	**0**	**0**	**9**
Unit-II: Transistors and Thyristors	BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.	**9**	**0**	**0**	**9**
Unit-III: Amplifiers	BJT small signal model, Analysis of CE, CB, CC amplifiers, Gain and frequency response, MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, Source follower, Gain and frequency response, High frequency analysis.	**9**	**0**	**0**	**9**

Unit-IV: Differential Amplifier	Differential amplifier, Common mode and Difference mode analysis, parameters of operational amplifier, Open and closed loop configuration, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator.	**9**	**0**	**0**	**9**
Unit-V: Feedback Amplifiers and Oscillators	Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.				

(Total Lectures 45, Total Contact Hours 45, Total Marks 60)

Mode of In-semester assessment:

1. Two internal examinations: **(20 Marks)**
2. GD/ Group Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Electronic devices and circuits, *David A. Bell*, Oxford University Higher Education.
2. Microelectronic circuits, *Sedra and Smith*, Oxford University Press.
3. Electronic devices and circuits, Balbir Kumar, *Shail. B. Jain*, PHI learning private Ltd.
4. Electronic devices, *Thomas L. Floyd*, Pearson Prentice Hall.
5. Electronic Circuit Analysis and Design, *Donald A. Neamen*, Tata McGraw Hill.
6. Electronic devices and circuit theory, *Robert L. Boylestad*.
7. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation *Robert B. Northrop*, CRC Press.

Course Title: Analytics / Computing With Python

Code: SEC- ELT-202A

Nature of the Course: Skill Enhancement Course

Credit assigned: 3

Distribution of credits: Theory – 1, Practical -2

Distribution of marks: 60 Marks

Course Description:

Course Objectives: The "Analytics/Computing with Python" course aims to equip students with essential skills in Python programming for data analytics and machine learning, fostering proficiency in handling, analyzing, and visualizing data. By introducing students to Python’s ecosystem, including tools like Anaconda, Jupyter Notebook, and libraries such as Pandas, NumPy, Matplotlib, Seaborn, and Sci-kit Learn, the course enables them to perform advanced data manipulation, cleansing, and visualization tasks. It also provides a foundational understanding of machine learning concepts, including supervised and unsupervised learning, with practical applications in linear and logistic regression. Additionally, the course emphasizes database integration through Python SQL connectivity, empowering students to manage data effectively and apply analytical techniques to real-world datasets, thereby enhancing their employability and research capabilities in data-driven fields.

Course Outcomes (COs): The students will able to

- Students will be able to learn about Python's main features and how they make Python a great tool for financial analysts.
- Students will be able to get familiarized with Anaconda and Jupyter Notebook.
- Students will be able to learn the basics of Machine learning.
- Students will be able to apply these techniques on data.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I	Python: General overview, Python vs. Excel, Anaconda and Jupyter notebook: Interface overview, Data types in Python, Python basic syntax: Assignment statements, creating variables, indentation, conditionals, and loops, writing user defined functions. Working with libraries: Pandas, NumPy, Matplotlib, and Seaborn. Python SQL Database Access: Introduction, Installation, DB Connection, Creating DB Table	**4**	**0**	**0**	**4**
Unit-II:	Pandas: Working with Data Frame, Importing from Excel or .csv files, Powerful filters and indexes. Numpy: Selecting data with loc and iloc, Using NumPy for speed, Trade-offs between arrays and lists, Array functions. Data cleansing and normalization: Libraries for data visualization, Types of charts/graphs and how to build them.	**5**	**0**	**0**	**5**
Unit-III	Machine learning: Introduction, Definitions, Supervised, unsupervised, python libraries for machine learning: Sci-kit learn, Regression: Linear regression, logistic regression, over-fitting and regularization.	**6**	**0**	**0**	**6**

(Total Lectures 15, Total Contact Hours 15, Total Marks 20)

2-credits practical

Demonstration and Laboratory:

1. **Setting Up Python Environment**

   Install Anaconda and explore the Jupyter Notebook interface.

   Create and run a simple Python script in Jupyter Notebook to print "Hello, World!" and demonstrate basic variable assignment.

2. **Python Basics and Syntax**

   Write a Python program that uses conditionals (if-else) and loops (for/while) to calculate the factorial of a user-input number.

   Create a user-defined function to compute the square of numbers in a given list and print the results.

3. **Working with Python Libraries**

   Use Pandas to load a sample dataset (e.g., CSV file) and display its first five rows.

   Create a simple line plot using Matplotlib and a heatmap using Seaborn from a sample dataset.

4. **Python SQL Database Access**

   Install a Python library like sqlite3 and create a SQLite database.

   Write a Python script to create a table, insert sample data, and retrieve records using SQL queries.

5. **Pandas Data Frame Operations**

   Import a CSV or Excel file into a Pandas DataFrame and perform operations like filtering rows based on a condition (e.g., values greater than a threshold).

   Use Pandas to group data by a column and compute summary statistics (e.g., mean, sum).

6. **NumPy Array Operations**

   Create a NumPy array and demonstrate the use of loc and iloc for data selection in a Pandas DataFrame.

   Write a Python script to compare the performance of NumPy arrays versus Python lists for a large dataset (e.g., summing 10,000 elements).

7. **Data Cleansing and Normalization**

   Load a dataset with missing values and use Pandas to handle missing data (e.g., fill with mean or drop rows).

   Normalize a numerical column in a dataset using Min-Max scaling or Z-score normalization.

8. **Data Visualization**

   Create a bar chart and a scatter plot using Matplotlib to visualize relationships in a dataset (e.g., sales vs. time).

   Use Seaborn to generate a box plot and a pair plot for a multivariate dataset.

9. **Introduction to Machine Learning**

   Load a sample dataset (e.g., Iris dataset from Sci-kit Learn) and explore its features and target variables.

   Split the dataset into training and testing sets using Sci-kit Learn's train_test_split.

10. **Linear Regression Model**

    Implement a linear regression model using Sci-kit Learn on a dataset (e.g., predicting house prices based on size).

Evaluate the model using metrics like Mean Squared Error (MSE) and R-squared.

11. **Logistic Regression Model**

    Apply logistic regression to a binary classification problem (e.g., predicting customer churn).

    Visualize the decision boundary using Matplotlib and compute the model's accuracy.

12. **Handling Overfitting**

    Implement a linear regression model with and without regularization (e.g., Ridge or Lasso) on a dataset with multiple features.

    Compare the performance of regularized and non-regularized models using cross-validation.

13. **Exploratory Data Analysis Project**

    Load a real-world dataset (e.g., from Kaggle) and perform exploratory data analysis using Pandas and NumPy.

    Generate multiple visualizations (e.g., histograms, scatter plots) to identify trends and patterns.

14. **Machine Learning Mini-Project**

    Build a machine learning pipeline using Sci-kit Learn to predict a target variable (e.g., student grades based on study hours and attendance).

    Present the results with visualizations and a summary of model performance.

15. **Database and Visualization Integration**

    Create a SQLite database, store a dataset, and retrieve it using Python.

    Use the retrieved data to generate a dashboard with multiple visualizations (e.g., bar chart, line chart) using Matplotlib and Seaborn.

(Total Practical Classes 30, Total Contact Hours 60, Total Marks 40)

Mode of In-semester assessment:

1. Internal exam / Viva-voce: **(Marks 20)**
2. Laboratory performance / Notebook: **(Marks 20)**

Mode of End-semester assessment:

1. Examination for 1 credit theory: **(Marks 20)**
2. Examination for 2 credit practical: **(Marks 40)**

Recommended Readings:

1. Pilgrim, M. (2004). Dive Into Python. Apress. Ch. 1,2,4
2. S Raschka, Python Machine Learning, V Mirjalili (2020), Ch 3
3. Mitchell, T. M. (1997). Machine Learning. New York: McGraw-Hill.
4. Liu, Y. (2019). Python machine learning by example: Implement machine learning algorithms and techniques to build intelligent systems (Second edition.). Packt Publishing.
5. Boschetti, A. (2016). Regression Analysis with Python (1st ed.). Packt Publishing.
6. Sivanandam, S.N., \& Deepa, S.N. (2011). Principles of soft computing.

Course Title: Design and Fabrication of Printed Circuit Boards
Course Code: SEC- ELT-202B
Nature of the Course: Skill Enhancement Course
Credit assigned: 3
Distribution of credits: Theory – 1, Practical -2
Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description: The course provides an in-depth understanding of the principles and practices involved in the design, fabrication, and application of Printed Circuit Boards (PCBs). This course covers the classification, components, and manufacturing processes of PCBs, emphasizing both theoretical concepts and practical skills. Students will learn about the schematic and layout design of PCBs, including component placement, conductor routing, and design considerations. Additionally, the course explores the technology of PCB fabrication, including design automation, materials used, soldering techniques, and quality control. Environmental concerns and recent advancements in the PCB industry will also be discussed.

Course Objectives: The primary objective of the course is to provide students with a comprehensive understanding of the principles and practices involved in the design, fabrication, and application of Printed Circuit Boards (PCBs). This course aims to equip students with the knowledge and technical skills necessary to effectively design and produce PCBs. Students will explore the basic concepts and classifications of PCBs, including single, double, multilayer, and flexible boards. They will gain proficiency in schematic and layout design, focusing on component placement, conductor routing, and essential design considerations. The course will delve into the materials and processes used in PCB fabrication, such as design automation, copper clad laminates, soldering techniques, and various printing and etching methods. Furthermore, students will develop the ability to perform quality control and testing to ensure PCB reliability and adherence to industry standards. By staying informed about the latest trends and environmental concerns in the PCB industry, students will be well- prepared to tackle real-world challenges in electronics design and manufacturing, enhancing their technical competence and employability in the field.

Course Outcomes (COs): The students will able to

- Understand the fundamental concepts of electric circuits and components.
- Gain proficiency in various types of wiring techniques and materials.
- Develop skills in reading electrical schematics and drawings.
- Understand safety measures and procedures in electrical installations.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: PCB Fundamentals	Advantages of PCB, Electronic components, Surface Mount	**4**	**0**	**0**	**4**

	Devices (SMD). Classification of PCB - single, double, multilayer and flexible boards, Manufacturing of PCB, PCB standards.				
Unit-II: Schematic and Layout Design	Schematic diagram, General, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding.	**5**	**0**	**0**	**5**
Unit-III: Technology OF PCB	Design automation, Design Rule Checking, copper clad laminates materials of copper clad laminates, properties of laminates (electrical & physical), types of laminates, soldering techniques. Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing and quality controls, Recent Trends and advances, Environmental concerns in PCB industry.	**6**	**0**	**0**	**6**

(Total Lectures 15, Total Contact Hours 15, Total Marks 20)

2-credits practical

Demonstration and Laboratory:

Hands on Tutorials/Demonstrations by using freeware version of Diptrace software/other open source equivalents:

1. Draw schematic circuit of RC band pass filter circuit and design its single sided PCB layout
2. Draw schematic circuit of Regulated DC power supply and design its single sided/double sided PCB layout
3. Draw schematic circuit of 741 Operational amplifier-based differentiator circuit and design its single sided/double sided PCB layout

PCB fabrication & etching:

1. Use screen printing / toner paper / CNC tools to convert the Diptrace PCB layout design above into actual PCB

Drilling and soldering:

2. Drilling should be done on the fabricated PCBs and components should be soldered during the demonstration session.

(Total Practical Classes 30, Total Contact Hours 60, Total Marks 40)

Mode of In-semester assessment:

1. Internal exam / Viva-voce: (Marks 20)
2. Laboratory performance / Notebook: (Marks 20)

Mode of End-semester assessment:

1. Examination for 1 credit theory: (Marks 20)
2. Examination for 2 credit practical: (Marks 40)

Recommended Readings:

1. Printed circuit Board – Design & Technology, *Walter C. Bosshart*, Tata McGraw Hill.
2. Printed Circuit Board – Design, Fabrication, Assembly & Testing, *R.S. Khandpur*, Tata McGraw Hill.

Semester III

Course title: Semiconductor Devices

Course code: C-ELT -303-T

Nature of the course: Core

Total credits: 3

Distribution of Marks: 45(End sem)+40 (In-sem)

Course Description: This course provides an in-depth understanding of electronic devices and their applications in circuits. It covers the fundamental principles of semiconductors, the operation of various diodes and transistors, and the characteristics of advanced electronic components. The course is designed to equip students with both theoretical knowledge and practical skills necessary for analyzing and designing electronic circuits.

Course Objectives: The course objectives for Semiconductor Devices focus on providing students with a comprehensive understanding of the fundamental principles, characteristics, and applications of semiconductor. Students will explore the foundational concepts of semiconductor materials, including energy bands, charge carriers, and doping mechanisms. They will study the operational principles and characteristics of semiconductor devices such as diodes, bipolar junction transistors (BJTs), field-effect transistors (FETs), and optoelectronic devices, gaining insights into their behavior in electronic circuits. The course aims to develop students' ability to analyze and design basic semiconductor circuits, applying theoretical knowledge to practical applications.

Prerequisites:

- Fundamental knowledge of electromagnetism, quantum mechanics and solid-state physics.
- Proficiency in calculus, differential equations, and linear algebra, as these are often used in modeling semiconductor devices and analyzing their behavior.
- Basic understanding of materials properties, especially semiconductor materials like silicon, germanium, and compound semiconductors.

Course Outcomes(COs): Upon successful completion of this course, students will be able to:

Understand Semiconductor Fundamentals: Explain the properties of semiconductor materials, including crystal structure, energy bands, effective mass, density of states, carrier concentration, Fermi level variations with temperature and doping, and carrier transport phenomena such as drift, diffusion, mobility, resistivity, and Hall effect.

Analyze P-N Junction Diodes: Describe the formation and characteristics of P-N junctions, derive barrier potential, depletion width, and diode equation, and analyze the I-V characteristics and applications of diodes, including Zener, Tunnel, Varactor, and Solar cells, as well as breakdown mechanisms (Zener and Avalanche).

Evaluate Bipolar Junction Transistors (BJTs): Analyze the operation of PNP and NPN transistors, including emitter efficiency, base transport factor, current gain, base-width modulation, and static characteristics in CB, CE, and CC configurations, and understand metal-semiconductor junctions (Ohmic and Rectifying contacts).

Investigate Field Effect Transistors (FETs): Explain the construction, working principles, and current-voltage characteristics of JFETs and MOSFETs (Depletion and Enhancement types, N- and P-channel), including channel formation, pinch-off, and CMOS technology, and evaluate their performance in electronic circuits.

Explore Power Devices: Describe the construction, operation, and characteristics of power devices such as UJT, SCR, Triac, Diac, IGBT, and MESFET, and analyze their applications in relaxation oscillators and power control circuits.

Apply Semiconductor Concepts to Circuit Design: Synthesize knowledge of semiconductor devices to analyze, design, and troubleshoot electronic circuits, demonstrating proficiency in applying theoretical principles to practical applications in electronics and power systems.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: Semiconductor Basics	Introduction to Semiconductor Materials, Crystal Structure, Planes and Miller Indices, Energy Band in Solids, Concept of Effective Mass	**12**	**0**	**0**	**12**

	and Density of States, Carrier Concentration in Intrinsic Semiconductors, Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes.				
Unit-II: P-N Junction Diode	Formation of Depletion Layer, Space Charge at a Junction, Derivation of Barrier Potential and Depletion Width, Depletion Capacitance. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Circuit Symbol, Characteristics and Applications of Zener diode, Tunnel diode, varactor diode and Solar cell	**12**	**0**	**0**	**12**
Unit-III: Bipolar Junction Transistors (BJT)	PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base- width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.	**10**	**0**	**0**	**10**
Unit-IV: Field Effect Transistors	JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and	**11**	**0**	**0**	**11**

	P Channel) and Enhancement type MOSFET (both N channel and P channel).Complimentary MOS (CMOS). **Power Devices:** UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR, Construction, Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.				

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examination (20 Marks)
2. GD/Group activity/ Assignment/ Presentation/ Attendance/ Classroom interaction/ Quiz etc. (20 Marks)

Recommended Readings:

1. Semiconductor Devices: Physics and Technology, *S. M. Sze*, WileyIndia.
2. Solid State Electronic Devices, *Ben G Streetman and S. Banerjee*, Pearson Education.
3. Transistors, *Dennis Le Croissette*, Pearson Education.
4. Semiconductor Devices: Basic Principles, *Jasprit Singh*, John Wiley and Sons.
5. Semiconductor Devices, *Kanaan Kano*, Pearson Education.
6. Semiconductor Device Fundamentals, *Robert F. Pierret*, Pearson Education.

Course title: Semiconductor Devices Lab
Course code: C-ELT-303-P
Nature of the course: Core Total credits: 1
Distribution of marks: 15 (End sem)

List of Experiments:

1. Identification of PN junction diode: its types, terminals
2. Study of the I-V Characteristics of Diode – Ordinary PN Diode.
3. Study of the I-V Characteristics of Zener Diode Diode.
4. Identification of BJT: its types, terminals
5. Study of the I-V Characteristics of the CE configuration of BJT and obtain ri, ro, β.
6. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain ri, ro, α.

7. Study of the I-V Characteristics of the UJT.
8. Study of the I-V Characteristics of the SCR.
9. Study of Characteristics of Solar Cell

Course title: Electronic Circuits
Nature of the course: Core
Course code: C-ELT-304-T
Total credits: 3
Distribution of Marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course explores fundamental principles and practical applications in electronic circuits and devices. Beginning with diode circuits and rectifiers, it progresses to bipolar junction transistors (BJTs) and field-effect transistors (MOSFETs), covering biasing techniques, amplifier configurations, feedback amplifiers, and oscillators. The curriculum delves into power amplifiers, including Class A, B, and C designs, and examines single-tuned amplifiers. Students learn through theoretical study and practical circuit analysis, focusing on characteristics, performance metrics, and applications of various electronic components and circuits. Emphasis is placed on understanding circuit behavior, design considerations, and applications in modern electronic systems.

Course Objectives: The primary objective of the Electronic Circuits course is to provide students with a thorough understanding of the fundamental principles and applications of electronic circuits. This course aims to equip students with the skills necessary to analyze and design various electronic circuits involving diodes, transistors, and operational amplifiers. Students will gain proficiency in circuit analysis techniques, including dc and ac load line analysis, and will learn to use hybrid models for transistor circuits. The course will also cover the concepts of feedback in amplifiers, enabling students to understand and design both negative and positive feedback circuits, as well as oscillators. Additionally, the course will introduce students to MOSFET circuits, power amplifiers, and single tuned amplifiers, providing a comprehensive understanding of their operation, design, and applications. Through a combination of theoretical knowledge and practical laboratory experiments, students will develop problem-solving skills and the ability to apply their learning to real-world electronic circuit design and analysis.

Prerequisites:

- Proficiency in algebra, calculus, and differential equations.
- Fundamental knowledge of electromagnetism and electric circuits.
- Basic knowledge of electronic components (resistors, capacitors, inductors) and simple circuits.

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

Analyze Diode-Based Circuits: Evaluate the behavior of ideal and piecewise linear diode models, perform DC load line analysis, and design clipping, clamping, rectifier (HWR, FWR), and filter circuits, while analyzing their ripple factor, efficiency, and waveforms.

Design and assess Zener diode regulator circuits for load and line regulation, identifying their limitations.

Understand and Design BJT Circuits: Analyze CE and CB transistor characteristics, biasing techniques (fixed, collector-to-base, voltage divider, emitter bias), and stability factors to prevent thermal runaway. Design BJT-based switches, Darlington pairs, and CE amplifiers, and perform DC and AC load line analysis, hybrid parameter modeling, and frequency response studies for single and cascaded CE amplifiers.

Evaluate Feedback Amplifiers and Oscillators: Explain the principles of negative and positive feedback, analyze voltage and current feedback amplifiers (series and shunt) for gain and impedance characteristics, and apply Barkhausen criteria to design and evaluate phase shift, Colpitts, and Hartley oscillators.

Analyze MOSFET and Power Amplifier Circuits: Analyze depletion and enhancement MOSFETs, their biasing, and small-signal parameters, and design common source amplifiers and CMOS circuits. Compare voltage and power amplifiers, evaluate Class A, B, and C power amplifiers for efficiency and distortion, and analyze transformer-coupled Class A and complementary symmetry Class B push-pull amplifiers, including crossover distortion and heat sink requirements.

Design and Assess Tuned Amplifiers: Design single-tuned amplifiers, analyze their frequency response and limitations, and evaluate their applications in communication circuits.

Apply Analog Circuit Design Principles: Synthesize knowledge of diode, BJT, MOSFET, feedback, and power amplifier circuits to design, simulate, and troubleshoot analog electronic systems, demonstrating proficiency in practical applications for communication and signal processing.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I: Diode Circuits	Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers: HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. Filters: types, circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.	**10**	**0**	**0**	**10**
Unit-II: Bipolar Junction Transistor	Review of CE, CB Characteristics and regions of operation. Hybrid parameters. Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with RE,	**10**	**0**	**0**	**10**

	collector to base bias, voltage divider bias and emitter bias (+VCC and –VEE bias), circuit diagrams and their working. Transistor as a switch, circuit and working, Darlington pair and its applications. BJT amplifier (CE), dc and ac load line analysis, hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).				
Unit-III: Feedback Amplifiers	Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances. Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.	**10**	**0**	**0**	**10**
Unit-IV: MOSFET Circuits	Review of depletion and enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits. **Power Amplifiers:** Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of a Class A single ended power amplifier. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion, heat sinks. **Single tuned amplifiers**: Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits.	**15**	**0**	**0**	**15**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45) Mode of In-semester Assessment:

1. Two internal examination **(20 Marks)**
2. GD/Gorup Activity/ Assignment / Presentation / Classroom interaction / Quiz etc.

(20 Marks)

Recommended Readings:

1. Electronic Devices and circuit theory, *Robert Boylstead and Louis Nashelsky*, PHI.
2. Electronic devices, *David A Bell*, Reston Publishing Company.
3. Electronic Circuits: Discrete and Integrated, *D. L. Schilling and C. Belove*, Tata McGraw Hill.
4. Electronic Circuit Analysis and Design, *Donald A. Neamen*, Tata McGraw Hill.
5. Integrated Electronics, *J. Millman and C. C. Halkias*, Tata McGraw Hill.
6. Microelectronic Circuit Design, *J. R. C. Jaegar and T. N. Blalock*, Tata McGraw Hill.
7. 2000 Solved Problems in Electronics, *J. J. Cathey*, Schaum's outline Series, Tata McGraw Hill.
8. Electronic Devices and Circuits, *Allen Mottershed*, Goodyear Publishing Corporation.

Course title: Electronic Circuits
Nature of the course: Core
Course code: C-ELT-304-P
Total credits: 1
Distribution of Marks: 15 (End sem)

List of Experiments:

1. Study of the half wave rectifier and Full wave rectifier.
2. Study of power supply using C filter and Zener diode.
3. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation.
4. Study of clipping and clamping circuits.
5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
6. Designing of a Single Stage CE amplifier.
7. Study of Class A, B and C Power Amplifier.
8. Study of the Colpitts's Oscillator.
9. Study of the Hartley's Oscillator.
10. Study of the Phase Shift Oscillator
11. Study of the frequency response of Common Source FET amplifier.

Course title: Semiconductor Devices
Course code: MIN-ELT-303-T
Nature of the course: Minor
Total credits: 3
Distribution of Marks: 45(End sem)+40 (In-sem)

Course Description: This course provides an in-depth understanding of electronic devices and their applications in circuits. It covers the fundamental principles of semiconductors, the operation of various diodes and transistors, and the characteristics of advanced electronic components. The course is designed to equip students with both theoretical knowledge and practical skills necessary for analyzing and designing electronic circuits.

Course Objectives: The course objectives for Semiconductor Devices focus on providing students with a comprehensive understanding of the fundamental principles, characteristics, and applications of semiconductor. Students will explore the foundational concepts of semiconductor materials, including energy bands, charge carriers, and doping mechanisms. They will study the operational principles and characteristics of semiconductor devices such as diodes, bipolar junction transistors (BJTs), field-effect transistors (FETs), and optoelectronic devices, gaining insights into their behavior in electronic circuits. The course aims to develop students' ability to analyze and design basic semiconductor circuits, applying theoretical knowledge to practical applications.

Prerequisites:

- Fundamental knowledge of electromagnetism, quantum mechanics and solid-state physics.
- Proficiency in calculus, differential equations, and linear algebra, as these are often used in modeling semiconductor devices and analyzing their behavior.
- Basic understanding of materials properties, especially semiconductor materials like silicon, germanium, and compound semiconductors.

Course Outcomes(COs): Upon successful completion of this course, students will be able to:

Understand Semiconductor Fundamentals: Explain the properties of semiconductor materials, including crystal structure, energy bands, effective mass, density of states, carrier concentration, Fermi level variations with temperature and doping, and carrier transport phenomena such as drift, diffusion, mobility, resistivity, and Hall effect.

Analyze P-N Junction Diodes: Describe the formation and characteristics of P-N junctions, derive barrier potential, depletion width, and diode equation, and analyze the I-V characteristics and applications of diodes, including Zener, Tunnel, Varactor, and Solar cells, as well as breakdown mechanisms (Zener and Avalanche).

Evaluate Bipolar Junction Transistors (BJTs): Analyze the operation of PNP and NPN transistors, including emitter efficiency, base transport factor, current gain, base-width modulation, and static characteristics in CB, CE, and CC configurations, and understand metal-semiconductor junctions (Ohmic and Rectifying contacts).

Investigate Field Effect Transistors (FETs): Explain the construction, working principles, and current-voltage characteristics of JFETs and MOSFETs (Depletion and Enhancement types, N- and P-channel), including channel formation, pinch-off, and CMOS technology, and evaluate their performance in electronic circuits.

Explore Power Devices: Describe the construction, operation, and characteristics of power devices such as UJT, SCR, Triac, Diac, IGBT, and MESFET, and analyze their applications in relaxation oscillators and power control circuits.

Apply Semiconductor Concepts to Circuit Design: Synthesize knowledge of semiconductor devices to analyze, design, and troubleshoot electronic circuits, demonstrating proficiency in applying theoretical principles to practical applications in electronics and power systems.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I: Semiconductor Basics	Introduction to Semiconductor Materials, Crystal Structure, Planes and Miller Indices, Energy Band in Solids, Concept of Effective Mass and Density of States, Carrier Concentration in Intrinsic Semiconductors, Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes.	**12**	**0**	**0**	**12**
Unit-II: P-N Junction Diode	Formation of Depletion Layer, Space Charge at a Junction, Derivation of Barrier Potential and Depletion Width, Depletion Capacitance. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Circuit Symbol, Characteristics and Applications of Zener diode, Tunnel diode, varactor diode and Solar cell	**12**	**0**	**0**	**12**
Unit-III: Bipolar Junction Transistors (BJT)	PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis	**10**	**0**	**0**	**10**

	of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base- width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.				
Unit-IV: Field Effect Transistors	JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel).Complimentary MOS (CMOS). **Power Devices:** UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR, Construction, Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.	**11**	**0**	**0**	**11**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examination (20 Marks)
2. GD/Group activity/ Assignment/ Presentation/ Attendance/ Classroom interaction/ Quiz etc. (20 Marks)

Recommended Readings:

7. Semiconductor Devices: Physics and Technology, *S. M. Sze*, WileyIndia.
8. Solid State Electronic Devices, *Ben G Streetman and S. Banerjee*, Pearson Education.
9. Transistors, *Dennis Le Croissette*, Pearson Education.
10. Semiconductor Devices: Basic Principles, *Jasprit Singh*, John Wiley and Sons.
11. Semiconductor Devices, *Kanaan Kano*, Pearson Education.
12. Semiconductor Device Fundamentals, *Robert F. Pierret*, Pearson Education.

Course title: Semiconductor Devices Lab
Course code: MIN-ELT-303-Lab
Nature of the course: Minor
Total credits: 1
Distribution of marks: 15 (End sem)

List of Experiments:

10. Identification of PN junction diode: its types, terminals
11. Study of the I-V Characteristics of Diode – Ordinary PN Diode.
12. Study of the I-V Characteristics of Zener Diode Diode.
13. Identification of BJT: its types, terminals
14. Study of the I-V Characteristics of the CE configuration of BJT and obtain ri, ro, β.
15. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain ri, ro, α.
16. Study of the I-V Characteristics of the UJT.
17. Study of the I-V Characteristics of the SCR.
18. Study of Characteristics of Solar Cell

Course title: Digital Logic Circuits
Course code: MDC-ELT-303
Nature of the course: Multidisciplinary Generic Elective Course
Total credits: 3
Distribution of marks: 60 (End sem) **+ 40** (In-sem)

Course Description: This course delves into the fundamentals of digital electronics, encompassing number systems, digital logic families, combinational and sequential circuits, and programmable logic devices. Students will learn about binary codes, error detection and correction, and various digital logic families such as RTL, DTL, TTL, ECL, and MOS. The course covers the design and implementation of combinational circuits using K-maps and explores synchronous and asynchronous sequential circuits. Additionally, it introduces programmable logic devices like PROM, PLA, PAL and CPLD.

Course Objectives: This course aims to provide a comprehensive understanding of digital electronics, focusing on the design and analysis of digital circuits. Students will gain proficiency in number systems, binary codes, and digital logic families. They will learn to design combinational and sequential circuits, including counters and shift registers, and understand the principles of programmable logic devices. By the end of the course, students will be equipped with the skills necessary to design, analyze, and implement complex digital systems.

Course Outcomes (COs): The students will able to

Understand number systems, binary codes, and digital logic families.
Design and analyze combinational logic circuits.
Understand and design synchronous sequential circuits.
Analyze and design asynchronous sequential circuits and programmable logic devices.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: Number Systems and Digital Logic Families	Number systems, Binary, Octal and Hexadecimal arithmetic, binary codes, error detection and correction codes (Parity and Hamming code), Digital Logic Families - comparison of RTL, DTL, TTL, ECL and MOS families.	**9**	**0**	**0**	**9**
Unit-II: Combinational Circuits	Combinational logic, representation of logic functions, SOP and POS forms, K-map representations, minimization using K maps, simplification and implementation of combinational logic, multiplexers and de multiplexers, Encoders and Decoders, binary Adder, half and full adder, binary subtractor.	**9**	**0**	**0**	**9**
Unit-III	Latches and Flip flops, S-R Flip flop, J-K Flip flop, T and D type Flip flop, Clocked and edge triggered Flip flops, Registers, Counters (synchronous and asynchronous and modulo-N), Ripple counter, up and down counter State Table, State Diagrams, Ring counter and Johnson counter.	**9**	**0**	**0**	**9**
Unit-IV: Practical	1. To verify and design AND gate using IC 2. To verify and design OR gate using IC 3. To verify and design NOT gate using IC 4. To verify and design NAND Gate using IC 5. To verify and design NOR Gate using IC 6. To verify and design XOR gate using IC	**18**	**0**	**0**	**18**

(Total Lectures 45, Total Contact Hours 45, Total Marks 60)

Mode of In-semester Assessment:

1. Two internal examinations: **(20 Marks)**

2. GD/Group Activity/Assignment / Presentation / Classroom interaction / Quiz etc.: **(20 Marks)**

Recommended Readings:

1. Digital Electronics, James *W. Bignel*, Cengage learning.
2. Digital Design with an introduction to the VHDL, *M. Morris Mano*, Pearson Education.
3. Digital Logic & State Machine Design, *Comer*, Oxford.
4. Digital Electronics Principles & Application, *Mandal*, McGraw Hill.
5. Digital Electronics - A Practical Approach with VHDL, *William Keitz*, Pearson.
6. Digital Fundamentals, *Thomas L. Floyd*, Pearson Education.
7. Digital System Design using VHDL, *Charles H. Roth, Jr, Lizy Lizy Kurian John*, Cengage.
8. Digital circuits and Design, *D. P. Kothari, J. S. Dhillon*, Pearson Education.

Course Title: APP Development using Flutter

Course Code: SEC- ELT-30**3**

Nature of the Course: Skill Enhancement Course

Credit assigned: 3

Distribution of credits: Theory – 1, Practical - 2

Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description:

Course Objectives: The "App Development using Flutter" course is designed to empower students with the skills to develop cross-platform mobile applications for Android, iOS, and web using the Flutter framework. The course introduces students to the fundamentals of Flutter, including its installation, widget-based architecture, and Dart programming language, enabling them to build interactive and responsive user interfaces. It aims to provide hands-on experience in state management, package integration, and structuring Flutter applications, while also covering advanced topics such as accessing REST APIs, database concepts, widget testing, and app deployment to major platforms like Google Play Store and Apple App Store. By the end of the course, students will be proficient in creating, testing, and deploying robust Flutter applications with a single codebase, preparing them for careers in mobile app development.

Course Outcomes (COs): The students will able to

- Students will be able to Install and use flutter
- Students will be able to use DART language
- Students will be able to build a cross-platform APP
- Students will be able to deploy application with single codebase.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I	Introduction to Flutter, Flutter - installation, Widgets, Gestures (Title, Body, Layouts, Columns, Root, Run app)	**4**	**0**	**0**	**4**
Unit-II	State Management, Flutter - Introduction To Package, Build method, Dart packages, app bar, text widgets, Scaffold, Containers, Structuring flutter apps, Using GitHub repos of flutter.	**5**	**0**	**0**	**5**
Unit-III	Flutter - Accessing Rest API, Database Concepts, Testing (Widget Testing). Deployment (Android Application On Play Store, IOS Application On APP Store)	**6**	**0**	**0**	**6**

(Total Lectures 15, Total Contact Hours 15, Total Marks 20)

2-credits practical

Demonstration and Laboratory:

1. **Flutter Installation and Setup**
    - Install Flutter SDK and set up the development environment (including Dart and Android Studio/VS Code).
    - Create and run a default Flutter app on an emulator or physical device to verify the setup.
2. **Exploring Flutter Widgets**
    - Build a simple Flutter app with basic widgets (e.g., Text, Container, Row, Column) to create a user profile card.
    - Experiment with GestureDetector to handle tap and swipe gestures in a Flutter app.
3. **Designing Layouts**
    - Create a Flutter app with a structured layout using Scaffold, AppBar, and Body to design a homepage.
    - Implement a grid layout using GridView to display a collection of images or items.
4. **State Management Basics**
    - Build a counter app using StatefulWidget to demonstrate state management in Flutter.
    - Modify the counter app to persist the counter value using setState and display changes dynamically.

5. **Using Dart Packages**
    - Integrate a Dart package (e.g., http for network requests) into a Flutter app from pub.dev.
    - Create an app that uses the url_launcher package to open a website or dial a phone number.
6. **Structuring Flutter Apps**
    - Develop a multi-screen Flutter app with navigation (e.g., a to-do list app) using Navigator and named routes.
    - Organize the app into modular files (e.g., separate files for widgets, models, and screens).
7. **Exploring GitHub Repos**
    - Clone a sample Flutter project from GitHub and run it locally to explore its structure.
    - Modify the cloned project by adding a new feature (e.g., a new button or screen).
8. **Accessing REST APIs**
    - Build a Flutter app that fetches and displays data from a public REST API (e.g., JSONPlaceholder) using the http package.
    - Implement error handling and loading states for API requests in the app.
9. **Database Concepts**
    - Create a Flutter app that uses SQLite (via the sqflite package) to store and retrieve a list of tasks locally.
    - Implement CRUD (Create, Read, Update, Delete) operations for the task list.
10. **Widget Testing**
    - Write unit tests for a Flutter widget (e.g., a custom button) using the flutter_test package.
    - Perform widget testing to verify the behavior of a text input field in a form.
11. **App Deployment Preparation**
    - Configure a Flutter app for release by setting up app icons, splash screens, and version details.
    - Generate a signed APK for Android and test it on a physical device.
12. **Deploying to Play Store**
    - Create a developer account on Google Play Console (simulated or guided) and prepare an app bundle for submission.
    - Follow the steps to upload and publish a simple Flutter app to the Google Play Store (mock exercise if actual deployment is not feasible).
13. **Deploying to App Store**
    - Simulate the process of preparing a Flutter app for iOS deployment, including generating an IPA file.
    - Document the steps required to submit an app to the Apple App Store, including provisioning profiles and certificates.
14. **Quiz App Project**
    - Develop a cross-platform quiz app with features like multiple-choice questions, score tracking, and a results screen.
    - Incorporate state management, API integration (e.g., fetching questions),

and local storage for saving high scores.

15. **Custom App Project**
    - Design and build a unique cross-platform app based on a student's idea (e.g., a weather app, note-taking app, or fitness tracker).
    - Implement advanced features like API calls, local database storage, and widget testing, and prepare the app for deployment.

(Total Practical Classes 30, Total Contact Hours 60, Total Marks 40)

Mode of In-semester Assessment:

1. Internal exam / Viva-voce: **(Marks 20)**
2. Laboratory performance / Notebook: **(Marks 20)**

Mode of End-semester Assessment:

1. Examination for 1 credit theory: **(Marks 20)**
2. Examination for 2 credit practical: **(Marks 40)**

Recommended readings:

1. https://docs.flutter.dev/
2. https://github.com/flutter

Semester IV

Course title: Operational Amplifiers and Applications
Nature of the course: Core
Course code: C-ELT-405-T
Total credits: 3
Distribution of Marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course provides a comprehensive study of operational amplifiers (Op-Amps) and their applications in electronic circuits. Starting with basic concepts and operational parameters of Op-Amps such as differential amplifiers and current mirrors, it progresses to various configurations including inverting, non-inverting, summing, and difference amplifiers. The course covers advanced topics like integrators, differentiators, comparators, and signal generators such as oscillators and voltage-controlled oscillators. Additionally, it explores multivibrators, phase-locked loops (PLL), and signal conditioning circuits like active filters and regulators. Practical circuit design, analysis techniques, and applications in signal processing are emphasized throughout the course.

Course Objectives: This course offers a comprehensive study of electronic circuits, emphasizing operational amplifiers (op-amps) and their diverse applications. Topics covered include differential amplifiers, op-amp parameters, and various amplifier configurations (inverting, non-inverting, summing, and difference amplifiers). Students will also explore comparators, signal generators (oscillators, square, triangle, sawtooth wave generators), multivibrators (IC 555), phase-locked loops (IC 565), and IC regulators (IC 78xx, 79xx, LM317). The course includes signal conditioning circuits such as active filters and log amplifiers. Through both theoretical learning and practical exercises, students will gain skills in designing, analyzing, and implementing electronic circuits.

Prerequisites:

- Fundamental knowledge of electromagnetism and electric circuits.
- Proficiency in algebra, calculus, and differential equations.
- Familiarity with basic electronic components and circuits.

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

- **Understand Operational Amplifier Fundamentals**: Explain the structure and operation of differential amplifiers, current mirrors, cascaded stages, and level translators in an operational amplifier (IC 741), and analyze key op-amp parameters such as input offset voltage, input bias current, common mode rejection ratio, slew rate, and supply voltage rejection ratio.
- **Design and Analyze Op-Amp Circuits**: Design and evaluate open-loop and closed-loop op-amp configurations, including inverting, non-inverting, summing, difference, integrator, and differentiator amplifiers, as well as voltage-to-current and current-to-voltage converters. Analyze frequency response and implement comparators, level detectors, voltage limiters, and Schmitt triggers.
- **Develop Signal Generators and Oscillators**: Design and analyze op-amp-based signal generators, including phase shift, Wein bridge, square wave, triangle wave, sawtooth wave, and voltage-controlled oscillators (IC 566), and evaluate their performance in generating precise waveforms.
- **Implement Multivibrators and PLL Circuits**: Design astable and monostable multivibrator circuits using IC 555, analyze their applications, and develop phase-locked loop (PLL) circuits using IC 565, understanding phase detectors and their role in signal synchronization.
- **Understand Voltage Regulators**: Explain the operation of fixed (IC 78xx, 79xx) and variable (IC LM317) voltage regulators, derive output voltage equations, and apply these concepts to design stable power supply circuits.
- **Design Signal Conditioning Circuits**: Develop and analyze sample-and-hold systems, first- and second-order Butterworth low-pass, high-pass, band-pass, band-reject, and all-pass filters, as well as log and antilog amplifiers, for effective signal processing and conditioning in electronic systems.
- **Apply Op-Amp Concepts to Practical Systems**: Synthesize knowledge of op-amps, multivibrators, regulators, and signal conditioning circuits to design, simulate, and troubleshoot analog electronic systems for applications in signal processing, control systems, and communication.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I: Basic Operational Amplifier	Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741) **Op-Amp parameters**: Input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.	**12**	**0**	**0**	**12**
Unit-II: Op-Amp Circuits	Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. **Comparators:** Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. **Signal generators:** Phase shift oscillator, Wein bridge oscillator, square wave generator, triangle wave generator, sawtooth wave generator, and Voltage controlled oscillator (IC 566).	**12**	**0**	**0**	**12**
Unit-III: Multivibrators (IC 555)	Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565. **Fixed and variable IC regulators:** IC 78xx and IC 79xx - concepts only, IC LM317- output voltage equation.	**12**	**0**	**0**	**12**
Unit-IV: Signal Conditioning	Sample and hold systems, Active filters: First order low pass and high pass Butterworth filter, Second	**11**	**0**	**0**	**11**

circuits	order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.				

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examination **(20 Marks)**
2. GD/Group Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Op-Amps and Linear IC's, *R. A. Gayakwad*, Pearson Education.
2. Operational amplifiers and Linear Integrated circuits, *R. F. Coughlin and F. F. Driscoll*, Pearson Education.
3. Integrated Electronics, *J. Millman and C. C. Halkias*, Tata McGraw-Hill.
4. Electronic Principals, *A. P. Malvino*, Tata McGraw-Hill.
5. OP-AMP and Linear Integrated Circuits, *K. L. Kishore*, Pearson.

Course title: Operational Amplifiers and Applications Lab
Nature of the course: Core Course code: C-ELT-405-P
Total credits: 1
Distribution of Marks: 15 (End sem)

List of Experiments:

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
3. Designing of analog adder and subtractor circuit.
4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.
11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series.

Course title: Digital Electronics

Nature of the course: Core
Course code: C-ELT-406-T
Total credits: 3
Distribution of marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course comprehensively covers digital electronics and logic design fundamentals. It begins with an in-depth study of number systems (decimal, binary, hexadecimal, octal), their conversions, and arithmetic operations. Students delve into Boolean algebra, exploring logic gates (AND, OR, NOT) and advanced operators (XOR, XNOR). Digital logic families (TTL, CMOS) are analyzed in terms of performance metrics and characteristics. Combinational logic analysis includes SOP, POS representations, Karnaugh map minimization, and designing multiplexers, decoders, adders, subtractors. Sequential logic design covers flip-flops (SR, JK, D), counters (synchronous, asynchronous), and programmable logic devices (ROM, PLA, PAL, CPLD, FPGA). Introduction to Verilog/VHDL covers module structure, data flow, behavioral, structural design styles, and simulation techniques.

Course Objectives: The course aims to provide a solid foundation in digital electronics and logic design. Students will master number systems and arithmetic operations, apply Boolean algebra to design logic circuits using basic and advanced gates, and minimize logic functions using Karnaugh maps. They will design and analyze combinational logic circuits like multiplexers, decoders, and adders/subtractors, and explore sequential logic circuits using flip- flops, registers, and counters. Additionally, students will gain practical experience with programmable logic devices and introductory proficiency in Verilog/VHDL for digital circuit description and simulation using various design styles.

Prerequisites:

- Basic understanding of mathematics, including arithmetic operations and number systems.
- Familiarity with fundamental concepts of logic and Boolean algebra.
- Prior knowledge of basic electronic components and circuits.
- Proficiency in problem-solving and analytical skills.
- Familiarity with any programming language or exposure to digital design concepts would be advantageous but not mandatory.

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

Demonstrate Proficiency in Number Systems and Logic Gates: Perform conversions and arithmetic operations in decimal, binary, hexadecimal, and octal number systems, utilize binary coded decimal codes, and apply Boolean algebra to design and analyze logic circuits using basic and universal gates (XOR, XNOR, NAND, NOR).

Evaluate Digital Logic Families: Analyze and compare TTL and CMOS logic families based on fan-in, fan-out, noise margin, power dissipation, and speed-power product, and design interfaces between these families for practical applications.

Design Combinational Logic Circuits: Construct and optimize combinational circuits, including encoders, decoders, multiplexers, demultiplexers, and binary adders/subtractors, using standard representations (SOP, POS) and Karnaugh map minimization techniques.

Develop Sequential Logic Circuits: Design and implement sequential circuits, including latches, flip-flops (S-R, J-K, T, D), registers, and various counters (synchronous, asynchronous, modulo-N, ripple, up/down, ring, and Johnson) using state tables, state diagrams, and excitation equations.

Apply Programmable Logic Devices: Utilize programmable logic devices (ROM, PLA, PAL, CPLD, FPGA) to implement digital circuits, and evaluate their functionality and advantages in modern digital system design.

Implement and Simulate HDL Designs: Develop and simulate digital designs using Verilog/VHDL, applying data flow, behavioral, structural, and mixed design styles, and manipulate language elements (data types, expressions, operators) to create efficient and functional hardware descriptions.

Synthesize Digital Systems: Integrate concepts of number systems, logic gates, combinational and sequential circuits, and HDL to design, simulate, and troubleshoot digital systems, demonstrating competence in real-world electronics and computer engineering applications.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I: Number System, Codes and Basic Logic Circuits	Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, Octal and Hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code. **Logic Gates and Boolean algebra**: Introduction to Boolean algebra and Boolean operators, Truth tables of basic gates, Basic postulates and fundamental theorems of Boolean algebra, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates. **Digital Logic families**: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison and interfacing.	**10**	**0**	**0**	**10**
Unit-II: Combinational Logic Analysis and Design	Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, half	**10**	**0**	**0**	**10**

	and full adder, binary subtractor, parallel adder/subtractor.				
Unit-III: Sequential Logic Design	Latches and Flip flops, S-R Flip flop, J-K Flip flop, T and D type Flip flop, Clocked and edge triggered Flip flops, master slave flip flop, Registers, Counters (synchronous and asynchronous and modulo-N), Ripple counter, up and down counter State Table, State Diagrams, counter design using excitation table and equations, Ring counter and Johnson counter. **Programmable Logic Devices:** Basic concepts- ROM, PLA, PAL, CPLD, FPGA	**15**	**0**	**0**	**15**
Unit-IV: Introduction to Verilog	A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog Introduction to Simulation and Synthesis Tools, Test Benches. Language Elements- Keywords, Identifiers, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Verilog: Module, Delays, brief description - data flow style, behavioral style, structural style, mixed design style, simulating design. Expressions: Operands, Operators, types of Expressions. Gate level modeling - Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).	**10**	**0**	**0**	**10**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examinations **(20 Marks)**
2. GD/ Group Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Digital System Design, *M. Morris Mano*, Pearson Education Asia.
2. Digital Fundamentals, *Thomas L. Flyod*, Pearson Education Asia.
3. Digital Electronics: An Introduction To Theory And Practice, *W. H. Gothmann*, Prentice Hall of India.
4. Digital Principles, *R. L. Tokheim*, Schaum's Outline Series, Tata McGraw-Hill.
5. A Verilog HDL Primer, *J. Bhasker*, BSP.
6. Verilog HDL-A guide to digital design and synthesis, *Samir Palnitkar*, Pearson.

Course title: Digital Electronics Lab

Nature of the course: Core

Course code: C-ELT-406-P

Total credits: 1

Distribution of marks: 15 (End sem)

List of Experiments:

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a BCD to seven segment display driver.
6. Design a 4:1 Multiplexer using gates.
7. Design a 1:4 De-Multiplexer using gates.
8. To build a Flip- Flop Circuits using elementary gates. (RS, D-type).
9. Design a counter using D/T/JK Flip-Flop.
10. Design a shift register and study Serial and parallel shifting of data.

Course title: Electronic Instrumentation

Course code: C-ELT-407-T

Nature of the course: Core

Total credits: 3

Distribution of marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course covers essential topics in instrumentation focusing on measurement principles and instruments. It begins with an exploration of measurement qualities, error analysis, and statistical methods. Students will study basic measurement instruments including PMMC instruments, galvanometers, and digital meters for DC and AC measurements. The curriculum includes in-depth discussions on measurement techniques for resistance, impedance, capacitance, and inductance using various bridge methods. Additionally, students will learn about A-D and D-A conversion techniques, oscilloscopes, signal generators, and various types of transducers for measuring physical quantities like displacement, pressure, temperature, and light.

Course Objectives: The objective of this course is to equip students with comprehensive knowledge and practical skills in instrumentation. By the end of the course, students will demonstrate proficiency in analyzing and minimizing measurement errors, understanding the characteristics and applications of basic measurement instruments, and utilizing various measurement techniques such as bridge methods for accurate determination of resistance, impedance, capacitance, and inductance. They will also gain hands-on experience with A-D and D-A conversion, oscilloscopes, signal generators, and different types of transducers for measuring diverse physical parameters effectively in real-world applications.

Prerequisites:

- Familiarity with electronic components, circuits, and their behavior, including basic measurement concepts such as voltage, current, and resistance.
- Understanding of fundamental principles in physics such as electricity, magnetism, and basic circuit theory.
- Proficiency in mathematics including algebra, trigonometry, and calculus is beneficial.

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

Analyze Measurement Systems and Errors: Evaluate the static and dynamic characteristics of measurement instruments, perform error analysis (gross, systematic, absolute, and relative errors), conduct uncertainty analysis, and apply statistical methods for data analysis and curve fitting.

Utilize Basic Measurement Instruments: Operate and analyze instruments such as PMMC, galvanometers, ammeters, voltmeters, ohmmeters, digital voltmeters (integrating and non-integrating), digital multimeters, and frequency meters, and identify appropriate connectors and probes (low capacitance, high voltage, current, audio/video, RF/coaxial, USB) for measurement applications.

Measure Impedance Using Bridge Circuits: Accurately measure low, medium, and high resistance using methods like Kelvin's double bridge, voltmeter-ammeter, Wheatstone bridge, and Megger, and determine inductance, capacitance, and frequency using AC bridges (Maxwell's, Hay's, Anderson's, Schering's, DeSauty's, and Wien's bridges).

Implement A-D and D-A Conversion Techniques: Design and analyze 4-bit binary weighted resistor and R-2R ladder D-A converters, and evaluate successive approximation A-D converters, understanding their characteristics and associated integrated circuits for digital signal processing.

Operate Oscilloscopes and Analyzers: Use cathode ray oscilloscopes (CRO), digital storage oscilloscopes (DSO), and power scopes to measure voltage, frequency, and phase, and operate spectrum analyzers, vector network analyzers, and LCR meters to analyze signal characteristics, bandwidth, and impedance.

Design and Apply Signal Generators: Generate and analyze signals using audio oscillators, pulse generators, and function generators, and apply these in testing and calibration of electronic circuits.

Evaluate Sensors and Transducers: Classify and characterize transducers (active, passive, resistive, capacitive, inductive, piezoelectric), and measure physical quantities such as displacement, velocity, acceleration, pressure, temperature, and light using transducers like potentiometers, strain gauges, LVDT, RTD, thermistors, thermocouples, and photodiodes.

Apply Instrumentation Principles: Synthesize knowledge of measurement techniques, instruments, and transducers to design, calibrate, and troubleshoot electronic measurement systems, demonstrating proficiency in practical applications for industrial and research settings.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: Qualities of Measurement	Decimal, Binary, Hexadecimal and Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting. **Basic Measurement Instruments:** Permanent Magnet Moving Coil (PMMC) instrument, galvanometer, DC measurement - ammeter, voltmeter, **o**hm meter, AC measurement, Digital voltmeter systems: integrating and non-integrating types, digital multimeters, digital frequency meter system: different modes and universal counter. **Connectors and Probes:** Low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc	**12**	**0**	**0**	**12**
Unit-II: Measurement of Impedance	Low Resistance: Kelvin's double bridge method, Medium Resistance by Voltmeter Ammeter method, Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay's bridge, and Anderson's bridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge. **A-D and D-A Conversion:** 4-bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive	**12**	**0**	**0**	**12**

	approximation ADC and associated integrated circuits.				
Unit-III: Oscilloscopes and Analyser	CRT, waveform display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Power scope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time). Spectrum analyser, Vector network analyser, LCR meter. **Signal Generators**: Audio oscillator, Pulse Generator, Function generators**.**	**12**	**0**	**0**	**12**
Unit-IV: Sensors and Transducers	Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type – Variable Permittivity type), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational). Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).	**11**	**0**	**0**	**11**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examinations **(20 Marks)**
2. GD/ Group Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Electronic Instrumentation, *H. S. Kalsi*, TMH.

2. Electronic Instrumentation and Measurement Techniques, *W. D. Cooper and A. D. Helfrick*, Prentice-Hall.
3. Instrumentation Measurement and analysis, *B. C. Nakra, K. Chaudry*, TMH.
4. Measurement Systems: Application and Design, *E.O. Doebelin*, McGraw Hill.
5. Elements of Electronic Instrumentation and Measurement, *Joseph J Carr*, Pearson Education.
6. Electronic Instrumentation and Measurements, *David A. Bell*, Prentice Hall.
7. Electronic Measurements and Instrumentation, *Oliver and Cage*, TMH.
8. Measurement and Instrumentation Principles. *Alan S. Morris*, Elsevier.
9. Electrical and Electronics Measurements and Instrumentation, *K Sawhney*, Dhanpat Rai and Sons.
10. Instrumentation Devices and Systems, *S. Rangan, G. R. Sarma and V. S. Mani*, Tata McGraw Hills

Course title: Electronic Instrumentation Lab

Course code: C-ELT-407-P

Nature of the course: Core

Total credits: 1

Distribution of marks: 15 (End sem)

List of Experiments:

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de'Sautys.
4. Measure of low resistance by Kelvin's double bridge.
5. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
6. To determine the Characteristics of LVDT.
7. To determine the Characteristics of Thermistors and RTD.
8. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
9. To study the Characteristics of LDR, Photodiode, and Phototransistor:
   a) Variable Illumination.
   b) Linear Displacement.
10. Characteristics of one Solid State sensor/ Fiber optic sensor).

Course title: C Programming and Data Structures

Nature of the course: Core

Course code: C-ELT-408
Total credit assigned: 3
Distribution of marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course introduces C programming, covering fundamentals such as language structure, operators, arrays, and I/O functions. It progresses to decision-making constructs, loops, functions, and pointers, emphasizing practical application through structures and basic C++ concepts. Further, it explores data structures including stacks, queues, linked lists, and introduces sorting algorithms and binary search trees. By the end, students gain proficiency in C programming essentials and foundational knowledge in data structures and algorithms.

Course Objectives: This course aims to equip students with a solid foundation in C programming, emphasizing its syntax, operators, and data types. Students will learn to implement decision-making structures, loops, and functions effectively. The course also introduces them to advanced concepts like pointers, structures, and basic C++ principles. Additionally, it focuses on developing proficiency in implementing fundamental data structures such as stacks, queues, and linked lists, along with sorting algorithms and binary search trees. By the end, students will be adept in both C programming essentials and introductory data structure applications.

Prerequisites:

- Basic understanding of programming concepts and logic.
- Familiarity with variables, control structures (if-else, loops), and basic data types.
- Understanding of algorithms and problem-solving techniques.
- Familiarity with any programming language (preferably).

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

Master C Programming Fundamentals: Write, compile, and debug C programs using appropriate data types, operators, arrays, and input/output functions, applying concepts such as tokens, variables, expressions, type casting, and operator precedence to solve computational problems.

Implement Control Structures and Functions: Design and implement decision-making (if, if-else, switch) and looping structures (for, while, do-while), and create reusable functions with arguments and return values to modularize C programs effectively.

Utilize Advanced C Features: Work with structures, pointers, and arrays (including multi-dimensional arrays), and manipulate structure variables, arrays within structures, and nested structures to manage complex data in C programs.

Understand Object-Oriented Programming Basics: Describe the principles and characteristics of object-oriented programming through an introduction to C++, laying the foundation for advanced programming paradigms.

Implement Data Structures: Design and implement fundamental data structures such as stacks, queues, linked lists (singly, circular, and doubly linked), and perform operations like infix-to-postfix conversion, postfix evaluation, and stack/queue implementation using arrays and linked lists.

Apply Sorting and Searching Algorithms: Implement and analyze sorting algorithms (insertion, selection, bubble, merge) and searching techniques (linear, binary) to efficiently process data in various applications.

Work with Binary Search Trees: Construct and manipulate binary search trees (BST), perform insertion, searching, and recursive traversals (pre-order, post-order, in-order), and understand their applications in data organization.

Develop Problem-Solving Skills: Synthesize programming constructs, data structures, and algorithms to design, implement, and optimize solutions for real-world computational problems, demonstrating proficiency in programming and data management.

Course Contents:

Unit	**Content**	**L**	**T**	**P**	**Total Hours**
Unit-I: C Programming Language	Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays-concepts, declaration, accessing elements, storing elements, two-dimensional and multi- dimensional arrays. Input output statement and library functions.	**10**	**0**	**0**	**10**
Unit-II: Decision making, branching & looping	Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions. **Structures:** Defining and declaring a structure variable, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions. Pointers.	**15**	**0**	**0**	**15**
Unit-III: Data	Definition of stack, array implementation of stack, conversion	**10**	**0**	**0**	**10**

Structures	of infix expression to prefix, postfix expressions, evaluation of postfix expression. Definition of Queue, Circular queues, Array implementation of queues. Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list**.**				
Unit-IV: Searching and sorting	Insertion sort, selection sort, bubble sort, merge sort, linear Search, binary search. **Trees:** Introduction to trees, Binary search tree, Insertion and searching in a BST, pre order, post order and in order traversal (recursive).	**10**	**0**	**0**	**10**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examinations **(20 Marks)**
2. GD/ Group Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Let Us C, *Yashavant Kanetkar*, BPB Publications.
2. Programming in ANSI C, *Balagurusamy*, TMH.
3. Programming with C, *Byron S Gottfried*, Schaum Series.
4. The C Programming Language, *Brian W. Kernighan, Dennis M. Ritchie*, Prentice Hall
5. Pointers in C, *Yashavant Kanetkar*, BPB Publications.
6. Data Structures, *S. Sahni and E. Horowitz*, Galgotia Publications
7. Data Structures using C, *Tanenbaum*, Pearson/PHI.
8. Fundamentals of Computer Algorithms, *Ellis Horowitz and Sartaz Sahani*, Computer Science Press.

Course title: C Programming and Data Structures

Nature of the course: Core

Course code: C-ELT-408-P

Total credit assigned: 1

Distribution of marks: 15 (End sem)

List of Experiments:

1. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series.
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.

4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non-zero coefficients A, B and C. Else report error.
6. Calculate the value of sin (x) and cos (x) using the series. Also print sin (x) and cos (x) value using library function.
7. Generate and print prime numbers up to an integer N.
8. Sort given N numbers in ascending order.
9. Find the sum & difference of two matrices of order MxN and PxQ.
10. Find the product of two matrices of order MxN and PxQ.
11. Find the transpose of given MxN matrix.
12. Find the sum of principle and secondary diagonal elements of the given MxN matrix.
13. Calculate the subject wise and student wise totals and store them as a part of the structure.
14. Maintain an account of a customer using classes.
15. Implement linear and circular linked lists using single and double pointers.
16. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list
17. Create circular linked list having information about a college and perform Insertion at front, Deletion at end.
18. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
19. Implement polynomial addition and subtraction using linked lists.
20. Implement sparse matrices using arrays and linked lists.
21. Create a Binary Tree to perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
22. Implement binary search tree using linked lists. Compare its time complexity over that of linear search.
23. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

Course title: Electronic Circuits

Nature of the course: Minor

Course code: MIN-ELT-404-T

Total credits: 3

Distribution of Marks: 45 (End sem) **+ 40** (In-sem)

Course Description: This course explores fundamental principles and practical applications in electronic circuits and devices. Beginning with diode circuits and rectifiers, it progresses to bipolar junction transistors (BJTs) and field-effect transistors (MOSFETs), covering biasing techniques, amplifier configurations, feedback amplifiers, and oscillators. The curriculum delves into power amplifiers, including Class A, B, and C designs, and examines single-tuned amplifiers. Students learn through theoretical study and practical circuit analysis, focusing on characteristics, performance metrics, and applications of various electronic components and circuits. Emphasis is placed on understanding circuit behavior, design considerations, and applications in modern electronic systems.

Course Objectives: The primary objective of the Electronic Circuits course is to provide students with a thorough understanding of the fundamental principles and applications of electronic circuits. This course aims to equip students with the skills necessary to analyze and design various electronic circuits involving diodes, transistors, and operational amplifiers. Students will gain proficiency in circuit analysis techniques, including dc and ac load line analysis, and will learn to use hybrid models for transistor circuits. The course will also cover the concepts of feedback in amplifiers, enabling students to understand and design both negative and positive feedback circuits, as well as oscillators. Additionally, the course will introduce students to MOSFET circuits, power amplifiers, and single tuned amplifiers, providing a comprehensive understanding of their operation, design, and applications. Through a combination of theoretical knowledge and practical laboratory experiments, students will develop problem-solving skills and the ability to apply their learning to real-world electronic circuit design and analysis.

Prerequisites:

- Proficiency in algebra, calculus, and differential equations.
- Fundamental knowledge of electromagnetism and electric circuits.
- Basic knowledge of electronic components (resistors, capacitors, inductors) and simple circuits.

Course Outcomes (COs): Upon successful completion of this course, students will be able to:

Analyze Diode-Based Circuits: Evaluate the behavior of ideal and piecewise linear diode models, perform DC load line analysis, and design clipping, clamping, rectifier (HWR, FWR), and filter circuits, while analyzing their ripple factor, efficiency, and waveforms. Design and assess Zener diode regulator circuits for load and line regulation, identifying their limitations.

Understand and Design BJT Circuits: Analyze CE and CB transistor characteristics, biasing techniques (fixed, collector-to-base, voltage divider, emitter bias), and stability factors to prevent thermal runaway. Design BJT-based switches, Darlington pairs, and CE amplifiers, and perform DC and AC load line analysis, hybrid parameter modeling, and frequency response studies for single and cascaded CE amplifiers.

Evaluate Feedback Amplifiers and Oscillators: Explain the principles of negative and positive feedback, analyze voltage and current feedback amplifiers (series and shunt) for gain and impedance characteristics, and apply Barkhausen criteria to design and evaluate phase shift, Colpitts, and Hartley oscillators.

Analyze MOSFET and Power Amplifier Circuits: Analyze depletion and enhancement MOSFETs, their biasing, and small-signal parameters, and design common source amplifiers and CMOS circuits. Compare voltage and power amplifiers, evaluate Class A, B, and C power amplifiers for efficiency and distortion, and analyze transformer-coupled Class A and complementary symmetry Class B push-pull amplifiers, including crossover distortion and heat sink requirements.

Design and Assess Tuned Amplifiers: Design single-tuned amplifiers, analyze their frequency response and limitations, and evaluate their applications in communication circuits.

Apply Analog Circuit Design Principles: Synthesize knowledge of diode, BJT, MOSFET, feedback, and power amplifier circuits to design, simulate, and troubleshoot analog electronic systems, demonstrating proficiency in practical applications for communication and signal processing.

Course Contents:

Unit	Content	L	T	P	Total Hours
Unit-I: Basic Operational Amplifier	Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741) **Op-Amp parameters**: Input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.	**12**	**0**	**0**	**12**
Unit-II: Op-Amp Circuits	Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. **Comparators:** Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. **Signal generators:** Phase shift oscillator, Wein bridge oscillator, square wave generator, triangle wave generator, sawtooth wave generator, and Voltage controlled oscillator (IC 566).	**12**	**0**	**0**	**12**
Unit-III: Multivibrators (IC 555)	Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565. **Fixed and variable IC regulators:** IC 78xx and IC 79xx - concepts only, IC LM317- output voltage equation.	**12**	**0**	**0**	**12**
Unit-IV: Signal Conditioning circuits	Sample and hold systems, Active filters: First order low pass and high pass Butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.	**11**	**0**	**0**	**11**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Mode of In-semester Assessment:

1. Two internal examination **(20 Marks)**
2. GD/Gorup Activity/ Assignment / Presentation / Classroom interaction / Quiz etc. **(20 Marks)**

Recommended Readings:

1. Electronic Devices and circuit theory, *Robert Boylstead and Louis Nashelsky*, PHI.
2. Electronic devices, *David A Bell*, Reston Publishing Company.
3. Electronic Circuits: Discrete and Integrated, *D. L. Schilling and C. Belove*, Tata McGraw Hill.
4. Electronic Circuit Analysis and Design, *Donald A. Neamen*, Tata McGraw Hill.
5. Integrated Electronics, *J. Millman and C. C. Halkias*, Tata McGraw Hill.
6. Microelectronic Circuit Design, *J. R. C. Jaegar and T. N. Blalock*, Tata McGraw Hill.
7. 2000 Solved Problems in Electronics, *J. J. Cathey*, Schaum's outline Series, Tata McGraw Hill.
8. Electronic Devices and Circuits, *Allen Mottershed*, Goodyear Publishing Corporation.

Course title: Electronic Circuits
Nature of the course: Minor
Course code: Min-ELT-404-P
Total credits: 1
Distribution of Marks: 15 (End sem)

List of Experiments:

1. Study of the half wave rectifier and Full wave rectifier.
2. Study of power supply using C filter and Zener diode.
3. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation.
4. Study of clipping and clamping circuits.
5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
6. Designing of a Single Stage CE amplifier.
7. Study of Class A, B and C Power Amplifier.
8. Study of the Colpitts's Oscillator.
9. Study of the Hartley's Oscillator.
10. Study of the Phase Shift Oscillator
11. Study of the frequency response of Common Source FET amplifier.