VARDHAMAN
COLLEGE OF ENGINEERING

CURRICULUM
For
Bachelor of Technology
Electrical and Electronics Engineering

Under
Choice Based Credit System (CBCS)

B. Tech. - Regular Four-Year Degree Program
(For batches admitted from the Academic Year 2025 - 2026)

&

B. Tech. - Lateral Entry Scheme
(For batches admitted from the Academic Year 2026 - 2027)

August 2025

VARDHAMAN COLLEGE OF ENGINEERING
(Autonomous)
Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade
Kacharam, Shamshabad, Hyderabad- 501 218, Telangana, India
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Department Vision

Producing professionally competent graduates in the domain of Electrical Engineering to serve the industry/society addressing the challenges.

Department Mission

M1: Provide professional skills in electrical circuit design and simulation to the students.

M2: Bringing awareness among the students with emerging technologies to meet the dynamic needs of the society.

M3: Develop industry-institute interface for collaborative research, internship and entrepreneurial skills among the stakeholders (Students/Faculty).

M4: Encourage multi-disciplinary activities through research and continuous learning activities.

Program Educational Objectives (PEOs)

PEO1: Graduates will excel to make way to give solutions to real-time problems through technical knowledge and operational skills in the field of Electrical Engineering.

PEO2: Graduates will demonstrate their ability to acquaint with the ongoing trends in the field of Electrical Engineering to address the needs of the society.

PEO3: Graduates will communicate effectively as team players to cope with building a Prospective career.

PEO4: Graduates of the program will act with Integrity and have interpersonal skills in catering the need-based requirements blended with ethics and professionalism.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost,reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).

PO3: Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).

PO4: Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

PSO1: Conceptualize complex electrical and electronics systems, employ control strategies for power electronics related applications to prioritize societal requirements.

PSO2: Design, analyze and create energy efficient and eco-friendly power & energy systems.

United Nations Sustainable Development Goals (SDGs)

SDG1: No Poverty – End poverty in all its forms everywhere.

SDG2: Zero Hunger – End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

SDG3: Good Health and Well-Being – Ensure healthy lives and promote well-being for all at all ages.

SDG4: Quality Education – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG5: Gender Equality – Achieve gender equality and empower all women and girls.

SDG6: Clean Water and Sanitation – Ensure availability and sustainable management of water and sanitation for all.

SDG7: Affordable and Clean Energy – Ensure access to affordable, reliable, sustainable and modern energy for all.

SDG8: Decent Work and Economic Growth – Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG9: Industry, Innovation and Infrastructure – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG10: Reduced Inequalities – Reduce inequality within and among countries.

SDG11: Sustainable Cities and Communities – Make cities and human settlements inclusive, safe, resilient and sustainable.

SDG12: Responsible Consumption and Production – Ensure sustainable consumption and production patterns.

SDG13: Climate Action – Take urgent action to combat climate change and its impacts.

SDG14: Life Below Water – Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

SDG15: Life on Land – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

SDG16: Peace, Justice and Strong Institutions – Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG17: Partnerships for the Goals – Strengthen the means of implementation and revitalize the global partnership for sustainable development.

I B.Tech. I Semester												
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9001	Matrices and Calculus	BS	45	15	-	60	120	4	40	60	100
2	A9009	Engineering Chemistry	BS	45	-	-	45	90	3	40	60	100
3	A9501	Programming for Problem Solving	ES	45	-	-	45	90	3	40	60	100
4	A9011	English for Skills Enhancement	HS	30	-	-	30	60	2	40	60	100
5	A9201	Electrical Circuits-I	ES	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9010	Engineering Chemistry Laboratory	BS	-	-	30	-	30	1	40	60	100
7	A9502	Programming for Problem Solving Laboratory	ES	-	-	30	-	30	1	40	60	100
8	A9012	English Language and Communication Skills Laboratory	HS	-	-	30	-	30	1	40	60	100
9	A9304	Computer Aided Engineering Graphics	ES	-	-	30	-	30	1	40	60	100
Community Related Project Work												
10	A9021	Community Centered Design Thinking	PW	-	-	-	45	45	1	40	60	100
Total				210	15	120	270	615	20	400	600	1000

I B.Tech. II Semester												
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9002	Ordinary Differential Equations and Vector Calculus	BS	45	15	-	60	120	4	40	60	100
2	A9007	Engineering Physics	BS	45	-	-	45	90	3	40	60	100
3	A9206	Electrical Circuits-II	ES	45	-	-	45	90	3	40	60	100
4	A9503	Data Structures	ES	45	-	-	45	90	3	40	60	100
5	A9207	Electrical Power Generation	ES	30	-	-	30	60	2	40	60	100
Practical Courses												
6	A9008	Engineering Physics Laboratory	BS	-	-	30	-	30	1	40	60	100
7	A9208	Electrical Circuits Laboratory	ES	-	-	30	-	30	1	40	60	100
8	A9504	Data Structures Laboratory	ES	-	-	30	-	30	1	40	60	100
9	A9302	Engineering Workshop	ES	-	-	30	-	30	1	40	60	100
Community Related Project Work												
10	A9022	Product Design and Development	PW	-	-	-	45	45	1	40	60	100
Total				210	15	120	270	615	20	400	600	1000

II B.Tech. I Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9003	Numerical Methods and Complex Variables	BS	45	-	-	45	90	3	40	60	100
2	A9210	Power System Transmission and Distribution	ES	45	-	-	45	90	3	40	60	100
3	A9211	Electrical Machines-I	PC	45	-	-	45	90	3	40	60	100
4	A9212	Control Systems	PC	45	-	-	45	90	3	40	60	100
5	A9412	Analog Devices and Circuits	PC	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9213	Electrical Machines-I Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9214	Control Systems Laboratory	PC	-	-	30	-	30	1	40	60	100
8	A9413	Analog Devices and Circuits Laboratory	PC	-	-	30	-	30	1	40	60	100
9	A9006	Computational Mathematics Laboratory	BS	-	-	30	-	30	1	40	60	100
Skill Development Course												
10	A9215	PCB Design	PC	-	-	30	-	30	1	40	60	100
Community Related Project Work												
11	A9023	Technology Entrepreneurship	PW	-	-	-	45	45	1	40	60	100
Total				225	0	150	270	645	21	440	660	1100

II B.Tech. II Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9014	Business Economics and Financial Analysis	HS	45	-	-	45	90	3	40	60	100
2	A9216	Electrical Machines-II	PC	45	-	-	45	90	3	40	60	100
3	A9217	Power Electronics	PC	45	-	-	45	90	3	40	60	100
4	A9422	Digital System Design	PC	45	-	-	45	90	3	40	60	100
5	A9218	Electromagnetic Field Theory	PC	45	15	-	60	120	4	40	60	100
Practical Courses												
6	A9219	Electrical Machines-II Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9220	Power Electronics Laboratory	PC	-	-	30	-	30	1	40	60	100
8	A9423	Digital System Design Laboratory	PC	-	-	30	-	30	1	40	60	100
Skill Development Course												
9	A9221	Python for Engineers	PC	-	-	30	-	30	1	40	60	100
Community Related Project Work												
10	A9024	Community Driven Product Evaluation	PW	-	-	-	45	45	1	40	60	100
Total				225	15	120	285	645	21	400	600	1000
11		Exit Optional: Work Based Vocational Course / Internship or Apprenticeship	PW	-	-	-	90	90	2	40	60	100

III B.Tech. I Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9222	Power System Analysis	PC	45	-	-	45	90	3	40	60	100
2	A9223	Signals and Linear Systems	PC	45	-	-	45	90	3	40	60	100
3	A9224	Power System Switchgear and Protection	PC	45	-	-	45	90	3	40	60	100
4		Professional Elective - I	PE	45	-	-	45	90	3	40	60	100
5		Open Elective - I	OE	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9225	Power System Analysis Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9013	English for Employability Skills Laboratory	HS	-	-	30	-	30	1	40	60	100
Skill Development Course												
8	A9226	Simulation Tools for Renewable Energy Systems	PC	-	-	30	-	30	1	40	60	100
Experiential Learning Course												
9	A9041	Internship/Industrial Training	PW	-	-	-	90	90	2	40	60	100
Value Added Course												
10	A9016	Gender Sensitization, Human Values and Professional Ethics	VA	15	-	-	15	30	1	40	60	100
Total				240	0	90	330	660	21	400	600	1000

III B.Tech. II Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9227	Electrical Measurements and Instrumentation	PC	45	-	-	45	90	3	40	60	100
2	A9435	RISC Microcontrollers	PC	45	-	-	45	90	3	40	60	100
3	A9228	Power System Operation and Control	PC	45	-	-	45	90	3	40	60	100
4		Professional Elective - II	PE	45	-	-	45	90	3	40	60	100
5		Open Elective - II	OE	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9229	Electrical Measurements and Instrumentation Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9436	RISC Microcontrollers Laboratory	PC	-	-	30	-	30	1	40	60	100
Skill Development Course												
8	A9230	Simulation tools for Power System Stability	PC	-	-	30	-	30	1	40	60	100
Experiential Learning Course												
9	A9042	Mini Project	PW	-	-	-	90	90	2	40	60	100
Value Added Course												
10	A9015	Environmental Science	VA	15	-	-	15	30	1	40	60	100
Total				240	0	90	330	660	21	400	600	1000

IV B.Tech. I Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	A9231	Power Semiconductor Drives	PC	45	-	-	45	90	3	40	60	100
2	A9232	IoT and its Applications	PC	45	-	-	45	90	3	40	60	100
3		Professional Elective - III	PE	45	-	-	45	90	3	40	60	100
4		Professional Elective - IV	PE	45	-	-	45	90	3	40	60	100
5		Open Elective - III	OE	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9233	Power Semiconductor Drives Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9234	IoT and its Applications Laboratory	PC	-	-	30	-	30	1	40	60	100
Experiential Learning Course												
8	A9043	Major Project – Phase I	PW	-	-	-	90	90	2	100	-	100
Value Added Course												
9	A9017	Indian Knowledge System	VA	15	-	-	15	30	1	40	60	100
Total				240	0	60	330	630	20	420	480	900

IV B.Tech. II Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1		Professional Elective – V	PE	45	-	-	45	90	3	40	60	100
2		Professional Elective – VI	PE	45	-	-	45	90	3	40	60	100
Experiential Learning Course												
3	A9044	Major Project – Phase II	PW	-	-	-	630	630	14	40	60	100
Total				90	0	0	720	810	20	120	180	300

Common Abbreviations Used in the Curriculum

BS – Basic Sciences
HS – Humanities & Social Sciences
ES – Engineering Sciences
PC – Professional Core
PE – Professional Elective
OE – Open Elective
PW – Project Work
VA – Value Added Course
CI – Classroom Instruction
LI – Laboratory Instruction
L – Lecture Hours
T – Tutorial Hours
P – Practical Hours
TW – Team Work
SL – Self Learning
H – Hours
C – Credits
CIE – Continuous Internal Evaluation
SEE – Semester End Examination
SDG – Sustainable Development Goals

List of Professional Electives

Domain: Energy Systems			
Year & Semester	**Professional Elective #**	**Course Code**	**Title of the Course**
III B.Tech. I Semester	Professional Elective – I	A9251	Solar Photovoltaic Systems
III B.Tech. II Semester	Professional Elective – II	A9255	Wind Energy Conversion Systems
IV B.Tech. I Semester	Professional Elective – III	A9259	Alternate Fuels
IV B.Tech. I Semester	Professional Elective – IV	A9263	Energy Storage Systems
IV B.Tech. II Semester	Professional Elective – V	A9267	Energy Audit and Management
IV B.Tech. II Semester	Professional Elective – VI	A9271	Hydrogen Energy Systems

Domain: Power Systems			
Year & Semester	**Professional Elective #**	**Course Code**	**Title of the Course**
III B.Tech. I Semester	Professional Elective – I	A9252	High Voltage Engineering
III B.Tech. II Semester	Professional Elective – II	A9256	Restructured Power Systems
IV B.Tech. I Semester	Professional Elective – III	A9260	Utilization of Electrical Energy
IV B.Tech. I Semester	Professional Elective – IV	A9264	HVDC Transmission
IV B.Tech. II Semester	Professional Elective – V	A9268	Power Quality
IV B.Tech. II Semester	Professional Elective – VI	A9272	Smart Grid Technologies

Domain: Power Electronics			
Year & Semester	**Professional Elective #**	**Course Code**	**Title of the Course**
III B.Tech. I Semester	Professional Elective – I	A9253	FACTS and Custom Power Devices
III B.Tech. II Semester	Professional Elective – II	A9257	Advanced Power Converters
IV B.Tech. I Semester	Professional Elective – III	A9261	Special Electrical Machines
IV B.Tech. I Semester	Professional Elective – IV	A9265	LED Lighting Technology
IV B.Tech. II Semester	Professional Elective – V	A9269	Electric Vehicles
IV B.Tech. II Semester	Professional Elective – VI	A9273	Industrial Electronics

Domain: Control Systems and Automation			
Year & Semester	**Professional Elective #**	**Course Code**	**Title of the Course**
III B.Tech. I Semester	Professional Elective – I	A9254	Digital Control Systems
III B.Tech. II Semester	Professional Elective – II	A9258	PLC and SCADA
IV B.Tech. I Semester	Professional Elective – III	A9262	Advanced Control Theory
IV B.Tech. I Semester	Professional Elective – IV	A9266	Neural Networks and Fuzzy Logic
IV B.Tech. II Semester	Professional Elective – V	A9270	Biomedical Instrumentation
IV B.Tech. II Semester	Professional Elective – VI	A9274	Robotics

List of Open Electives

Industry Skills		
#	Course Code	Title of the Course
1	A9505	Computer Organization
2	A9507	Operating Systems
3	A9509	Database Management Systems
4	A9515	Software Engineering
5	A9604	Web Application Engineering
6	A9612	Information Security
7	A9681	Cyber Security
8	A9682	Java Programming
9	A9683	Prompt Engineering
10	A9701	Artificial Intelligence
11	A9702	Machine Learning
12	A9705	Deep Learning
13	A9707	Natural Language Processing
14	A9710	Generative AI
15	A9803	Data Mining
16	A9851	Data Science for Engineers
Emerging Technologies		
#	Course Code	Title of the Course
17	A9381	Fundamentals of Robotics
18	A9382	Introduction to 3D Printing
19	A9383	Hybrid Vehicles
20	A9481	Internet of Things (IoT)
21	A9482	Consumer Electronics
22	A9483	VLSI Design Fundamentals
23	A9484	PCB Design and Fabrication
24	A9656	Blockchain Technology
Sustainability		
#	Course Code	Title of the Course
25	A9166	Smart Cities
26	A9181	Disaster Management
27	A9182	Road Safety Engineering
28	A9183	Building Science and Technology
29	A9281	Renewable Energy Systems
30	A9282	Smart Grid Technologies
31	A9283	Electrical Safety and Sustainable Engineering Practices
32	A9284	Smart Power Systems for Data Centers
33	A9285	E-Waste Management

List of Open Electives (Continued...)

Entrepreneurship		
#	Course Code	Title of the Course
34	A9081	Entrepreneurship Development
35	A9082	Research Methodology and IPR
36	A9083	Principles of Management
37	A9084	Organizational Behavior
38	A9355	Operations Research
39	A9684	E-Commerce
Life Skills and Holistic Development		
#	Course Code	Title of the Course
40	A9085	Emotional Intelligence and Leadership
41	A9086	Yoga and Wellness
42	A9087	National Cadet Corps (NCC)

I B.Tech. I Semester

A9001 – Matrices and Calculus

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	15	0	60	120	4	40	60	100

Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the solution of system of linear equations, eigen values and eigen vectors, functions of several variables, multiple integrals. The course is designed to build conceptual clarity and problem-solving skills, with emphasis on both theoretical understanding and practical applications.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

Course Outcomes

After the completion of the course, the student will be able to:

A9001.1. Solve system of equations using rank of a matrix.

A9001.2. Construct the canonical form of a quadratic form using orthogonal transformations.

A9001.3. Express a function in series by mean value theorems and evaluate improper integrals using Beta and Gamma functions.

A9001.4. Examine the extremum of a function of several variables.

A9001.5. Apply multiple integrals to find the areas and volumes.

Course Syllabus

Unit-I:

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

Unit-II:

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

Unit-III:

Single Variable Calculus: Limit and Continuous of functions and its properties. Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem, Taylor's Series (All the theorems without proof), Definition of Improper Integral, Beta and Gamma functions and their applications.

Unit-IV:

Multivariable Calculus (Partial Differentiation and applications): Definitions of Limit and Continuity, Partial Differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

Unit-V:

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

Books and Materials

Text Books:

1. Grewal, B. S. *Higher Engineering Mathematics*, 43rd ed., Khanna Publications, 2015.
2. Jain, R. K., Iyengar, S. R. K. *Advanced Engineering Mathematics*, 5th ed., Narosa Publishing House, 2016.

Reference Books:

1. Seymour Lipschutz and Marc Lars Lipson *Schaum's Outline of Linear Algebra* , 6th ed., McGraw-Hill Education, 2018.
2. Greenberg Michael D.*Advanced Engineering Mathematics*, 2nd ed., Upper Saddle River, N.J. Prentice Hall, 1998.
3. Kreyszig, E. *Advanced Engineering Mathematics*, 9th ed., John Wiley & Sons, 2006.
4. Ramana, B. V. *Higher Engineering Mathematics*, 32nd reprint, McGraw Hill Education (India), 2018.

A9009 – Engineering Chemistry

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course emphasizes the application of chemical principles to analyse and address engineering problems, including water and its treatment for diverse purposes, the study of engineering materials such as plastics, fibres, elastomers, and composites, as well as non-conventional energy sources, batteries, and fuel cells. The course aims to integrate theoretical knowledge with practical applications, preparing students to evaluate and implement chemical solutions in engineering contexts.

Course Pre/Co-requisites

This course has no specific prerequisites and co requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 6: Clean Water and Sanitation
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action

Course Outcomes

After the completion of the course, the student will be able to:

A9009.1. Analyse the hardness and other impurities present in the water for industrial and domestic applications.

A9009.2. Apply electrochemical principles to protect the metals from corrosion.

A9009.3. Illustrate the types of energy sources along with their characteristics and applications.

A9009.4. Differentiate the properties of various polymeric materials based on their structure and engineering applications.

A9009.5. Compare the materials to study various physical and chemical properties.

Course Syllabus

Unit-I:

Water and its treatment: Introduction – hardness of water – causes of hardness – types of hardness: temporary and permanent – expression and units of hardness, numerical problems. Steps involved in the treatment of potable water - disinfection of potable water by chlorination and break-point chlorination. Boiler troubles: sludges, scales and caustic embrittlement. Internal treatment of boiler feed water – Calgon conditioning – Phosphate conditioning – Colloidal conditioning – softening of water by ion exchange processes. Desalination of water – Reverse osmosis.

Unit-II:

Electrochemistry and Corrosion: Introduction- Electrode potential, standard electrode potential, Nernst equation (no derivation), electrochemical cell - Galvanic cell, cell representation, EMF of cell - numerical problems. Types of electrodes, reference electrodes - primary reference electrode - standard Hydrogen Electrode (SHE), Secondary reference electrode - Calomel electrode. Construction, working and determination of pH of an unknown solution using SHE and Calomel electrode.

Corrosion: Introduction- definition, causes and effects of corrosion – theories of corrosion, chemical and electrochemical theories of corrosion, Types of corrosion: galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion - nature of the metal, nature of the corroding environment. Corrosion control methods - electroplating, electroless plating and metal cladding.

Unit-III:

Energy Sources:

Batteries: Introduction – Classification of batteries - Primary, secondary and reserve batteries with examples. Construction, working and applications of Lead acid battery and Lithium ion battery. Fuel Cells – differences between a battery and a fuel cell, construction and applications of Hydrogen-Oxygen fuel cell.

Fuels: Introduction and characteristics of a good fuel, Calorific value – Units - HCV, LCV- Dulongs formula - Numerical problems. *Fossil fuels:* Introduction, Classification, Petroleum - Refining of Crude oil, Cracking - Types of cracking - Moving bed catalytic cracking. LPG and CNG composition and use. *Synthetic Fuels:* Fischer-Tropsch process, Introduction and applications of Hythane and Green Hydrogen.

Unit-IV:

Polymeric Materials: Terminology, types of polymerization – addition and condensation polymerization with examples. Plastics: Thermoplastic resins & Thermosetting resins. Preparation, properties and engineering applications of Polyvinyl chloride and Teflon. Fibers: Preparation, properties and engineering applications of Nylon-6,6 and Dacron. Elastomers: Natural rubber and its vulcanization, artificial rubbers - Buna-S and Butyl rubber. Conducting Polymers: classification, mechanism of conduction in trans - polyacetylene – applications. Biodegradable polymers: Polylactic acid and its applications.

Unit-V:

Advanced Functional Materials:

Graphene: Isolation, Structure and strength, applications in Computer, Electrical and Electronic Devices.

Smart materials: Introduction, Classification with examples - Shape Memory Alloys – Nitinol, Piezoelectric materials – quartz and their engineering applications. Biosensor - Definition, Amperometric Glucose monitor sensor.

Portland cement: Chemical constituents, Setting and Hardening and applications of cement.

Books and Materials

Text Books:

1. Rama Devi, B., Aparna, P., and Prasanta Rath. *Engineering Chemistry.* 2nd ed., Cengage Publications, 2025.
2. Jain, Jain. *Engineering Chemistry.* 16th ed., Dhanpat Rai Publication Company, 2015.

Reference Books:

1. Agarwal, Shikha. *Engineering Chemistry.* Cambridge University Press, Delhi, 2015.
2. Chawla, Shashi. *Engineering Chemistry.* Dhanpat Rai and Company (P) Ltd., Delhi, 2011.
3. Thirumala Chary, M., E. Laxminarayana, and K. Shashikala. *A Textbook of Engineering Chemistry.* Pearson Publications, 2021.
4. Singh, Paramvir, Avinash Kumar Agarwal, Anupma Thakur, and R. K. Sinha. *Challenges and Opportunities in Green Hydrogen.* Springer, 2024.
5. Leo, Donald J. *Engineering Analysis of Smart Material Systems.* John Wiley & Sons, 2007.
6. *E-book:* "Engineering Chemistry by Shashi Chawla." Internet Archive, https://archive.org/details/EngineeringChemistryByShashiChawla/page/n11/mode/2up.

A9501 – Programming for Problem Solving

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces the principles of problem-solving and programming through C language. It begins with the basics of algorithms, flowcharts, and structured program design, enabling students to develop logical thinking skills. Core programming concepts such as variables, operators, control statements, arrays, and strings are covered to build a strong foundation. The course further explores modular programming using functions and recursion, along with structures and unions for handling complex data. Advanced concepts like pointers and dynamic memory management are introduced to enhance program efficiency. File handling techniques are discussed for effective data storage and retrieval. Fundamental searching and sorting algorithms are included to improve problem-solving efficiency and performance analysis. By the end of the course, students will be able to design, implement, and evaluate C programs that solve real-world computational problems systematically and efficiently.

Course Pre/Co-requisites

This Course has no specific Pre/Co requisites

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9501.1. Use basic programming constructs and control statements to design solutions for computational problems.

A9501.2. Develop programs using arrays and strings to store and manipulate sequential data.

A9501.3. Implement modular programming using functions, structures, and unions to manage complex problems and data.

A9501.4. Make use of pointers and file handling to effectively manage and process data.

A9501.5. Choose appropriate searching and sorting technique to organize and retrieve data efficiently.

Course Syllabus

Unit-I:

Problem Solving Techniques: Algorithms- Algorithmic approach, characteristics of algorithm and Examples, Flowcharts- Definition, Symbols and examples, Problem solving strategies: Top-down approach and Bottom-up approach.

Introduction to C: Structure of a C Program, Identifiers, Variables, Constants and Data Types. Operators and Expressions. Precedence of operators and Evaluation of Expressions, Type conversions, Formatted input and output. Control Statements: Conditional Statements- if, if else, nested if, else if ladder and switch statements. Iterative or Loop statements- while, do while and for statements. Jump statements- break, continue and goto statements.

Unit-II:

Arrays and Strings: Arrays: Introduction, One Dimensional Arrays - Declaration and initialization, Reading and Writing. Two Dimensional Arrays - Declaration and initialization, Reading and Writing. Manipulating elements of Arrays. Strings: Introduction, Declaration, and initialization, Reading and writing, string handling functions, handling two dimensional strings.

Unit-III:

Functions, Structures and Unions: Functions- Introduction, Function definition and Function call, Categories of functions, Recursion, Limitations of recursive functions, storage classes, Passing Arrays to functions, Common Pre-processor Directives. Structures- Definition, Declaration, and Initialization, accessing structure members, Array of Structures, Arrays within structures, Structures and functions, size of structures, Unions- Definition, Declaration, and Initialization, accessing Union member.

Unit-IV:

Pointers and Files: Pointers-Declaration, Initialization, Pointer to Pointer, Pointer Arithmetic, Parameter Passing Techniques, Pointer to Arrays, Pointers to Structures. Files- Introduction, defining, opening, and closing a File, Input / Output operations on Files, Random Access in files, Command line arguments.

Unit-V:

Searching and Sorting: Time and Space Complexity, Searching- Linear Search and Binary Search, Sorting- Bubble Sort, Selection Sort, Insertion Sort and Quick Sort.

Books and Materials

Text Books:

1. Thareja, Reema. *Programming in C.* AICTE ed., 2nd rev. ed., Oxford University Press, 2018.
2. Forouzan, Behrouz A., and Richard F. Gilberg. *Computer Science: A Structured Programming Approach Using C*, 3rd ed., reprint, Cengage Learning (formerly Course Technology), 2007.

Reference Books:

1. Kanetkar, Yashavant P. *Let Us C: Authentic Guide to C Programming Language.*, 20th ed., reprint, BPB Publications, 2024.
2. Gottfried, Byron S. *Programming with C.*, 4th ed., reprint, McGraw-Hill Education (India), 2018.
3. Padmanabham, P. *C & Data Structures.*, 3rd ed., B.S. Publications, 2016.
4. Hanly, Jeri R., and Elliot B. Koffman. *Problem Solving and Program Design in C.*, 8th ed., reprint, Pearson, 2015.
5. Balagurusamy, E. *Programming in ANSI C.*, 9th ed., reprint, McGraw-Hill Education India, 2024.

A9011 – English for Skill Enhancement

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
30	0	0	30	60	2	40	60	100

Course Description

Course Overview

This course has been designed to develop linguistic and communicative competencies among engineering students. The Reading and Writing skills of the students are honed during the sessions using the prescribed textbook. Additionally, students are trained on effective usage of grammar and vocabulary. Further, they are encouraged to read texts which are aimed at developing their comprehension skills.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 17: Partnerships for the Goals

Course Outcomes

After the completion of the course, the student will be able to:

A9011.1. Identify and use appropriate vocabulary to compose and deliver clear oral and written communication
A9011.2. Practice adept usage of grammar for effective communication
A9011.3. Interpret and summarize known and unknown passages
A9011.4. Develop proficiency in writing for academic purposes
A9011.5. Demonstrate basic proficiency in professional correspondence

Course Syllabus

Unit-I:

Theme: Perspectives
Text: Lesson on 'The Generation Gap' by Benjamin M. Spock
Vocabulary: Word Formation - Prefixes and Suffixes; Synonyms and Antonyms
Grammar: Identifying Common Errors in Writing with reference to Articles and Prepositions, Conjunctions
Reading: Reading and its importance - Sub skills of Reading – Skimming and Scanning
Writing: Sentence Structures - Use of Phrases and Clauses in Sentences - Types of Sentences; Punctuation; Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence - Organizing Principles of Paragraphs in Documents

Unit-II:

Theme: Digital Transformation
Text: Lesson on 'Emerging Technologies'
Vocabulary: Homophones, Homonyms and Homographs
Grammar: Identifying Common Errors in Writing with reference to Tenses, Noun-Pronoun Agreement and Subject-Verb Agreement
Reading: Reading Strategies - Guessing Meaning from Context – Identifying Main Ideas - Exercises for Practice
Writing: Essay writing.

Unit-III:
Theme: Attitude and Gratitude
Text: Poems on 'Leisure' by William Henry Davies and 'Be Thankful' – Unknown Author
Vocabulary: Words often Confused; Phrasal Verbs
Grammar: Misplaced Modifiers
Reading: Sub-Skills of Reading – Identifying Topic Sentence and Providing Supporting Ideas - Exercises for Practice
Writing: Letter Writing: Letter of Request, Letter of Inquiry, Letter of Apology, Letter of Complaint, Email writing - Format, Style and Etiquette.

Unit-IV:
Theme: Entrepreneurship
Text: Lesson on 'Why a Start-up Needs to Find its Customers First' by Pranav Jain
Vocabulary: Standard Abbreviations in English, Idioms
Grammar: Redundancies in Oral and Written Communication, Transformation of sentences - Active and Passive Voice
Reading: Prompt Engineering Techniques – Comprehending and Generating Appropriate Prompts - Exercises for Practice
Writing: Precis Writing; Writing a Letter of Application and Resume/CV.

Unit-V:
Theme: Integrity and Professionalism
Text: Lesson on 'Professional Ethics'
Vocabulary: Technical Vocabulary and its Usage, Collocations
Grammar: Transformation of sentences - Reported Speech, Common Errors covering all other aspects of grammar
Reading: Survey, Question, Read, Recite and Review (SQ3R Method) – Inferring the Meaning and Evaluating a Text - Exercises for Practice
Writing: Technical Reports - Introduction – Characteristics of a Report - Structure of Report (Manuscript Format)

Books and Materials

Text Books:

1. Board of Editors, *English for the Young in the Digital World.* Orient Black Swan Pvt. Ltd. 2025.

Reference Books:

1. Swan, Michael, *Practical English Usage.* Oxford University Press. New Edition, 2016.
2. Karal, Rajeevan, *English Grammar Just for You.* Oxford University Press. New Delhi, 2023.
3. Cengage India, *Empowering with Language: Communicative English for Undergraduates.* Cengage Learning India Pvt. Ltd. New Delhi, 2024.
4. Sanjay Kumar & Pushp Lata, *Communication Skills – A Workbook.* Oxford University Press. New Delhi, 2022.
5. Wood, F.T., *Remedial English Grammar.* Macmillan, 2007.
6. Vishwamohan, Aysha. *English for Technical Communication for Engineering Students.* McGraw-Hill Education India Pvt. Ltd, 2013.

A9201 – Electrical Circuits-I

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course provides fundamental knowledge of electrical circuits and their analysis. It covers basic circuit laws, steady-state analysis of single-phase and three-phase systems, and the application of various network theorems. Students will also learn the concepts of magnetic coupled circuits, enabling them to analyze and solve practical electrical circuit problems effectively.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9201.1. Apply network theorems and circuit laws to solve electrical networks with active and passive elements.

A9201.2. Apply network theorems to simplify and analyze DC circuits.

A9201.3. Apply phasor concepts to determine impedance, power, and steady-state response in single-phase AC circuits.

A9201.4. Analyze three-phase systems to determine voltages, currents, and power in star and delta connections for balanced and unbalanced loads.

A9201.5. Apply the concepts of self and mutual inductance to determine the behavior of series and parallel coupled circuits.

Course Syllabus

Unit-I:

Network Elements and Laws: Active elements- Types of sources, Passive elements- R, L and C, Energy stored in Inductance and Capacitance, Kirchhoff's laws, Source transformation, Star-Delta transformation, Node voltage method, and Mesh current method with DC Excitation.

Unit-II:

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorems, Maximum power transfer theorem and Reciprocity theorem with DC excitation.

Unit-III:

Single-Phase Circuits: RMS and average values of periodic sinusoidal wave forms, Phasor representation, j-Notation, Steady-state analysis of series, parallel circuits. Impedance, Admittance, Active and Reactive Powers, Complex Power.

Unit-IV:

Three-Phase Circuits: Polyphase Systems, Advantages of Three-Phase System, Phase Sequence, Inter-Connection of Three-Phase Sources and Loads, Star to Delta and Delta to Star Transformation, Voltage, Current and Power in a Star Connected System, Voltage, Current and Power in a Delta Connected System, Three-Phase Balanced Circuits, Three-Phase Unbalanced Circuits.

Unit-V:

Magnetic Coupled Circuits: Concept of self and mutual inductance, Dot convention, Coefficient of coupling, Analysis series and parallel connection of coupled circuits with mutual inductance.

Books and Materials

Text Books:

1. Singh, Ravish R. *Network Analysis and Synthesis* , 2nd ed., McGraw Hill, 2019.
2. Van Valkenburg, M. E. *Network Analysis.*, 3rd ed., Prentice Hall of India, 2000.
3. Alexander, Charles K., and Matthew N. O. Sadiku. *Fundamentals of Electric Circuits.*, 7th ed., McGraw-Hill, 2022.

Reference Books:

1. Subramanyam, B. *Electric Circuit Analysis* , 9th ed., Dream tech Press & Wiley, 2021
2. Nilsson, James W., and Susan A. Riedel. *Electric Circuits* , 11th ed., Pearson, 2020
3. Sudhakar, A., and Shyammohan S. Palli. *Circuits and Networks: Analysis and Synthesis.*, 5th ed., McGraw Hill, 2017.
4. Hayt, William H., Jack E. Kemmerly, and M. Durbin. *Engineering Circuit Analysis.*, 6th ed., McGraw Hill, 2002.

A9010 – Engineering Chemistry Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

The Engineering Chemistry Laboratory equips students with practical skills essential for understanding the chemical principles behind engineering materials and processes. It bridges theoretical knowledge with real-world applications, fostering analytical thinking and precision. Students learn to handle instruments, analyze data, and interpret results relevant to industrial and environmental contexts. The course emphasizes the role of chemistry in addressing engineering challenges and societal needs. Overall, it builds a strong foundation for innovation and responsible technological development.

Course Pre/Co-requisites

This course has no specific prerequisites and co requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 6: Clean Water and Sanitation
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action

Course Outcomes

After the completion of the course, the student will be able to:

A9010.1. Apply the instrumental techniques to find out the strength of solutions.
A9010.2. Analyze the impurities present in the water using volumetric analysis.
A9010.3. Make use of different titrimetric methods to measure chemical species.
A9010.4. Analyze the importance of temperature and pressure on physical properties of liquids.
A9010.5. Calculate the yield of synthesized compounds by maintaining appropriate reaction conditions.

Course Syllabus

List of Experiments:

1. Estimation of amount of ferrous ion in the given solution by permanganometry.
2. Estimation of hardness of water by complexometry using EDTA.
3. Estimation of amount of hydrochloric acid in the given solution by conductometry.
4. Estimation of amount of strong and weak acid in the given solution by conductometry.
5. Estimation of amount of hydrochloric acid in the given solution by potentiometry.
6. Estimation of amount of ferrous ion in the given solution using potassium permanganate by potentiometry.
7. Estimation of manganese ion in the given solution by colorimetry.
8. Estimation of Copper ion in the given solution by colorimetry.
9. Determination of viscosity of the given liquid by Ostwald's viscometer.
10. Determination of surface tension of the given liquid by using stalagmometer.

11. Preparation of Bakelite.
12. Preparation of Nylon 6,6.

Laboratory Equipment/Software/Tools Required:

1. Digital Conductometer
2. Digital Potentiometer
3. Digital Colorimeter
4. Electrical Water Heater
5. Wall Mount Distillation Plant
6. Analytical/Digital Weighing Balance
7. Ostwald's Viscometer
8. Stalagmometer
9. Stopwatch
10. Thermometer
11. RB Flask condenser
12. Magnetic Stirrer
13. Pipette
14. Burette
15. Beaker

Books and Materials

Text Books:

1. Rama Devi, B., Aparna, P., and Prasanta Rath. *Engineering Chemistry.* 2nd ed., Cengage Publications, 2025.

Reference Books:

1. Vogel, A. I. *Inorganic Quantitative Analysis.* ELBS Publications.
2. Ahluwalia, V. K. *College Practical Chemistry.* Narosa Publications Ltd., 2007

A9502 – Programming for Problem Solving Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course aims to build practical programming skills using the C language. Students learn to approach problems logically and implement solutions efficiently. Emphasis is given to writing clear and structured programs using control statements and modular design. They gain hands on experience with data handling, including arrays, strings, and user-defined data types. Pointers are introduced to manage memory and work with complex data efficiently. File operations are covered to handle data storage and retrieval. Students practice implementing algorithms for sorting, searching, and numerical computations. The course develops debugging and problem-solving abilities through practical exercises. Focus is placed on optimizing code for better performance and readability. By the end, learners can design and implement robust C programs for a variety of computational problems.

Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9502.1. Make use of fundamental programming constructs to develop solutions for computational problems.

A9502.2. Perform various operations on arrays and strings to effectively organize, process, and manipulate sequential data in programs.

A9502.3. Develop programs with functions and structures to design modular programs that efficiently handle and process data.

A9502.4. Apply pointers and file handling techniques to implement programs for storing and managing data effectively.

A9502.5. Implement searching and sorting algorithms to efficiently organize and access data.

Course Syllabus

List of Experiments:

1. Variables and Expressions
   a. Write a C program for Swapping of two numbers using a third variable.
   b. Write a C program for the simple and compound interest.
   c. Write a C program to evaluate the expressions (Finding $y = m \cdot x + c$, displacement).
2. Conditional Statements–I
   a. Write a C program for finding the max and min from the three numbers.
   b. Write a C program to check the given year is leap year or not.

c. Write a C program to find the roots of a quadratic equation.

3. Conditional Statements–II
   a. Write a C program to check the given number is power of 2 or not using bitwise operators.
   b. Write a C program to read 3 subject marks. Calculate and display the grade of a student based on the percentages.
   c. Write a C program to perform Arithmetic Operations using switch statement.
4. Iterative Statements–I
   a. Write a C program to find sum of n natural numbers $(1+2+3+\cdots+n)$.
   b. Write a C program to find factorial of a given number.
   c. Write a C program to print Fibonacci numbers.
   d. Write a C program to find reverse of the given number.
   e. Write a C program to check if the binary representation of a positive number is palindrome or not. (Examples: 101, 11, 11011, 1001001 are palindromes. 100, 110, 1011 are not).
5. Iterative Statements–II
   a. Write a C program to read a password until it is correct. For wrong password print "Incorrect password" and for correct password print "Correct password" and quit the program. (The correct password is 1234).
   b. Write a C program to check the given number is prime or not.
   c. Write a C program to find the GCD of given two numbers.
   d. Write a C program to print the output in various triangle patterns using nested `for` loops.
   e. Write a C program to find the sum of the series Geometric Progression.
6. Arrays
   a. Write a C program to find the largest and smallest number among a list of integers.
   b. Write a C program to read an array of n elements and find the mean, variance, and standard deviation.
   c. Write a C program to find addition of two matrices.
   d. Write a C program to find multiplication of two matrices.
7. Strings
   a. Write a C program to demonstrate the string handling functions.
   b. Write a C program to check whether a given string is palindrome or not.
   c. Write a C program to concatenate three strings.
   d. Write a C program to count the lines, words and characters in a given text.
   e. Write a C program that displays the position of a character ch in the string S or -1 if S doesn't contain ch.
8. Functions
   a. Write a C program to find the factorial of a given number using non-recursive and recursive function.
   b. Write a C program to find the nth term of a Fibonacci series using recursive function.
   c. Write a C program to compute x^y.
9. Structures
   a. Write a C program to create a Student structure containing name, rollNo and grade as structure members. Display the name, rollNo and grade of a student.

b. Write a C program to create a Student structure containing name, rollNo and grade as structure members. Display the name, rollNo and grade of n students by using array of structures concept.

10. Structures and functions
    a. Write a C program to add two complex numbers by passing structure to a function.
    b. Write a C program to add two distances (in inch-feet system) using structures.
11. Pointers
    a. Write a C program to swap two integers using the following methods:
        i. Call by Value
        ii. Call by Reference
    b. Write a C program to demonstrate pointer arithmetic.
    c. Write a program to display values in reverse order from an array using a pointer.
    d. Write a program through a pointer variable to find sum of n elements from an array.
    e. Write a C program to check the given string is palindrome or not using pointer.
    f. Write a C program to print n city names using pointers and strings.
12. Files
    a. Write a C program to merge two files into a third file.
    b. Write a C program to reverse the contents of a file.
    c. Write a C program to use random access functions in files.
    d. Write a C program to count the number of times a character occurs in a text file (file name and character are supplied as command line arguments).
13. Searching
    a. Write a C program that uses a non-recursive function to search for a key value in a list of integers using linear search.
    b. Write a C program that uses a non-recursive function to search for a key value in a sorted list of integers using binary search.
14. Sorting
    a. Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.
    b. Write a C program that sorts the given array of integers using selection sort in descending order.
    c. Write a C program that sorts the given array of integers using quick sort in ascending order.
    d. Write a C program that sorts the given array of integers using insertion sort in ascending order.
15. Miscellaneous
    1. Write a program that shows the binary equivalent of a given positive number between 0 to 255.
    2. Write a C program to calculate the following, where x is a fractional value:

$$1 - \frac{x}{2} + \frac{x^2}{4} - \frac{x^3}{6}$$

    3. Write a C program to read in two numbers, `x` and `n`, and then compute the sum of this geometric progression:

$$1 + x + x^2 + x^3 + \cdots + x^n$$

    For example: if $n = 3$ and $x = 5$, the program computes $1 + 5 + 25 + 125$.

4. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
5. Write a C program that converts a number ranging from 1 to 50 to its Roman equivalent.
6. Write a C program that uses functions to perform the following operations:
   i. To insert a sub-string into a given main string from a given position.
   ii. To delete n characters from a given position in a given string.
7. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).
8. Write a program for display values reverse order from an array using a pointer.
9. Write a program through a pointer variable to sum of n elements from an array.
10. Write a C program that sorts the given array of integers using insertion sort in ascending order

Laboratory Equipment/Software/Tools Required:

1. Computer Systems (PCs) installed with Ubuntu OS (Open source/ Freeware)
2. GCC Compiler (Open source/ Freeware)

Books and Materials

Text Books:

1. Thareja, Reema. *Programming in C.* AICTE ed., 2nd rev. ed., Oxford University Press, 2018.
2. Forouzan, Behrouz A., and Richard F. Gilberg. *Computer Science: A Structured Programming Approach Using C.*, 3rd ed., reprint, Cengage Learning (formerly Course Technology), 2007.

Reference Books:

1. Kanetkar, Yashavant P. *Let Us C: Authentic Guide to C Programming Language*, 20th ed., reprint, BPB Publications, 2024.
2. Gottfried, Byron S. *Programming with C*, 4th ed., reprint, McGraw-Hill Education (India), 2018.
3. Padmanabham, P. *C & Data Structures*, 3rd ed., B.S. Publications, 2016.
4. Hanly, Jeri R., and Elliot B. Koffman. *Problem Solving and Program Design in C*, 8th ed., reprint, Pearson, 2015.
5. Balagurusamy, E. *Programming in ANSI C*, 9th ed., reprint, McGraw-Hill Education India, 2024.

A9012 – English Language and Communication Skills Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course is designed to cater to the needs of students in developing their oral communication skills. It begins with an introduction to Phonetics to make them understand the received pronunciation and to help them speak with a neutral accent. This course incorporates listening skills and draws exercises of listening comprehension from various general and business contexts. The speaking exercises in this course will help the students to present their ideas in different situations, besides helping them to develop team spirit by participating in pair/group activities.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 17: Partnerships for the Goals

Course Outcomes

After the completion of the course, the student will be able to:

A9012.1. Acquire the received pronunciation and speak in a neutral accent
A9012.2. Use language effectively in real-life situations
A9012.3. Demonstrate effective use of non verbal communication
A9012.4. Interpret visual data for oral communication
A9012.5. Develop the ability to enhance listening skills

Course Syllabus

List of Experiments:

1. CALL Lab:

Instruction: Speech Sounds - Listening Skills - Listening vs. Hearing - Importance – Purpose - Types
Practice: Listening to Distinguish Speech Sounds (Minimal Pairs) - Testing Exercises

2. ICS Lab:

Diagnostic Test: Activity titled 'Express Your View'
Instruction: Spoken and Written language - Formal and Informal English - Greetings – Introducing Oneself and Others
Practice: Any Ice-Breaking Activity

3. CALL Lab

Instruction: Barriers to Listening - Active Listening
Practice: Listening for General Information - Multiple Choice Questions - Listening Comprehension - Exercises for practice

4. ICS Lab:
Instruction: Features of Good Conversation – Strategies for Effective Communication
Practice: Role Play Activity - Situational Dialogues – Expressions used in Various Situations – Making Requests and Seeking Permissions – Taking Leave - Telephone Etiquette

5. CALL Lab
Instruction: Minimizing Errors in Pronunciation (MTI)
Practice: Differences between British and American Pronunciation – Listening Comprehension – Exercises for practice

6. ICS Lab:
Instruction: Describing Objects, Situations, Places, People and Events
Practice: Picture Description Activity – Looking at a Picture and Describing Objects, Situations, Places, People and Events

7. CALL Lab:
Instruction: Techniques for Effective Listening
Practice: Listening for Specific Details - Listening - Gap Fill Exercises - Listening Comprehension – Exercises for practice

8. ICS Lab:
Instruction: Information transfer - oral interpretation of graphical data
Practice: Activity on oral interpretation of graphical data

9. CALL Lab:
Instruction: Identifying the literal and implied meaning
Practice: Listening for Evaluation - Write the Summary – Listening Comprehension – Exercises for practice

10. ICS Lab:
Instruction: Understanding Non-Verbal Communication
Practice: Dumb Charades Activity
Post-Assessment Test: 'Express Your View'

Laboratory Equipment/Software/Tools Required:

1. Computers with internet
2. K VAN Solutions Software
3. Headphones
4. Audio Visual Equipment
5. Camcorder

Books and Materials

Lab Manual:

1. Laboratory Handbook on English Language and Communication Skills Lab.

Reference Books:

1. Brook-Hart, Guy. *Cambridge English Business Benchmark - Upper Intermediate Business Vantage (with CD)*, 2nd Edition, South Asian Edition, Cambridge University Press, 2019.
2. Shobha, KN & Rayen, J. Lourdes. *Communicative English – A workbook.* Cambridge University Press, 2019.
3. Board of Editors. *ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities.* Orient BlackSwan Pvt. Ltd. , 2016.
4. Mishra, Veerendra et al. *English Language Skills: A Practical Approach.* Cambridge University Press, 2020.
5. *English Language Communication Skills – Lab Manual cum Workbook.* Cengage Learning India Pvt. Ltd.
6. Ur, Penny and Wright, Andrew. *Five Minute Activities – A Resource Book for Language Teachers.* Cambridge University Press, 2022.
7. *TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).*

A9304 - Computer Aided Engineering Graphics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course provides students from diverse engineering disciplines with essential skills in computer-aided engineering drawing using AutoCAD. It focuses on the fundamentals of constructing two-dimensional geometric objects, understanding orthographic projections of points, lines, planes, and solids, and applying isometric projections. Students will learn to use AutoCAD tools such as Draw, Modify, Layers, and Dimensioning to create technically accurate drawings aligned with engineering standards. The course emphasizes practical applications relevant to civil, electrical, electronics, and other engineering fields, enabling students to visualize, interpret, and communicate design concepts effectively.

Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

Relevant Sustainable Development Goals (SDG(s))

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9304.1. Analyze the basic drawing and editing tools to create and modify 2D sketches.

A9304.2. Interpret the projection principles to draw points and lines in different quadrants.

A9304.3. Compare the projected views of planes to identify their true shape and inclination.

A9304.4. Apply the orthographic projection principles to construct two-dimensional views of solids.

A9304.5. Construct isometric views by applying principles derived from orthographic drawings.

Course Syllabus

Unit-I:

Introduction to AutoCAD: User Interface and Workspace Customization, Basic Drawing Tools, Modify and Editing Tools, Properties and Object Management, Layer Management, Dimensioning and Annotation, Layouts and Plotting, Geometrical construction of two-dimensional objects.

Unit-II:

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants. Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.

Unit-III:

Projections of Planes: Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Unit-IV:

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Unit-V:

Isometric Projections: Isometric coordinates, Isometric Scale, Isometric Views of Lines, Planes and solids. Conversion of Isometric View to Orthographic View and Vice-versa.

Books and Materials

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., *Engineering Drawing*, 53rd Edition, Charotar Publishing House, 2019.
2. K. Balaveera Reddy et al, *Computer Aided Engineering Drawing*, 2nd Edition, CBS Publications, 2015.

Reference Books:

1. Narayana, K.L. & P Kannaiah, *Text book on Engineering Drawing*, 3rd Edition, Sci-Tech Publishers, 2020.
2. Basant Agrawal B. and Agrawal C. M., *Engineering Graphics*, 3rd Edition, TMH Publication, 2020.
3. Shah, M.B., Rana B.C., *Engineering Drawing and Computer Graphics*, 2nd Edition, Pearson Education, 2009.

A9021 - Community Centered Design Thinking

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	0	45	45	1	40	60	100

Course Description

Course Overview

The "Community-Centered Design Thinking" course aims to enable students to identify and address unique needs and challenges within local communities. Through the application of design thinking principles, students will develop creative problem-solving mindsets and the ability to collaborate effectively in multidisciplinary teams. The course emphasizes integrating moral code, professional standards, and sustainability principles into design solutions.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 3: Good Health and Well-being
SDG 4: Quality Education
SDG 11: Sustainable Cities and Communities
SDG 17: Partnerships for the Goals

Course Outcomes

After the completion of the course, the student will be able to:

A9021.1. Apply the principles of design thinking, empathy, and sustainability to identify and understand real-world community challenges.

A9021.2. Conduct field research surveys and observation to define community-based problem statements.

A9021.3. Ideate creative solutions using appropriate tools and techniques to meet the identified community needs.

A9021.4. Collaborate with community members, NGOs, and peers to test, refine, and validate design solutions through feedback and co-design processes.

A9021.5. Communicate design outcomes effectively through documentation, storytelling, and ethical reflection considering accessibility, inclusivity, and life-cycle impact.

Course Syllabus

Unit-I:

Community-Centered Design Thinking: Understanding the significance of community-centered approaches, Overview of Design Thinking principles for community engagement.

Unit-II:

Needs and Challenges Assessment: Techniques for identifying and analyzing unique needs within local communities, SDGs Alignment, Case studies illustrating successful community-centered design projects.

Unit-III:

Research and Comparative Analysis for Innovation: Investigating existing solutions to community challenges, comparing their effectiveness, and identifying opportunities to create improved, innovative approaches.

Unit-IV:

Ethical Design and Sustainability: Integrating moral code and professional standards into the design process. Incorporating sustainability principles in design to define socially responsible solutions.

Unit-V:

Refine Problem Statement: study existing solutions, and generate creative, community-focused ideas, with all findings documented for the next stage of development.

Activity Plan

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
1	Unit-I: CCDT	Understand significance of community centered approaches	Concept Briefing + Discussion	Icebreaker: list visible community challenges	Reflection notes: "Why is community engagement critical?"	CO1
2	Unit-I: CCDT	Learn design thinking principles	Concept Briefing + Activity	Mini design thinking cycle for sample issue	Mind-map of 5 stages applied to local issue	CO1
3	Unit-II: Needs Assessment	Acquire techniques for identifying needs	Concept Briefing + Hands on Session	Practice mock interviews, empathy mapping	Conduct mini survey (3–5 people)	CO2
4	Unit-II: Needs Assessment	Connect needs to SDGs	Concept Briefing + Case Study	Group analysis: link issues to SDGs	Case study report (2–3 pages)	CO2
5	Unit-III: Research	Investigate existing solutions	Guided Research	Group research on 2–3 existing interventions	Summary table of solutions	CO3
6	Unit-III: Comparative Analysis	Compare effectiveness of solutions	Presentations	Present comparison of solutions (pros/cons)	Comparative chart submission	CO3
7	Unit-IV: Ethics	Integrate ethics into design	Debate	Debate: "Should cost outweigh ethics?"	Short essay on ethical dilemma	CO4
8	Unit-IV: Sustainability	Apply sustainability principles	Hands on Session	Create sustainability checklist for ideas	Submit checklist + reflection	CO4
9	Unit-V: Refinement	Refine problem statements	Guided Group Work	Rewrite into "How Might We..." questions	Final problem statement submission	CO2, CO5

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
10	Unit-V: Refinement	Study existing solutions deeply	Problem Statement Review	Critique and identify gaps in solutions	Gap Analysis Report	CO3, CO5
11	Unit-V: Ideation	Generate creative ideas	Ideation Hands-on Session	Brainstorming, SCAMPER, Story boarding	Sketches/story boards of top 3 ideas	CO3, CO5
12	Unit-V: Documentation & Presentation	Present and document findings	Final Showcase	Group presentations + reflection sharing	Final report + individual reflection essay	CO5

Books and Materials

Text Books:

1. Pavan Soni. *Design Your Thinking*, Penguin Random House India, New Delhi, 2020.
2. Anuja Agarwal. *Design Thinking: A Framework for Applying Design Thinking in Problem Solving*, Cengage India, 2024.

Reference Books:

1. Srinivasan R., Mohammed Ismail, Arulmozhi Srinivasan. *Design Thinking: Principles, Processes and Applications*, S Chand Publishing, 2025.

I B.Tech. II Semester

A9002 – Ordinary Differential Equations and Vector Calculus

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	15	0	60	120	4	40	60	100

Course Description

Course Overview

This course provides the fundamental mathematical concepts and techniques essential for engineering applications. In this course, the students are acquainted with ordinary differential equations of first and higher order and Laplace transforms, vector calculus. The course is designed to build conceptual clarity and problem-solving skills, with emphasis on both theoretical understanding and practical applications.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9002.1. Make use of first order differential equations to solve real world problems.

A9002.2. Solve ordinary differential equations of higher order.

A9002.3. Apply Laplace transforms to solve ordinary differential equations.

A9002.4. Determine divergence and curl of a vector point function.

A9002.5. Compute line, surface, and volume integrals and convert them into one another using appropriate theorems.

Course Syllabus

Unit-I:

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

Unit-II:

Ordinary Differential Equations of Higher Order: Higher order linear differential equations with constant coefficients: Non-homogeneous terms of the type e^{ax}, $\sin ax$, $\cos ax$, polynomials in x, $e^{ax}V(x)$ and $xV(x)$, method of variation of parameters.

Unit-III:

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

Unit-IV:

Vector Differentiation: Vector point functions and scalar point functions, Gradient, Directional derivatives, Divergence and Curl, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

Unit-V:

Vector Integration: Line integral, Surface integral and Volume Integral. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Books and Materials

Text Books:

1. Grewal, B. S. *Higher Engineering Mathematics*, 43rd ed., Khanna Publications, 2015.
2. Jain, R. K., Iyengar, S. R. K. *Advanced Engineering Mathematics*, 5th ed., Narosa Publishing House, 2016.

Reference Books:

1. Raisinghania M.D. *Ordinary and Partial Differential Equations* , 20th ed., S. Chand Publishing, 2024.
2. Greenberg Michael D.*Advanced Engineering Mathematics*, 2nd ed., Upper Saddle River, N.J. Prentice Hall, 1998.
3. Kreyszig, E. *Advanced Engineering Mathematics*, 9th ed., John Wiley & Sons, 2006.
4. Ramana, B. V. *Higher Engineering Mathematics*, 32nd edition reprint, McGraw Hill Education (India), 2018.

A9007 – Engineering Physics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

The Engineering Physics course introduces the fundamental principles of quantum mechanics, semiconductor physics, quantum computing, magnetic and dielectric materials, as well as lasers and fibre optics. Students will explore theoretical foundations, material properties, and device concepts alongside their practical applications in modern technologies such as electronics, communication, sensing, and computing systems. This course bridges core physics concepts with real-world innovations, preparing learners for advanced studies and research in emerging technologies.

Course Pre/Co-requisites

This course has no specific prerequisites and co requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy
SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9007.1. Apply quantum mechanical principles to understand the particle behavior and formation of energy bands in solids.

A9007.2. Analyze semiconductor properties and explain the operation of P–N junction diode and their applications.

A9007.3. Apply quantum gates to design quantum circuits and implement fundamental quantum algorithms.

A9007.4. Analyze magnetic and dielectric properties relevant to modern technological applications.

A9007.5. Apply laser and fibre optic principles to communication and sensing technologies.

Course Syllabus

Unit-I:

Quantum Mechanics: Introduction, de-Broglie hypothesis, Heisenberg uncertainty principle, physical significance of wave function, postulates of quantum mechanics: operators in quantum mechanics, eigen values and eigen functions, Schrödinger's time independent wave equation, particle in a 1D box, Bloch's theorem (qualitative), Kronig-Penney model (qualitative): E-k diagram, effective mass of electron, formation of energy bands, origin of band gap, classification of solids, concept of discrete energy levels.

Unit-II:

Semiconductor Physics: Intrinsic semiconductors, density of states, Fermi-Dirac distribution function, carrier concentration in intrinsic semiconductors, direct and indirect band gap semiconductors, extrinsic semiconductors, characteristics of P-N junction diode, applications: Light Emitting Diode (LED), solar cell, Hall effect.

Unit-III:

Quantum Computing: Introduction, linear algebra for quantum computation, Dirac's Bra and Ket notation and their properties, Hilbert space, Bloch's sphere, concept of quantum computer, classical bits, Qubits, multiple Qubit system, quantum computing system for information processing, evolution of quantum systems, quantum measurements, entanglement, quantum gates (Hadamard, CNOT, Toffoli), challenges and advantages of quantum computing over classical computation, Introduction to quantum algorithms: Deutsch-Jozsa, Shor, Grover (Qualitative).

Unit-IV:

Magnetic and Dielectric Properties: Introduction to magnetic materials, origin of magnetic moment, classification of magnetic materials (dia, para, ferro), Weiss domain theory of ferromagnetism, hysteresis, soft and hard magnetic materials, applications: magnets for EV, Giant Magneto Resistance (GMR) device. Introduction to dielectric materials, types of polarization (qualitative): electronic, ionic & orientational; ferroelectric, piezoelectric, pyroelectric materials and their applications: Ferroelectric Random-Access Memory (Fe-RAM), load cell and fire sensor.

Unit-V:

Lasers and Fibre Optics: Introduction to laser, characteristics of laser, Einstein coefficients and their relations, metastable state, population inversion, pumping, lasing action, Ruby laser, He-Ne laser, semiconductor diode laser, applications: Bar code scanner, LIDAR for autonomous vehicle. Introduction to fibre optics, total internal reflection, construction of optical fibre, acceptance angle, numerical aperture, classification of optical fibres, losses in optical fibres, applications: optical fibre for communication system, sensor for structural health monitoring.

Books and Materials

Text Books:

1. T. Vijaya Krishna, T. Madhu Mohan, B.K. Pandey, Manoj K. Harbola, and S. Chaturvedi. *Physics for Engineers.* 2nd ed., Cengage, 2024.
2. M. N. Avadhanulu, P. G. Kshirsagar, and T. V. S. Arun Murthy. *A Textbook of Engineering Physics.* 13th ed., S. Chand & Company Pvt. Ltd., 2023.
3. Thomas G. Wong. *Introduction to Classical and Quantum Computing.* Rooted Grove.

Reference Books:

1. Jozef Gruska. *Quantum Computing.* McGraw Hill Education, 1999.
2. Michael A. Nielsen and Isaac L. Chuang. *Quantum Computation and Quantum Information.* Cambridge University Press, 2010.
3. John M. Senior. *Optical Fiber Communications: Principles and Practice.* Pearson Education Limited, 2009.

A9206 – Electrical Circuits-II

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces the analysis of RL, RC, and RLC circuits under transient and steady-state conditions. It emphasizes the application of Laplace transforms in circuit analysis, enabling systematic solutions for complex electrical networks. The course also covers the study of two-port networks and the design of passive filters, providing a strong foundation for advanced topics in electrical circuit theory and applications.

Course Pre/Co-requisites

A9001 – Matrices and Calculus

A9201 – Electrical Circuits-I

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9206.1. Model and analyze the performance of two-port networks for series, parallel, and cascade connections.

A9206.2. Apply network theorems to simplify and analyze AC circuits.

A9206.3. Apply network topology techniques and resonance concepts in RLC circuits.

A9206.4. Analyze the transient response of RL, RC, and RLC circuits under DC excitation.

A9206.5. Apply Laplace transform techniques for solving RL, RC, and RLC circuits under DC excitation.

Course Syllabus

Unit-I:

Two-port Network Parameters: Open-circuit impedance and short-circuit admittance parameters, Transmission and Hybrid parameters, Series, parallel and cascade connection of two port networks.

Unit-II:

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorems, Maximum power transfer theorem and Reciprocity theorem with AC Excitation.

Unit-III:

Network Topology: Graph, tree, chord, Tie-set, cut-set, incident matrices, Problems on Tie-set and cut-set matrices.

Resonance: Series and parallel RLC circuits, bandwidth and quality factor of a series RLC circuit.

Unit-IV:

Transient Analysis: Significance of Initial conditions of R, L and C elements. Transient response of series RL, RC and RLC circuits using differential approach for DC excitation.

Unit-V:

Electrical Circuit Analysis using Laplace Transforms: Laplace Transforms of step, ramp, exponential, impulse functions (inputs). Transient response of series RL, RC and RLC circuits using Laplace Transforms approach for DC excitation.

Books and Materials

Text Books:

1. Singh, Ravish R. *Network Analysis and Synthesis* , 2nd ed., McGraw Hill, 2019.
2. Van Valkenburg, M. E. *Network Analysis.*, 3rd ed., Prentice Hall of India, 2000.
3. Alexander, Charles K., and Matthew N. O. Sadiku. *Fundamentals of Electric Circuits.*, 7th ed., McGraw-Hill, 2022.

Reference Books:

1. Subramanyam, B. *Electric Circuit Analysis*, 9th ed., Dream tech Press & Wiley, 2021
2. Nilsson, James W., and Susan A. Riedel. *Electric Circuits* , 11th ed., Pearson, 2020
3. Sudhakar, A., and Shyammohan S. Palli. *Circuits and Networks: Analysis and Synthesis.*, 5th ed., McGraw Hill, 2017.
4. Hayt, William H., Jack E. Kemmerly, and M. Durbin. *Engineering Circuit Analysis.*, 6th ed., McGraw Hill, 2002.

A9503 – Data Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces C++ programming with a focus on designing and implementing data structures. It covers object-oriented concepts such as classes, encapsulation, and abstraction for modular programming. Students learn to use pointers and dynamic memory for efficient data management. Templates and the Standard Template Library (STL) are taught for generic and reusable code. Linked lists are explored for dynamic data storage and sequential operations. Stacks and queues are implemented for practical applications like expression evaluation and task management. Tree structures are studied to represent hierarchical data with traversal and search methods. Binary search trees and AVL trees are covered to ensure organized and balanced data storage. Graph concepts and algorithms are introduced to model and navigate complex relationships. Hashing and dictionary structures provide fast data retrieval and efficient storage solutions. The course emphasizes hands-on programming to reinforce theoretical concepts. By the end, students can design, implement, and analyze core data structures effectively in C++.

Course Pre/Co-requisites

A9501 – Programming for Problem Solving

A9502 – Programming for Problem Solving Laboratory

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9503.1. Make use of programming constructs, Templates and STL components to implement data structures and solve computational problems effectively.

A9503.2. Implement linked list data structures using abstract data types to perform various operations.

A9503.3. Implement stack and queue abstract data types for solving applications on linear data.

A9503.4. Choose an appropriate nonlinear data structure for representing and solving real world problems.

A9503.5. Examine hashing and dictionary structures for insertion, deletion, and searching in computational problems.

Course Syllabus

Unit-I:

Introduction to C++ and Data Structures: Structure of a C++ Program, Classes and objects, Dynamic memory allocation (new and delete), Constructors and destructors, Access specifiers (public, private), Encapsulation and abstraction, Pointers and references, Functions, Inline functions, and function overloading. Template Definition, Function Templates, class Templates, Generic Function, Template function Overloading. Standard Template Library (STL) Overview- Containers: vector, list, map, set. Iterators and algorithms, Using STL templates in practical applications.

Unit-II:

Linked Lists: Classification of Data Structures, Abstract Data Types, Introduction to Linked Lists, Applications of Linked Lists, Node Structure and Memory Allocation. Linked List ADT, Singly Linked List Operations-Insert, Delete, Search and Traverse. Doubly Linked List Operations – Insert, Delete, Search and Traverse and Circular Linked Lists.

Unit-III:

Stacks and Queues: Stack ADT – Concepts and Applications. Array and Linked List implementation of Stacks. Applications – Conversion of Expression from infix to postfix, Evaluation of Postfix Expression. Queue ADT – Concepts & Applications. Array and Linked List implementation of Linear Queues, Array Implementation of Circular Queue and Double Ended Queue.

Unit-IV:

Trees and Graphs: Tree ADT, Binary Tree Terminology and Properties, Binary Tree Traversals – Inorder, Preorder and Postorder. Binary Search Tree Operations – Insertion, Deletion and Searching. AVL Trees, Definition, Height of an AVL Tree, Operations – Insertion, Deletion and Searching. Graph Definitions and Terminology. Graph Representations – Adjacency Matrix and Adjacency List. Graph Traversals – Depth-First Search (DFS) and Breadth-First Search (BFS).

Unit-V:

Dictionaries and Hashing: Hash Table Representation: hash functions, collision resolution-separate chaining, open addressing, linear probing, quadratic probing, double hashing, rehashing, extendible hashing. Dictionaries-linear list representation, skip list representation, operations - insertion, deletion and searching.

Books and Materials

Text Books:

1. Horowitz, Ellis, Sartaj Sahni, and Dinesh Mehta. *Fundamentals of Data Structures in C++*, 2nd ed., Universities Press, 2019.
2. Horowitz, *Data Structures Using C++*, 3rd edition, Course Technology, 2010.

Reference Books:

1. Drozdek, Adam. *Data Structures and Algorithms in C++*, 5th ed., Cengage Learning, 2025.
2. Dale, Nell, Chip Weems, and Tim Richards. *C++ Plus Data Structures*, 6th ed., Jones & Bartlett Learning, 2018.

A9207 – Electrical Power Generation

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
30	0	0	30	60	2	40	60	100

Course Description

Course Overview

This course explores the generation of power, its economic aspects, and methods of tariff, covering conventional power stations and their components. It also delves into non-conventional energy resources like solar, wind, hydro, geothermal, and biomass energy. Additionally, the course touches on alternate fuels such as hydrogen fuel cells, bio fuels and synthetic fuels providing a comprehensive understanding of sustainable energy solutions and equipping students to address the challenges of energy production and consumption.

Course Pre/Co-requisites

This course has no specific pre requisites or co-requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 13: Climate Action

Course Outcomes

After the completion of the course, the student will be able to:

A9207.1. Apply the fundamentals of thermal and nuclear power plants to explain the operation of their plant components.

A9207.2. Apply the concepts of hydro, geothermal, tidal, and wave energy systems to describe their operation, design aspects, and limitations..

A9207.3. Apply the concepts of wind and solar power generation to analyze their layouts, components, and limitations.

A9207.4. Apply biomass conversion and hydrogen production technologies to explain their utilization as renewable energy sources.

A9207.5. Apply load curve analysis and cost–tariff calculations to determine the economic performance of power stations.

Course Syllabus

Unit-I:

Thermal and Nuclear Power Plants: Site selection, Plant layout, Coal and its storage, Preparation, Handling, Feeding and burning, Cooling towers, Ash handling, Water treatment plant, High pressure boilers and steam turbines. Main components of nuclear power plant, Nuclear reactor types and applications, Radiation shielding - conceptual description only. .

Unit-II:

Hydro, Geothermal and Tidal Power Plants: Hydro Electric Power Plant Site selection, Plant layout, various components, Pumped storage plants. Principle of working, types of geothermal station with schematic diagram, scope of geothermal energy. Fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations, Devices for Harnessing Wave Energy – conceptual description only.

Unit-III:

Wind and Solar Power Systems: : Basics of wind energy and wind turbine technology, Site selection of Wind Power Plants, Types of wind turbines: horizontal axis and vertical axis. Fundamentals of solar energy and photovoltaic (PV) technology, Types of PV Systems, Solar Thermal Power Plant, Solar Ponds – conceptual description only. .

Unit-IV:

Alternate Fuels: Biomass as a renewable energy source: types and characteristics, Conversion technologies: combustion, gasification, and anaerobic digestion, biomass feedstock selection and availability, Environmental impacts and sustainability. Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water– conceptual description only.

Unit-V:

Economic Aspects of Power Generation and Tariff Methods: Base load and peak load on power station. Interconnected grid system, Load curve, load duration and integrated load duration curves, demand, diversity, capacity, utilization and plant use factors. Costs of electrical energy - Fixed, Semi-fixed and Running Costs, Tariff, Characteristics and Types of Tariffs- Numerical Problems on tariff.

Books and Materials

Text Books:

1. Gupta, B. R. *Generation of Electrical Energy,*, 7th ed., S. Chand & Company Ltd., 2017
2. Soni, M. L., P. V. Gupta, U. S. Bhatnagar, and A. Chakrabarti. *A Textbook on Power System Engineering*, 2nd ed., Dhanpat Rai & Co. Pvt. Ltd., 2010.
3. Wadhwa, C. L. *Generation, Distribution and Utilization of Electrical Energy* , 3rd ed., New Age International (P) Ltd., 2010.

Reference Books:

1. Kothari, D. P., and I. J. Nagrath. *Power System Engineering.*, 4th ed., Tata McGraw-Hill Education, 2018.
2. Grigsby, Leonard L. *Electric Power Generation, Transmission, and Distribution* , 3rd ed., CRC Press, 2012.
3. Mehta, V. K., and Rohit Mehta. *Principles of Power System.*, 3rd ed., CRC Press, 2012.

A9008 – Engineering Physics Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

The Engineering Physics laboratory course provides hands-on experience with fundamental concepts in semiconductors, magnetism, optics, and wave phenomena. Students will conduct practical experiments including the I-V characteristics of LEDs and solar cells, Hall effect measurements, and determination of energy band gaps. The course also covers the analysis of magnetic and dielectric properties, measurement of laser wavelength, characterization of optical fibre parameters, and AC frequency determination using a sonometer. These experiments are designed to enhance conceptual understanding and develop experimental skills relevant to modern physics and engineering applications.

Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 7: Affordable and Clean Energy
SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9008.1. Determine key parameters of LEDs and solar cells from their I–V characteristics.

A9008.2. Apply the Hall Effect to determine the type of semiconductor and estimate the density of majority charge carriers.

A9008.3. Evaluate material properties including energy band gap, magnetic moment, dielectric constant, and magnetic hysteresis behavior.

A9008.4. Apply the principles of lasers and optical fibres to determine laser wavelength and Numerical Aperture.

A9008.5. Apply principles of mechanical waves to determine AC supply frequency.

Course Syllabus

List of Experiments:

1. Determination of threshold voltage of LED from its I-V characteristics.
2. Study the I-V characteristics of Solar cell and find the fill factor.
3. Verification of the type of semiconductor material by estimating the density of majority carriers using the Hall Effect.
4. Determination of the energy band gap of a given semiconductor.
5. Determine the Magnetic moment of a given magnet and Horizontal component of earth's magnetic field.
6. Study of B-H curve of a ferromagnetic material.
7. Determination of dielectric constant of a given material.
8. Determination of the wavelength of a laser source using a plane transmission grating.

9. Evaluation of the numerical aperture (NA) and acceptance angle of a given optical fibre.
10. Determination of the frequency of an AC supply using a sonometer.

Laboratory Equipment/Software/Tools Required:

1. Light Emitting Diode Kit
2. Solar Cell Kit
3. Hall Effect Setup
4. Energy Gap of a Semiconductor Kit
5. Magnetic Moment Setup
6. B-H Curve Kit
7. Dielectric Constant Setup
8. Semiconductor Diode Laser
9. Plane Diffraction Grating
10. Optical Fibre Trainer Kit
11. Sonometer Setup
12. Meters – Ammeter, Voltmeter, Digital Multimeter, Deflecting Magnetometer, Thermometers

Books and Materials

Text Books:

1. Jain, Sushil Kumar, and Manjeet Singh *Applied Physics Experiments*, JBC Press, 2013.

Reference Books:

1. Mal, S. B., and Er. Ashish Jesuja *Practical Physics for Engineering Students of B.Tech*, JBC Press, 2020.

A9208 – Electrical Circuits Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

Electrical Circuits Laboratory is a practical course intended to enhance the problem-solving skills of the students in electric circuits by conducting various experiments. This course aims at imparting practical skills to the students on basic circuital laws, network theorems, mesh and nodal analysis. This course also aims at imparting practical knowledge to the students on AC circuit analysis and two port networks.

Course Pre/Co-requisites

A9001 – Matrices and Calculus

A9201 – Electrical Circuits - I

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9208.1. Apply fundamental electrical laws to analyze and verify basic DC and AC circuits experimentally.

A9208.2. Analyze AC circuits containing RL, RC, and RLC elements to determine impedance, phase angle, resonant frequency, and bandwidth.

A9208.3. Apply network theorems to simplify and analyze electrical networks.

A9208.4. Apply experimental methods to determine and analyze Z, Y, Hybrid, and Transmission parameters of electrical networks.

A9208.5. Apply experimental methods to evaluate and interpret the transient response of RL and RC series circuits.

Course Syllabus

List of Experiments:

1. Verification of Ohms Law.
2. Verification of KVL and KCL.
3. Verification of Node and Mesh Analysis.
4. Calculation and Verification of Impedance, Voltage and Current of series RL, RC and RLC circuits.
5. Determination of resonant frequency and band width of series RLC circuit.
6. Verification of Super Position Theorem
7. Verification of Thevenin's and Norton's theorems.
8. Verification of Maximum power transfer theorem.
9. Determination of Impedance(Z) and Admittance(Y) parameters.
10. Determination of Hybrid(h) and Transmission(ABCD) parameters.

11. Transient analysis of series RL circuits with DC Excitation.
12. Transient analysis of series RC circuits with DC Excitation.

Laboratory Equipment/Software/Tools Required:

1. Verification of Ohm's Law Kit
2. Verification of KVL and KCL Kit
3. Calculation and Verification of Impedance, Voltage and Current of series RL, RC and RLC circuits Kit
4. Verification of Superposition theorem Kit
5. Verification of Thevenin's and Norton's theorems Kit
6. Verification of Maximum power transfer theorems Kit
7. Function generator
8. Single phase transformer
9. DRB, DLB, DCB
10. Determination of Z and Y parameters Kit
11. Determination of Hybrid and Transmission parameters Kit
12. Transient analysis of series RL/RC circuits Kit
13. Digital Storage Oscilloscope

Books and Materials

Text Books:

1. Van Valkenburg, M. E. *Network Analysis.*, 3rd ed., Prentice Hall of India, 2000.
2. Singh, Ravish R. *Network Analysis and Synthesis.*, 2nd ed., McGraw Hill, 2019.
3. Alexander, Charles K., and Matthew N. O. Sadiku. *Fundamentals of Electric Circuits.*, 7th ed., McGraw-Hill, 2022

Reference Books:

1. Subramanyam, B. *Electric Circuit Analysis.*, Dream tech Press & Wiley, 2021.
2. Nilsson, James W., and Susan A. Riedel. *Electric Circuits.* , 11th reprint, Pearson, 2020.
3. Sudhakar, A., and Shyammohan S. Palli. *Circuits and Networks: Analysis and Synthesis.*, 5th reprint, McGraw Hill, 2017.
4. Hayt, William H., Jack E. Kemmerly, and M. Durbin. *Engineering Circuit Analysis.*, 6th reprint, McGraw Hill, 2002.

A9504 – Data Structures Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course enables to design and implement efficient C++ programs. Students learn object-oriented concepts such as classes, objects, and dynamic memory. It covers data structures including arrays, linked lists, stacks, queues, trees, and graphs. Hands-on exercises emphasize insertion, deletion, traversal, and searching operations. Students explore algorithms to improve performance and optimize data handling. Practical work with STL containers, iterators, and templates is included. Hashing and dictionary implementations demonstrate efficient data retrieval techniques. The course develops analytical thinking and systematic problem-solving skills. Students gain experience in building reliable, maintainable, and scalable software. By the end, students can apply programming concepts to solve real-world computational problems.

Course Pre/Co-requisites

A9501 – Programming for Problem Solving

A9502 – Programming for Problem Solving Laboratory

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9504.1. Implement programs that efficiently manage and manipulate data using dynamic programming techniques in C++.

A9504.2. Apply various linked list techniques to perform insertion, deletion and traversal on given data.

A9504.3. Develop programs using linear data structures stack and queue to handle data processing tasks efficiently.

A9504.4. Implement nonlinear data structures to solve real time aplications.

A9504.5. Choose appropriate hashing and dictionary methods to efficiently store, retrieve, and manipulate data.

Course Syllabus

List of Experiments:

1. Implementing Classes, Objects, and Dynamic Memory Allocation
   a. Define a Student class with attributes: rollNumber, name, marks
   b. Implement a constructor to initialize objects and a destructor to display a message when an object is deleted
   c. Dynamically allocate an array of Student objects using new
   d. Input details of n students and display them
   e. Release allocated memory using delete

2. Function Overloading and Templates
   a. Implement two overloaded functions add() that can add:Two integers, Two floating-point numbers
   b. Define a function template swapValues() that swaps two variables of any type.
   c. Test swapValues() with integer, float, and string types
3. Using STL Containers and Iterators
   a. Create a vector of integers, insert elements, and display them using an iterator
   b. Create a list of strings, perform insertion and deletion, and traverse using an iterator
   c. Use a map to store StudentID -> Name pairs and display all elements
   d. Use a set to store unique integers and print them in sorted order
   e. Apply STL algorithms like sort(), find(), and count() on the containers
4. Implementing Singly Linked List (ADT) Operations
   a. Define a Node structure containing data and a next pointer Implement functions to:
   b. Insert a node at the beginning, end, and at a given position
   c. Delete a node from the beginning, end, and a specified position..
   d. Traverse the linked list and display all elements
   e. Search for an element in the list and return its position.
   f. Demonstrate all operations with sample inputs
5. Implementing Doubly Linked List (ADT) Operations
   a. Define a DoublyNode structure containing data, prev, and next pointers. Implement functions to:
   b. Insert a node at the beginning, end, and any position
   c. Delete a node from the beginning, end, and a specified position
   d. Traverse the list forward and backward
   e. Search for an element in the list.
   f. Demonstrate all operations with sample inputs
6. Circular Linked Lists (ADT) Operations
   a. Define a Node structure for circular singly linked lists with a next pointer pointing to the first node. Implement functions to:
   b. Insert a node at the beginning and end
   c. Delete a node from the beginning and end
   d. Traverse the list starting from any node and print all elements.
   e. Extend the above to circular doubly linked lists with prev and next pointers
   f. Demonstrate operations with sample inputs.
7. Implementing Stack (ADT) Using Array and Linked Lists Implement the following operations:
   a. push() – insert an element onto the stack
   b. pop() – remove the top element from the stack
   c. peek() – view the top element without removing it
   d. isEmpty() and isFull() – check stack status
8. Expression Conversion and Evaluation Using Stack
   a. Implement infix to postfix conversion using a stack
   b. Implement evaluation of postfix expressions using a stack
   c. Test with different arithmetic expressions (including parentheses)

9. Implementing Queues (ADT) Using Array and Linked Lists Implement a linear queue using:
    a. Array with enqueue() and dequeue() operations
    b. Linked list dynamically allocating nodes for each element
    c. Display or traverse list using array and linked list
10. Implementing Queues (ADT) Using Circular Linear List Implement a linear queue using:
    a. Array with enqueue() and dequeue() operations.
    b. Display or traverse list using array.
11. Binary Tree (ADT) Implementation and Traversals
    a. Define a Node structure with data, left, and right pointers. Implement functions to:
    b. Insert nodes into a binary tree
    c. Traverse the tree using:
    d. Inorder Traversal
    e. Preorder Traversal
    f. Postorder Traversal
    g. Demonstrate traversal operations with a sample binary tree
12. Binary Search Tree (BST) and AVL Tree Operations Implement BST operations:
    a. Insert a node
    b. Delete a node
    c. Search for a value
    d. Display the tree using Inorder traversal to verify correctness
13. AVL Tree Operations Implement BST operations:
    a. Insert a node
    b. Delete a node
    c. Search for a value
    d. Implement AVL tree insertion and deletion with rotations to maintain balance
    e. Display the tree using Inorder traversal to verify correctness
14. Hash Table Implementation and Collision Handling
    a. Implement a hash table using an array
    b. Design and apply a simple hash function
    c. Implement collision resolution techniques: Separate Chaining using linked lists Open Addressing: linear probing, quadratic probing, and double hashing
    d. Perform insertion, deletion, and searching operations.
    e. Demonstrate handling of collisions with sample inputs.
15. Dictionary Implementation Using Linear List and Skip List
    a. Implement a dictionary using a linear list: Perform insertion, deletion, and search operations.
    b. Implement a dictionary using a skip list for faster search: Include multiple levels with forward pointers. Implement insertion, deletion, and search.
    c. Compare the efficiency of linear list and skip list implementations with sample data order

Laboratory Equipment/Software/Tools Required:

1. Computer Systems (PCs) installed with Ubuntu OS (Open source/ Freeware)
2. GCC Compiler (Open source/ Freeware)

Books and Materials

Text Books:

1. Horowitz, Ellis, Sartaj Sahni, and Dinesh Mehta. *Fundamentals of Data Structures in C++*, 2nd ed., Schaum's Outlines, Universities Press, 2019.
2. Malik D.S.*Data Structures and Algorithms in C++.* , 5th ed., Course Technology, 2010.

Reference Books:

1. Drozdek, Adam. *Data Structures and Algorithms in C++.* , 5th ed., Cengage Learning, 2025.
2. Dale, Nell, Chip Weems, and Tim Richards. *C++ Plus Data Structures.*, 6th ed., Jones & Bartlett Learning, 2018.

A9302 – Engineering Workshop

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

The Engineering Workshop course is designed to introduce students to basic and advanced manufacturing processes, workshop trades, and hands-on practical skills essential for engineering practice. The course provides experiential learning on a variety of trade skills including fitting, carpentry, welding, foundry, plumbing, electrical house wiring, and fabrication techniques such as 3D Printing. Students will gain practical familiarity with common tools, machines, and manufacturing methods, along with safety and quality management practices.

Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

Relevant Sustainable Development Goals (SDG(s))

SDG 4: Quality Education
SDG 9: Industry, Innovation, and Infrastructure
SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9302.1. Demonstrate the ability to perform fundamental workshop trades, including fitting, carpentry, welding, and plumbing, by completing a variety of hands-on tasks.

A9302.2. Demonstrate safe and effective usage of fabrication tools and digital equipment.

A9302.3. Identify and operate common workshop machines and tools while strictly adhering to safety protocols and quality management practices.

A9302.4. Recognize the properties of different materials and select appropriate tools and processes for specific manufacturing applications.

A9302.5. Fabricate a complete, functional assembly by integrating multiple skills learned across different workshop trades.

Course Syllabus

Part - A (Practical)

1. Fitting: L - Fit / V - Fit / Square - Fit / Semi Circular - Fit.
2. Carpentry: Lap Joint/ T- Bridle Joint / Mortise & Tenon Joint.
3. House wiring: Series / Parallel / One Bulb by One Switch / Tube Light / One Bulb by Two way Switch.
4. Welding: Butt Joint / Lap Joint / T Joint.
5. Foundry: Single Piece Pattern/ Split Piece Pattern / Multi Piece Pattern.
6. Tin Smithy: Open Scoop / Funnel / Rectangular Tray / Cylindrical.
7. Plumbing: Pipe Threading / Pipe Joints.
8. 3D Printing: Prepare a 3D Printing Model.

Part - B (Demonstration)

1. CNC Machining & Power Tools.
2. Casting & Plastic Moulding.
3. Welding (TIG/MIG, Gas Welding), Brazing.
4. Blacksmithy.

Laboratory Equipment/Software/Tools Required:

1. Fitting: Bench vise, Hacksaw frame, Calipers, Files, Try Square.
2. Carpentry: Carpentry vise, Chisels, Saws, Wooden Hammer, Try Square.
3. House Wiring: Voltage Tester, Wire Cutter, Wire Stripper, Cutting Plier, Nose Plier, Wire Gauge.
4. Welding: Welding M/c, Safeguards, Chipping Hammer, Electrode Holder.
5. Foundry: Wooden patterns, Riddle, Riser, Runner, Gate cutter, Rammers.
6. Tin Smithy: Wire Gauge, Snips, Pliers, Steel rule, Soldering kit, Spot Welding, Nylon Hammers.
7. Plumbing: Pipe Wrench, Pipe Cutter, Pliers, Pipe Die Set.
8. 3D Printing, 3D Modeling & Slicer Software.
9. Furnace, tongs, Swage Block.
10. Additional: Model Joints, Craft Knives and Electric Boards.

Books and Materials

Text Books:

1. Hajra Choudhury, S.K., and Nirjhar Rao. *Elements of Workshop Technology [Vol. 1, Manufacturing Processes]*, Revised and Enlarged 7th ed., Media Prompters & Publishers, 2023.
2. Singh, Devendra, et al. *Workshop Technology: Crafting Innovation for Engineering Students*, 1st ed., Redshine Publication, 2025.
3. Rosenberg, Neil. *Designing 3D Printers: Essential Knowledge*, 3rd ed., Independently published, 2023.

Reference Books:

1. Reddy, K. Venkata. *Workshop Practice Manual*, Reprint, 6th ed., BSP Books Private Ltd, 2025.
2. Gupta, Ram K. *3D Printing: Fundamentals to Emerging Applications*, 1st ed., CRC Press, 2024.
3. Devi, V. Lakshmi, and Kumar K. *Battery Technology Handbook: Classification, Control, and System Integration: Comprehensive Guide to EV Battery Design and Management Systems*, 1st ed., Notation Press, 2024.

A9022 - Product Design and Development

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	0	45	45	1	40	60	100

Course Description

Course Overview

This course equips students with a community-focused approach to product design, taking them from initial concept to a refined, practical solution. They will learn core design principles, understand the product development life cycle, and explore essential hardware and software tools through curated resources. Students will engage in prototyping, testing, and iterative refinement using feedback from community partners, ensuring sustainability and user-centered results. The course also develops their ability to document and communicate designs effectively, including preparing detailed specifications and user manuals.

Course Pre/Co-requisites

A9021 - Community Centered Design Thinking

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 9: Industry, Innovation, and Infrastructure
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9022.1. Explain the principles of product design and the product development life cycle, with an emphasis on addressing real-world community needs

A9022.2. Generate and evaluate innovative product concepts using relevant Hardware and Software design tools

A9022.3. Develop functional prototypes using appropriate prototyping tools, and perform initial testing and validation

A9022.4. Refine prototypes through iterative feedback loops, integrating sustainability and user-centered design principles

A9022.5. Document and communicate product designs effectively with comprehensive specifications and user manuals tailored for community stakeholders

Course Syllabus

Unit-I:

Introduction to Product Design for Community Need: Understanding the principles and significance of product design, product development life cycle. Communicating design concepts to community partner. Refining designs based on feedback.

Unit-II:

Product Development Skills: Identify & Develop proficiency in using relevant Hardware & Software design tools. Equip with curated resources on tools essential for managing and scaling products effectively.

Unit-III:

Prototype & Testing: Introducing the concepts and purpose of prototyping. Creating functional prototypes to represent product designs using appropriate tools and techniques. Testing prototypes for performance, usability, and alignment with design goals.

Unit-IV:

Iterative Refinement: Refinement of prototypes based on community partner feedback and verification of product sustainability, with integration of user-centered design principles to align with community needs and expectations.

Unit-V:

Documentation and Communication Strategies: Documenting product designs with detailed specifications, Effective communication strategies for conveying designs to community partners, Preparation of user manuals and documentation for community partners.

Activity Plan

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
1	Unit-I: Intro to Product Design	Understand product design principles & life cycle	Concept briefing	Case study analysis of successful community-based product	Short reflection: "Importance of product design for communities"	CO1
2	Unit-I: Intro to Product Design	Identify community needs & build empathy	Concept briefing + Fieldwork preparation	Practice empathy mapping, mock survey in class	Conduct 3–5 interviews/surveys with stakeholders	CO1, CO2
3	Unit-I: Intro to Product Design	Define problem statements	Guided teamwork + Brainstorm session	Develop "How Might We" questions, prioritize opportunities	Submit refined problem statement document	CO1, CO2
4	Unit-II: Product Development Skills	Generate diverse concepts	Creativity Hands-on Session (SCAMPER, Role-storming)	Group ideation, sketching concepts	Sketchbook submission (min. 10 ideas)	CO2
5	Unit-II: Product Development Skills	Apply digital design tools	Hands-on training + Peer support	Practice in Figma / SolidWorks / TinkerCAD	Submit wireframes / 3D sketches	CO2
6	Unit-II: Product Development Skills	Evaluate concepts systematically	Evaluation + User testing demo	Apply Pugh method to concepts, gather peer feedback	Submit evaluation matrix + selected final concept	CO2, CO3

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
7	Unit-III: Prototype & Testing	Build low-fidelity prototype	Practical lab session + Peer feedback	Teams construct basic prototypes from cardboard/foam	Submit prototype photos + reflection	CO3
8	Unit-III: Prototype & Testing	Develop high-fidelity prototype	Prototype building - Hands-on Session	Create working model with core functionality	Submit tested prototype (video evidence optional)	CO3
9	Unit-IV: Iterative Refinement	Collect & apply user/community feedback	User feedback roundtable	Usability testing with peers/partners	Submit iteration log with design changes	CO4
10	Unit-IV: Iterative Refinement	Refine based on sustainability & ergonomics	Fine-tuning activity	Refine materials, safety, visual design, ergonomics	Submit refined prototype design brief	CO4
11	Unit-V: Documentation	Document & communicate design	Documentation + Visual design session	Create instruction guides, packaging design, visuals	Draft user manual (Canva/InDesign optional)	CO5
12	Unit-V: Communication Strategies	Present & reflect on outcomes	Final Showcase	Final presentations: video demos, posters, product showcase	Final report, user manual, and presentation	CO5

Books and Materials

Text Books:

1. Pavan Soni. *Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving*, Penguin Random House India, 2024.
2. Anuja Agarwal. *Design Thinking: A Framework for Applying Design Thinking in Problem Solving*, Cengage India, 2024.

Reference Books:

1. Shalini Rahul Tiwari, Rohit Rajendra Swarup. *Design Thinking: A Comprehensive Textbook*, Wiley India, 2023.
2. Srinivasan R., Mohammed Ismail, Arulmozhi Srinivasan. *A Textbook on Design Thinking: Principles, Processes and Applications*, reprint, S. Chand Publishing, 2025.

II B.Tech. I Semester

A9003 – Numerical Methods and Complex Variables

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. This course covers numerical methods to evaluate roots of algebraic and transcendental equations, find missing data values by interpolating, and perform numerical differentiation and integration, express periodic and non-periodic functions in terms of sine and cosine, calculus of functions of single complex variable, region of convergence of a power series and theory of residues. This course provides essential techniques for problem-solving skills, with emphasis on both theoretical understanding and practical applications.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9003.1. Apply appropriate Numerical method to approximate the roots of an equation and interpolate to estimate function values at given intermediate points.

A9003.2. Compute an approximate value of a definite integral and obtain numerical solutions for first-order ordinary differential equations.

A9003.3. Construct periodic functions using Fourier series and express non-periodic functions using Fourier transforms in terms of sine and cosine.

A9003.4. Apply Cauchy-Riemann equations to test analyticity and construct harmonic functions using the Milne-Thomson method.

A9003.5. Evaluate integrals along a contour and express complex functions in power series.

Course Syllabus

Unit-I:

Solution of Algebraic and Transcendental Equations: Bisection method, Regula-falsi method, and Newton-Raphson method. Finite Differences: Forward differences, backward differences, symbolic relations and separation of symbols, Interpolation using Newton's forward and backward difference formulae and Lagrange's method of interpolation.

Unit-II:

Numerical Integration: Trapezoidal rule, Simpson's $(1/3)^{rd}$ rule and Simpson's $(3/8)^{th}$ rule.

Numerical solution of first order ODE: Taylor Series, Picard's method, Euler and modified Euler's methods and Runge-Kutta method of fourth order.

Unit-III:

Fourier Series & Fourier Transforms: Fourier series, Dirichlet's Conditions, Half-range Fourier series. Fourier Transforms: Fourier Integral Theorem (Only statements), Fourier Sine and Cosine transforms (Elementary illustrations).

Unit-IV:

Complex Differentiation: Limit, Continuity, differentiability, analyticity and properties, Cauchy-Riemann equations (without proof) in Cartesian and polar coordinates, harmonic and conjugate harmonic functions, Milne-Thomson method to construct analytic function.

Unit-V:

Complex Integration: Line integral in complex plane, Cauchy's integral theorem and Cauchy's integral formula. Complex power series: Taylor's series and Laurent's series. Zeros, singular points and classification of isolated singular points, Residue, Cauchy Residue Theorem.

Books and Materials

Text Books:

1. Grewal, B. S. *Higher Engineering Mathematics*, 43rd ed., Khanna Publications, 2015.
2. Sastry, S.S *Introductory methods of numerical analysis*, 4th ed., Printice Hall India, 2005.

Reference Books:

1. Jain, M.K., Iyengar, S.R.K and Jain, R.K.*Numerical methods for Scientific and Engineering Computations*, 8th ed., New Age International publishers, 2007.
2. Churchill, R.V. and Brown, J.W.*Complex Variables and Applications* , 8th ed., McGraw Hill Education (India) Pvt Ltd, 2009.
3. Kreyszig, E. *Advanced Engineering Mathematics*, 9th ed., John Wiley & Sons, 2006.
4. Kendall E. Atkinson *An introduction to Numerical Analysis* , 2nd ed., John Wiley & Sons, 2008.

A9210 – Power System Transmission and Distribution

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	15	0	60	120	4	40	60	100

Course Description

Course Overview

This course deals with the calculation of electrical parameters for transmission lines, including inductance, capacitance, and constants for different line types. It explores the performance analysis of short, medium, and long transmission lines, considering effects like skin effect, Ferranti effect, and corona discharge. The course also addresses sag and tension calculations for overhead conductors, insulator characteristics, and underground cable design. It also covers the classification and performance analysis of AC distribution systems with voltage drop calculations in various feeder configurations.

Course Pre/Co-requisites

A9207- Electrical Power Generation

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 11: Sustainable Cities and Communities

Course Outcomes

After the completion of the course, the student will be able to:

A9210.1. Apply the knowledge of electromagnetic fields to calculate transmission line parameters for single phase and three phase systems.

A9210.2. Analyze transmission line models to determine regulation, efficiency, and performance under various loading conditions using appropriate models and constants.

A9210.3. Analyze sag, tension, and corona phenomena in transmission lines considering environmental and electrical factors. environmental and electrical factors.

A9210.4. Analyze the constructional features and insulating materials of cables and insulators to determine their electrical characteristics and performance.

A9210.5. Apply concepts of AC distribution systems to evaluate different topologies and calculate voltage drops in radial and ring main networks

Course Syllabus

Unit-I:

Transmission Line Parameters: Calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR & GMD, symmetrical conductor configuration, concept of transposition. Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance, capacitance calculations for symmetrical single and three phase, single and double circuit lines- Numerical Problems.

Unit-II:

Performance of Short, Medium and Long Length Transmission Lines: Classification of Transmission Lines, Short, medium and long line and their model representations, Nominal-T, Nominal-Pie and A, B, C, D Constants for symmetrical networks. Mathematical Solutions to estimate regulation and efficiency of all types of lines. Long Transmission Line, evaluation of A, B, C, D Constants- Numerical Problems.

Unit-III:

Factors Governing the Performance of Transmission Line: Skin and Proximity effects, Ferranti effect, charging current, effect on regulation of the transmission line, shunt compensation. Corona, description of the phenomenon, factors affecting corona, critical voltages and power loss- Numerical Problems. SAG and tension calculations: Sag and Tension Calculations with equal and unequal heights of towers, effect of wind and ice on weight of conductor- Numerical Problems.

Unit-IV:

Overhead Line Insulators and Underground Cables: Types of Insulators, String efficiency and Methods for improvement, voltage distribution, calculation of string efficiency, capacitance grading and static shielding. Types of cables, construction, types of insulating materials. Capacitance of Single and 3-Core belted cables- Numerical Problems.

Unit-V:

AC Distribution Systems: Classification of AC Distribution Systems, Under Ground and Over Head Distribution Systems, Voltage Drop Calculations in Radial A.C Distribution system fed at one end and at both ends (equal/unequal Voltages) and Ring Main Distributor- Numerical Problems.

Books and Materials

Text Books:

1. Wadhwa, C. L., *Electrical Power Systems*, 8th ed., New Age International (P) Limited, 2022.
2. Soni, M. L., P. V. Gupta, U. S. Bhatnagar, and A. Chakrabarti. *A Textbook on Power System Engineering*, 2nd ed., Dhanpat Rai Publishing Company (P.) Ltd., 2008.
3. Mehta, V. K., and Rohit Mehta. *Principles of Power System*. 3rd ed., S. Chand Publishing, 2013. ISBN: 978-8121924962.

Reference Books:

1. B. R. Gupta. *Power System Analysis and Design*, Revised Edition, S. Chand & Company Limited, New Delhi, 2008.
2. Hadi Saadat. *Power System Analysis*, 3rd ed., Public Affairs Information Service, New Delhi, 2010.
3. I. J. Nagrath, D. P .Kothari *Modern Power System Analysis* , 3rd ed., Tata Mc Graw Hill Higher Education, New Delhi, 2006.

A9211 – Electrical Machines–I

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course aims at imparting knowledge to the students on the construction, operation and characteristics of DC machines and transformers. This course enables the students to analyze the difference between the various speed control methods employed in DC motors. This course also helps the students to familiarize with the different testing methods adopted for DC machines and transformers.

Course Pre/Co-requisites

A9201 - Electrical Circuits-I

A9206 - Electrical Circuits-II

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9211.1. Apply the concepts of DC generators to determine voltage, efficiency, and performance under different loads and during parallel operation

A9211.2. Apply the principles of DC motors to determine torque, speed regulation, and efficiency.

A9211.3. Apply testing techniques to assess the losses, efficiency, and operational behavior of DC machines.

A9211.4. Apply transformer principles to determine voltage and current relationships, phasor behavior, and efficiency under different loading conditions.

A9211.5. Use testing methods to determine transformer performance, power losses, and effectiveness of various connection schemes.

Course Syllabus

Unit-I:

DC Generators: Construction, Principle of Operation, Armature Reaction, Commutation, EMF Equation, Methods of Excitation, Types of Generators, Magnetization and Load Characteristics, Parallel operation- Numerical Problems.

Unit-II:

DC Motors: Principle of operation, Types, Equivalent Circuit, Torque Equation, Performance Characteristics, Speed control Methods and 3-point and 4-point Starters- conceptual description only.

Unit-III:

Testing of DC Machines: Losses and efficiency, Swinburne's test, Brake test, Hopkinson's test, Field's Test, Retardation Test- Numerical Problems.

Unit-IV:

Transformers: Concept of self and mutual inductance, Principle of operation of Single Phase Transformer, construction, EMF equation, No load and ON load condition, phasor diagrams, Equivalent circuit, regulation-Numerical Problems.

Unit-V:

Testing of Transformers: Losses and efficiency- All day Efficiency- OC and SC test, Sumpner's test, Separation of core losses Test.

Connections of 3-Phase Transformers: Various Connections of 3-phase transformers, Relation between line & phase voltages and currents, Scott connection of transformers- Numerical Problems.

Books and Materials

Text Books:

1. Gupta, J. B., *Theory & Performance of Electrical Machines*, 15th ed., S. K. Kataria & Sons, 2015 (reprint 2024).
2. Theraja, B. L., and A. K. Theraja. *A Textbook of Electrical Technology* , S. Chand Publishing, 2014.

Reference Books:

1. Fitzgerald, A. E., Charles Kingsley Jr., and Stephen D. Umans, *Electric Machinery*, 7th ed., McGraw-Hill, 2013.
2. Bimbra, P. S. *Electrical Machinery* , 7th ed., Khanna Publishing House, 2021.

A9212 – Control Systems

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

In this course, students will grasp the principles and real-world applications of control systems in everyday scenarios. It covers the modelling of control systems through transfer functions and state space, illustrating system representation via block diagrams and signal flow graphs. The course delves into time domain analysis, the R-H stability criterion, and frequency domain analysis. Graphical techniques such as Root locus, Bode plot, Polar plot and Nyquist plot are employed for analysis and design of control systems. Additionally, the course highlights the practical utilization of PID controllers within the realms of power electronics and power systems.

Course Pre/Co-requisites

A9001 – Matrices and Calculus

A9206 – Electrical Circuits-II

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 11: Sustainable Cities and Communities

Course Outcomes

After the completion of the course, the student will be able to:

A9212.1. Develop the transfer function and state space models of electro-mechanical dynamic systems.

A9212.2. Analyze time response, steady state errors and performance indices of linear time invariant control systems.

A9212.3. Apply Routh's and Nyquist stability criterion to analyze and design feedback control systems.

A9212.4. Examine the performance of feedback control system by using graphical techniques.

A9212.5. Design the various compensators and controllers for time-invariant systems.

Course Syllabus

Unit-I:

Basics of Control Systems: Introduction to control problem, open loop and closed loop control systems and differences, effects of feedback.

Mathematical Modelling of Control Systems: Differential equations and transfer function of electrical systems, Block diagram representations and reduction rules, Signal flow graph representation, reduction using Mason's gain formula.

Unit-II:

Control System Components: Block diagram representation and transfer function modeling of armature-controlled and field-controlled DC servo motors; Construction, operating principle, characteristics, and transfer function of AC servo motor; Construction, working principle, and operation of Synchro transmitter–receiver pair and their application in position control systems.

Time Response Analysis: Standard test signals; characteristic equation of a feedback control system; time response analysis of first-order and second-order systems; concepts of damping ratio and natural frequency; classification of systems based on damping ratio; transient response of a second-order underdamped system; time-domain specifications; steady-state response; steady-state errors and static error constants (Kp, Kv, Ka).

Unit-III:

Routh's Stability and Root Locus Technique: The concept of stability, Routh's stability criterion, qualitative stability and conditional stability, limitations of Routh's stability. The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s)on the root loci.

Unit-IV:

Frequency Response Analysis: Introduction, frequency domain specifications, Polar plots, construction of Bode diagrams, phase margin and gain margin, stability analysis from Bode plots and polar plots. Nyquist stability analysis- principle of argument, Nyquist plots, Nyquist stability criterion.

Unit-V:

Compensators and Controllers: Compensation techniques- Lag, Lead, and Lead Lag Compensators, P, PI, PD & PID Controllers.

State Space Analysis: Concepts of state, state variables and state model, various state models representations, state transition matrix and its properties, solving the time invariant state equations, concepts of controllability and observe ability.

Books and Materials

Text Books:

1. Nagrath, I. J., and M. Gopal. *Control Systems Engineering.* 6th ed., reprint 2017, New Age International (P) Ltd., 2017.
2. Kuo, Benjamin C., and Farid Golnaraghi. *Automatic Control Systems.* 10th ed., reprint January 2017, John Wiley & Sons, 2017.

Reference Books:

1. Ogata, Katsuhiko. *Modern Control Engineering.* 5th ed., reprint 2015, Pearson Education (Prentice Hall of India), 2015.
2. Sinha, N. K. *Control Systems.* 3rd ed., New Age International Ltd., 2008.
3. Nagoor Kani A. *Control Systems Engineering.* 2nd ed., Oxford & IBH Publishing Company Pvt. Ltd. 2020.

A9412 – Analog Devices and Circuits

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course covers fundamental topics that are common to a wide variety of electronic de vices, circuits, and systems. The topics include right from the inception of evolution of semiconductor devices to their real time applications. This course starts with the structure of various semiconductor devices like PN junction diode, BJT, JFET, and MOSFET, review their operation and characteristics. This course provides a basis for students to continue education by undertaking advanced study and research in the variety of different branches of semiconductor devices and applications.

Course Pre/Co-requisites

A9007 – Engineering Physics

A9201 – Electrical Circuits-I

A9206 – Electrical Circuits-II

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9412.1. Demonstrate the operation and characteristics of diodes and bipolar transistors under various biasing conditions.

A9412.2. Make use of rectifier, filter, and regulator circuits to design DC regulated power supply.

A9412.3. Analyze single stage transistor amplifier circuits using low frequency h-parameter mode.

A9412.4. Analyze the effect of feedback and oscillator circuits for given specifications.

A9412.5. Illustrate the operation and characteristics of JFET, MOSFET under various conditions.

Course Syllabus

Unit-I:

Diode Characteristics: Current-voltage characteristics of PN-junction diode, diode resistance and capacitance, diode models and I-V characteristics of Zener diode. **Diode Applications:** Fullwave rectifier (center tapped and bridge), rectifier with capacitor filter, clippers and clampers, Zener diode as a voltage regulator.

Unit-II:

Bipolar Junction Transistor (BJT): Structure and working principle of BJT, Configurations: Common Base (CB) and Common Emitter (CE), Input and output characteristics, DC analysis- load line and operating point, Biasing techniques: Fixed bias and Voltage divider bias

Unit-III:

Transistor Amplifiers: Transistor as an amplifier, small-signal equivalent circuits, single stage BJT amplifier (common-emitter mode only) using exact and approximate h-parameter model.

Unit-IV:

Feedback Amplifiers and Oscillators: Concept of Feedback in amplifiers, Negative feedback- Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain and bandwidth. Positive feedback– Review of the basic concept, Barkhausen criterion, RC phase shift, Hartley and Colpitts oscillators.

Unit-V:

Field Effect Transistor (FET): Junction Field Effect Transistor (JFET)- Structure, principle of operation, and characteristics of n-channel. Metal Oxide Semiconductor Field-Effect Transistor (MOSFET): Enhancement and Depletion modes- Structure, principle of operation and characteristics of n-channel

Books and Materials

Text Books:

1. Boylestad, Robert L., and Louis Nashelsky. *Electronic Devices and Circuit Theory.* 11th ed., PHI, 2013.
2. Sedra, Adel S., and Kenneth C. Smith. *Microelectronic Circuits.* 7th ed., Oxford University Press, 2014.

Reference Books:

1. Millman, Jacob, and Christos C. Halkias. *Electronic Devices and Circuits.* Tata McGraw-Hill, 1991.
2. Millman, Jacob, and Christos C. Halkias. *Electronic Devices and Circuits.* 2nd ed., Tata McGraw-Hill, 2008.

A9213 – Electrical Machines-I Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This Course, Electrical Machines-I Laboratory gives hands-on practice adequately supported by required hardware. It deals with D.C. Machines and Transformers where students will learn construction, operation and characteristics. Performance of these electrical machines will be verified by conducting various experiments in the laboratory.

Course Pre/Co-requisites

A9211– Electrical Machines-I

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy
SDG 9: Industry, Innovation, and Infrastructure
SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9213.1. Perform tests to determine the magnetization and load characteristics of DC shunt and compound generators.

A9213.2. Analyze the performance characteristics and speed control methods of various DC motors through experimental procedures.

A9213.3. Apply standard testing procedures such as Swinburne's, Hopkinson's, Field's, and brake tests to evaluate efficiency and losses of DC machines.

A9213.4. Perform open circuit, short circuit, and Sumpner's tests to evaluate the efficiency and losses of single-phase transformers.

A9213.5. Apply three phase transformer connection techniques to investigate their performance in practical scenarios.

Course Syllabus

List of Experiments:

1. Determination of Magnetization characteristics of DC shunt generator.
2. Load characteristics of DC shunt generator.
3. Determination of Load Characteristics of DC Compound Generator.
4. Determination of Efficiency of DC Series Machine Using Field's Test.
5. Speed Control of DC Shunt Motor.
6. Determination of Performance Characteristics of DC Series Motor.
7. Brake test on DC Compound motor.
8. Predetermination of efficiency of a DC Shunt Machine (Swinburne's test).
9. Hopkinson's test on DC Shunt Machines.

10. O. C. & S. C. Tests on Single phase Transformer.
11. Sumpner's test on a pair of single-phase transformers.
12. Scott connection of transformers.

Laboratory Equipment/Software/Tools Required:

1. DC Motor Generator sets.
2. DC Shunt Generators.
3. DC Series Generators.
4. DC Compound Generators.
5. DC Voltmeters
6. DC Ammeters.
7. Single Phase Transformers.
8. DC Shunt Motors.
9. DC Series Motors.
10. Watt meters.
11. 1-Phase Variac.
12. AC Voltmeters.
13. AC Ammeters.

Books and Materials

Text Books:

1. Gupta, J. B., *Theory and Performance of Electrical Machines* , 15th ed., S. K. Kataria & Sons, 2015 (reprint 2024).
2. Theraja, B. L., and A. K. Theraja.*A Textbook of Electrical Technology* , S. Chand Publishing, 2014.

Reference Books:

1. Fitzgerald, A. E., Charles Kingsley Jr., and Stephen D. Umans *Electric Machinery*, 7th ed., McGraw-Hill, 2013.
2. Bimbra, P. S. *Electrical Machinery* , 7th Khanna Publishing House, 2021.

A9214 – Control Systems Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This practical course offers hands-on practice utilizing MATLAB/Simulink alongside essential hardware support. It aims to provide students with a comprehensive understanding of control systems principles and their real-world applications. Time domain analysis, Routh-Hurwitz stability criterion, and frequency domain analysis are thoroughly discussed and validated within the course. Graphical techniques including Root locus, Bode plot, Polar plot, and Nyquist plot are employed to analyze and design control systems effectively. Moreover, the course highlights the practical utilization of PID controllers within power electronics and power systems domains, enhancing students' ability to address real-world challenges in these fields.

Course Pre/Co-requisites

A9001 – Matrices and Calculus

A9206 – Electrical Circuits-II

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 11: Sustainable Cities and Communities

Course Outcomes

After the completion of the course, the student will be able to:

A9214.1. Transform and interpret transfer function and state-space models to represent dynamic system behavior.

A9214.2. Analyze the performance characteristics of DC and AC servomotors and synchros through experimental methods.

A9214.3. Analyze transient response and time-domain specifications of linear time-invariant second-order control systems.

A9214.4. Examine system stability and performance of feedback control systems using graphical methods.

A9214.5. Analyze compensators and controllers through Hardware and MATLAB simulations.

Course Syllabus

List of Experiments:

1. Time response of second order system.
2. Characteristics of Synchros.
3. DC Position control system.
4. Frequency response (Magnitude and Phase plot) of Lead and Lag compensator circuits.
5. Temperature control using PID controller.
6. Characteristics of AC servomotor.
7. Transfer function of DC motor.

8. Linear system analysis (Time domain analysis and Error analysis) using MATLAB.
9. Stability analysis of Linear Time Invariant (LTI) system using Root locus plot, Bode plot, and Nyquist plot using MATLAB.
10. State space model for classical transfer function using MATLAB.
11. Design of passive RC Lead and RC Lag compensating networks for a given system based on specifications using MATLAB.
12. Effect of P, PI, PD and PID controller on speed control of DC motor system using MATLAB-Simulink.

Laboratory Equipment/Software/Tools Required:

1. Time response kit.
2. Synchro transmitter – receiver pair kit.
3. DC position control systems kit.
4. Temperature control-PID module.
5. Lead – Lag Compensator kit.
6. AC servo motor kit.
7. Transfer function of DC Motor Module.
8. Multimeter, Rheostat and CRO.
9. PC with MATLAB/SIMULINK Software.

Books and Materials

Text Books:

1. Palani, S. *Automatic Control Systems: With MATLAB*, 2nd edition, Springer International Publishing, 2022. ISBN: 978-3030934446.
2. Ogata, Katsuhiko. *MATLAB for Control Engineers*, 2nd edition, Pearson, 2011; Reprinted 2015.
3. Nise, Norman S. *Control Systems Engineering*, 8th edition, Wiley, 2019; Reprinted 2021.

Reference Books:

1. López, César. *MATLAB Control Systems Engineering.* Springer, 2014. Reprint 2017.
2. Srivastava, Manjita, M. C. Srivastava, and Smriti Bhatnagar. *Control Systems.* Tata McGraw-Hill, 2009.
3. Tewari, Ashish. *Modern Control Design: with MATLAB and SIMULINK.* Wiley, 2002.

A9413 – Analog Devices and Circuits Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

The analog devices and circuits laboratory is one of the fundamental laboratory course that a student will undergo. The students become familiar with laboratory test and measuring instruments such as CRO, regulated power supply, function generator, ammeter, voltmeter and digital multimeter. The exposure of the students to these instruments and the knowl edge about basic electronic components will enable them to design, construct and test the basic electronic circuits such as power supplies, amplifiers and oscillators.

Course Pre/Co-requisites

A9007 – Engineering Physics

A9201 – Electrical Circuits-I

A9206 – Electrical Circuits-II

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9413.1. Analyze the characteristics of diodes and transistors under various biasing conditions

A9413.2. Design and implement amplifiers and oscillator circuits for the given specifications

A9413.3. Build electronic circuits making use of diodes and transistors and verify the operation practically

A9413.4. Analyze the effect of feedback in amplifiers in terms of gain and bandwidth

A9413.5. Simulate and analyze the characteristics of FET and MOSFET devices to determine their performance parameters.

Course Syllabus

List of Experiments:

A. Hardware-Based Experiments (any 6)

1. Study the I–V characteristics of a PN junction diode in forward and reverse bias to determine cut-in voltage and dynamic resistance.
2. Design line and load voltage regulation circuits using Zener diode.
3. Design and analyze full-wave rectifiers (center-tapped and bridge) with and without capacitor filters to evaluate ripple factor and output voltage.
4. Plot the input and output characteristics of a BJT in Common Base configuration to determine input/output resistance and current gain.
5. Design and test voltage divider bias circuits to establish a stable operating point for a BJT amplifier and study DC load line behavior
6. Design single stage CE amplifier for the given specifications to analyze the frequency response

7. Design RC phase shift oscillator for a specifed frequency and observe their output waveforms

B. Software-Based Simulation Experiments (any 6)

1. Simulate negative and positive clipper circuits for a given specifications and observe the waveform.
2. Simulate negative and positive clamping circuits for a given specifications and observe the waveform.
3. Simulate Colpitts Oscillator for a specified frequency and observe their output waveforms
4. Simulate Hartley Oscillator for a specified frequency and observe their output waveforms
5. Simulate voltage series feedback amplifier and compare its frequency responses with and without feedback
6. Simulate the drain and transfer characteristics of a JFET to determine characteristic parameters.
7. Simulate the drain and transfer characteristics of a MOSFET to determine characteristic parameters.

Laboratory Equipment/Software/Tools Required:

1. Cathode Ray Oscilloscope
2. Function Generator
3. Regulated Power Supply
4. Multimeters
5. DC Voltmeter and Ammeter
6. Discrete Components
7. Breadboard
8. Computers installed with operating system
9. Multisim Software

Books and Materials

Text Books:

1. Boylestad, Robert L., and Louis Nashelsky. *Electronic Devices and Circuit Theory.* 11th ed., PHI, 2013.
2. Sedra, Adel S., and Kenneth C. Smith. *Microelectronic Circuits.* 7th ed., Oxford University Press, 2014.

Reference Books:

1. Millman, Jacob, and Christos C. Halkias. *Electronic Devices and Circuits.* Tata McGraw-Hill, 1991.

A9006 – Computational Mathematics Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course provides hands-on experience in solving mathematical problems using computational tools. This course covers numerical methods and implementation using MATLAB or Python. The course helps to develop skills in algorithm development, data visualization, and scientific computing. In addition, the computational methods for real- world mathematical modeling can be applied.

Course Pre/Co-requisites

A9001 - Matrices and Calculus

A9002 - Ordinary Differential Equations and Vector Calculus

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9006.1. Develop the code to find the Eigen values and Eigen Vectors using Python/MATLAB

A9006.2. Develop the code to find solution of Algebraic and Transcendental using Python/MATLAB

A9006.3. Develop the code to find solution of Linear system of equations using Python/MATLAB

A9006.4. Write the code to solve problems of First-Order linear differential equations with constant coefficients

A9006.5. Write the code to solve problems of Higher order linear differential equations with constant coefficients

Course Syllabus

List of Experiments:

Visualize all solutions graphically using programs.

1. Eigen values and Eigen Vectors
   a. Finding real and complex Eigen values.
   b. Finding Eigen vectors.
2. Solution of Algebraic and Transcendental Equations - Bisection method, Newton Raphson Method
   a. Root of a given equation using Bisection method.
   b. Root of a given equation using Newton Raphson Method.
3. Linear system of equations - Jacobi's iteration method and Gauss-Seidal iteration method
   a. Solution of given system of linear equations using Jacobi's method.
   b. Solution of given system of linear equations using Gauss-Seidal method.

4. First-Order ODEs - Exact and non-exact equations, Applications: exponential growth/decay, Newton's law of cooling
   a. Solving exact and non-exact equations.
   b. Solving exponential growth/decay and Newton's law of cooling problems.
5. Higher order linear differential equations with constant coefficients
   a. Solving homogeneous ODEs.
   b. Solving non-homogeneous ODEs.

Books and Materials

Text Books:

1. Rajkumar Basal, Ashok Kumar Geo, and Manoj Kumar Sharma. *MATLAB and Its Applications in Engineering*. Pearson.
2. Kenneth A. Lambert. *The Fundamentals of Python: First Programs*. Cengage Learning, 2011.
3. Allen B. Downey. *Think Python*. 1st ed., O'Reilly Media.

Reference Books:

1. William Mitchell, Povel Solin, Martin Novak, et al. *Introduction to Python Programming*. NCLab Public Computing, 2012.
2. Jacob Fredslund. *Introduction to Python Programming*. 2007.
3. John C. Lusth. *An Introduction to Python*. University of Alabama, 2011.
4. Dave Kuhlman. *Introduction to Python*. 2008.

A9215 – PCB Design

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This skill-based laboratory course introduces students to the fundamentals of Printed Circuit Board (PCB) design using open-source Electronic Design Automation (EDA) tools such as KiCad and Easy EDA. The course emphasizes hands-on experience in designing, simulating, and creating PCB layouts for basic electronic circuits. Students will learn to convert electronic schematics into manufacturable PCB designs, apply design rule checks, and generate industry-standard Gerber files for fabrication. The course covers essential aspects of PCB design, including component selection, schematic entry, footprint mapping, routing strategies, simulation using integrated SPICE tools, and output file generation. By the end of the course, students will be able to independently design and validate single-layer PCB circuits suitable for educational or prototype-level applications.

Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9215.1. Demonstrate understanding of PCB fundamentals, design flow, fabrication, and assembly processes.

A9215.2. Apply EDA tools to design schematic layouts, perform Design Rule Checks (DRC), and correct errors in PCB designs.

A9215.3. Design electronic circuits such as rectifiers, voltage regulators, relay drivers, and display drivers for PCB implementation.

A9215.4. Develop PCB layouts for both discrete-component and microcontroller-based application circuits using EDA tools.

A9215.5. Fabricate, assemble, and test application-specific PCBs to validate designed circuits and ensure functionality.

Course Syllabus

List of Experiments:

1. Introduction to PCB, design software, fabrication & assembly process.
2. Introduction to layout tool, and creating layout board using EDA tool.
3. PCB Design Rule Check (DRC) and Error Fixing
4. Design of rectifier using diodes.
5. Design of regulatorcircuitusing7805
6. Design a Relay Driver Circuit
7. Design a 7-Segment Display Driver Circuit

8. Design an Arduino-based Temperature Sensor Interface
9. Fabrication and assembly of rectifier
10. Fabrication and assembly of regulator circuit
11. Fabrication and assembly of Relay Driver Circuit
12. Fabrication and assembly of 7-Segment Display Driver Circuit
13. Fabrication and assembly of an Arduino-based Temperature Sensor Interface
14. Design and Fabrication of Application-Specific Printed Circuit Boards using EDA Tools

Laboratory Equipment/Software/Tools Required:

1. Ki Cad (open source software)
2. Ng spice (for circuit simulation in Ki Cad) (open source software)
3. Datasheets of commonly used components
4. Digital Multimeters
5. Breadboards
6. PCB boards
7. Single-sided copper clad sheet.
8. Glossy photo paper (130gsm) hands on schematic implantation on board.
9. Hand drilling/Power drilling machine,
10. Hand Glouses
11. Soldering iron, Soldering paste flux, Soldering lead
12. Heat sinks

Books and Materials

Text Books:

1. Khandpur, Raghbir Singh. *Printed Circuit Boards: Design, Fabrication, Assembly and Testing.* McGraw-Hill, 2006.
2. Mehta, S. D. *Electronic Product Design.* S. Chand Publishing, 2011.

A9023 - Technology Entrepreneurship

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	0	45	45	1	40	60	100

Course Description

Course Overview

This course enables students to transform refined product designs into viable entrepreneurial ventures or patentable innovations. Building on skills from previous courses in design thinking and product development, students will explore opportunity identification, intellectual property protection, market research, sustainable business models, funding strategies, and go-to-market planning. Emphasis is placed on aligning innovations with community needs while preparing for startup creation, patent filing, or both.

Course Pre/Co-requisites

A9022 - Product Design and Development

textbfRelevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education

SDG 8: Decent Work and Economic Growth

SDG 9: Industry, Innovation, and Infrastructure

SDG 17: Partnerships for the Goals

Course Outcomes

After the completion of the course, the student will be able to:

A9023.1. Identify and analyze market opportunities for community-driven technological innovations.

A9023.2. Apply intellectual property strategies for protecting product designs and innovations.

A9023.3. Develop sustainable and scalable business models for product commercialization.

A9023.4. Formulate funding, financial, and go-to-market strategies for product launch.

A9023.5. Prepare and deliver investor-ready pitches or patent documentation to relevant stakeholders.

Course Syllabus

Unit-I:

Entrepreneurial Mindset and Opportunity Identification: Understanding technology entrepreneurship in the community context. Startup ecosystem and innovation pathways. Market analysis and opportunity mapping for commercialization of Product.

Unit-II:

Intellectual Property and Innovation Protection: Overview of IP: patents, trademarks, copyrights, and trade secrets; patent search, drafting, filing, and grant procedures; leveraging IP for competitive advantage and innovation scaling.

Unit-III:

Market Research and Business Model Development: Defining target markets, customer segments, and value propositions. Competitive analysis and differentiation strategies. Business Model Canvas and Lean Startup principles.

Unit-IV:

Funding, Financial Planning and Sustainability: Study of funding options including grants, angel investors, venture capital, and crowd funding; budgeting, forecasting, and financial planning for startups; and integration of sustainability into long-term business growth strategies.

Unit-V:

Go-to-Market Strategy, Pitching and Documentation: Branding, marketing, and distribution planning; creating persuasive pitches for investors, partners, and stakeholders; preparing necessary documentation; final presentation of patent draft or startup business plan to an expert panel.

Activity Plan

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
1	Unit-I: Entrepreneurial Mindset	Understand technology entrepreneurship & startup ecosystem	Concept briefing + Open forum	Discussion: examples of community-based startups	Reflection note: "Why entrepreneurship matters for communities"	CO1
2	Unit-I: Opportunity Identification	Identify & map opportunities	Hands on session + Case analysis	Opportunity mapping using local problems	Opportunity mapping chart submission	CO1
3	Unit-II: IP Basics	Learn types of IP (patents, trademarks, copyrights)	Concept briefing + Example-driven discussion	Analyze famous patents & trademarks	Short report: "One innovation and its IP protection strategy"	CO2
4	Unit-II: Patent Process	Apply patent search & filing basics	Demo session + Hands-on exercise	Perform a mock patent search online (guided)	Draft simple patent claim for a product	CO2
5	Unit-III: Market Research	Define target market & customer segments	Concept briefing + Team activity	Build customer personas for chosen product idea	Submit customer persona & value proposition canvas	CO3
6	Unit-III: Business Model Development	Apply BMC & Lean Startup	Business modeling – Hands on session	Teams fill out Business Model Canvas	Submit BMC with initial differentiation strategy	CO3
7	Unit-IV: Funding Sources	Understand startup funding landscape	Concept briefing + Case discussion	Funding source comparison (VC, grants, crowdfunding)	Assignment: Funding strategy document for idea	CO4

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
8	Unit-IV: Financial Planning	Apply budgeting & forecasting	Hands on session	Build basic revenue/cost projection table	Submit 1-year financial projection	CO4
9	Unit-IV: Sustainability	Integrate sustainability in startups	Group reflection	Apply sustainability checklist to business model	Submit revised BMC integrating sustainability	CO4
10	Unit-V: Go-to-Market	Learn branding & marketing strategies	Hands on session + Peer feedback	Draft a marketing plan with target channels	Submit draft marketing & distribution strategy	CO4, CO5
11	Unit-V: Pitching Skills	Develop persuasive pitch	Startup pitch drill	Students deliver 3-min practice pitches with feedback	Submit pitch deck draft	CO5
12	Unit-V: Final Showcase	Present final startup plan/patent draft	Showcase + Expert review	Final presentations to panel (faculty/guests)	Final project submission: startup plan or patent draft	CO5

Books and Materials

Text Books:

1. Deependra Sharma. *Entrepreneurship in India* , Routledge, 2023.
2. Dr. S. Glory Swarupa & Ms. Swapna Vanamala. *Innovation, Incubation and Intellectual Property Rights*, 2023.

Reference Books:

1. Neck, Heidi M., Patricia G. Greene, and Candida G. Brush. *Teaching Entrepreneurship: A Practice-Based Approach*, Edward Elgar Publishing, 2014.
2. Drucker, Peter F. *Innovation and Entrepreneurship: Practice and Principles*, reprint, Harper & Row, 1985.

II B.Tech. II Semester

A9014 - Business Economics and Financial Analysis

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces the fundamentals of Business Economics and Financial Analysis, covering business structures, economic concepts, demand and supply analysis, production and cost, market structures, and pricing. It also focuses on accounting principles, preparation of financial statements, ratio analysis, and capital budgeting methods to support effective financial decision-making.

Course Pre/Co-requisites

This course has no specific prerequisite and co-requisite.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure
SDG 17: Partnerships for the Goals

Course Outcomes

After the completion of the course, the student will be able to:

A9014.1. Analyze business and economic concepts to assess their impact on the overall economic environment.

A9014.2. Examine the relationship between demand, supply, and elasticity in understanding market behavior.

A9014.3. Apply production, cost, market structure, and pricing concepts to interpret business operations and competitive strategies.

A9014.4. Apply accounting principles and rules for preparing financial statements.

A9014.5. Analyze financial statements and capital budgeting techniques to evaluate the financial health of a business.

Course Syllabus

Unit-I:

Introduction to Business and Economics: Business-Structure of Business Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for company – Conventional and Non-Conventional. Economics-Significance of Economics, Micro and Macro Economic Concepts. Business Economics- Nature and Scope, Role of Business Economist. National Income-Concepts and Importance, Inflation and Money Supply. Business Cycle -Features and Phases.

Unit-II:

Demand and Supply Analysis: Demand-Function, Determinants and types. Law of Demand-Assumption and Exceptions. Elasticity of Demand- Types, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand. Demand Forecasting- Methods of Demand Forecasting. Supply Analysis-Functions, Determinants and Law of Supply.

Unit-III:

Production, Cost, Market Structures & Pricing: Production Analysis- Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale. Cost analysis: Types of Costs, Short run and Long run Costs Break Even Analysis (simple problems). Market Structure: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition. Pricing-Types of Pricing, Product Life Cycle based Pricing,

Unit-IV:

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

Unit-V:

Ratios Analysis and Capital Budgeting: Concept of Ratio Analysis, Importance and Types of Ratios- Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios– Analysis and Interpretation. Capital Budgeting – Capital, Types of capital, Capital Budgeting Methods (Simple Problems).

Books and Materials

Text Books:

1. D. Chaturvedi, S. L. Gupta. *Business Economics Theory and Applications* 4th ed., Interna tional Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri. *Financial Accounting*, 3rd ed., Tata Mc–Graw Hill, 2011.

Reference Books:

1. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury. *Managerial Economics*, 2nd ed., Tata Mc Graw Hill Education Pvt. Ltd. 2012.
2. A.R. Aryasri, *Managerial Economics and Financial Analysis*, 9th ed., TMH, India, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury. *Managerial Economics*, 2nd ed., Tata Mc Graw Hill Education Pvt. Ltd. 2012.

A9216 – Electrical Machines-II

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course covers the construction, working principles, and performance analysis of three-phase and single-phase induction motors, along with starting and speed control methods. It also addresses synchronous generators, focusing on their construction, winding configurations, EMF generation, and factors affecting performance such as harmonics and reactance. Students will learn voltage regulation techniques, two-reaction theory, and concepts of load sharing and parallel operation. The course emphasizes analytical methods supported by numerical problem-solving to develop a thorough understanding of electrical machines used in industry.

Course Pre/Co-requisites

A9211- Electrical Machines – I

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9216.1. Apply the concept of rotating magnetic fields to determine the torque-slip characteristics of three-phase induction motors.

A9216.2. Apply various starting and speed control methods to regulate the performance of three phase induction motors.

A9216.3. Apply principles of single-phase induction motors to determine their starting methods and performance.

A9216.4. Analyze the effect of construction and winding configurations of Synchronous generator on EMF, harmonics, and reactance.

A9216.5. Analyze the constructional features, winding arrangements, and equivalent reactances of synchronous machines to evaluate their performance characteristics.

Course Syllabus

Unit-I:

Three Phase Induction Motors: Production of rotating magnetic field, construction, working principle, Torque Equation, starting and running torque, torque–slip characteristics, Equivalent circuit, Cogging & Crawling- Numerical Problems.

Unit-II:

Starting and Speed Control Methods of Induction Motors: Methods of starting, speed control-change of frequency, poles, cascade connection and Injection of an EMF into rotor circuit- conceptual description only.

Unit-III:

Single Phase Induction Motors: Double revolving field theory, capacitance starting motor, Capacitance start and capacitor run motor, permanent capacitor motor, Shaded pole motor- conceptual description only.

Unit-IV:

Synchronous Generators: Construction & Operation, Armature windings, Integral slot and fractional slot windings, Distributed and concentrated windings, pitch and winding factors, E.M.F Equation, Characteristics, Harmonics, armature reaction, leakage reactance, synchronous reactance and impedance- Numerical Problems.

Unit-V:

Regulation of Synchronous Generators: Regulation by E.M.F., M.M.F., Z.P.F. methods. Two reaction analysis, determination of Xd and Xq (Slip test)-Numerical Problems. Parallel Operation of Synchronous Generators: Synchronizing alternators within finite bus bars, parallel operation and load sharing-conceptual description only.

Books and Materials

Text Books:

1. Gupta, J. B., *Theory & Performance of Electrical Machines* , 15th ed., S. K. Kataria & Sons, 2015 (reprint 2024).
2. Theraja, B. L., and A. K. Theraja.*A Textbook of Electrical Technology* , S. Chand Publishing, 2014.

Reference Books:

1. Fitzgerald, A. E., Charles Kingsley Jr., and Stephen D. Umans *Electric Machinery*, 7th ed., McGraw-Hill, 2013.
2. Bimbra, P. S. *Electrical Machinery* , 7th ed., Khanna Publishing House, 2021.

A9217 – Power Electronics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course introduces the operation, characteristics, and applications of power semiconductor devices and converters used in power electronics. It covers controlled rectifiers, AC voltage controllers, choppers, and inverters with emphasis on their working principles, control strategies, performance analysis, and waveform interpretation. Students will learn to analyze and design power electronic circuits for effective voltage and current control in industrial applications.

Course Pre/Co-requisites

A9412 - Analog Devices and Circuits

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy
SDG 9: Industry, Innovation, and Infrastructure
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action

Course Outcomes

After the completion of the course, the student will be able to:

A9217.1. Apply electronic device principles to determine the switching behavior of power semiconductor devices.

A9217.2. Apply phase control methods to determine the performance of single-phase and three-phase AC-DC converters.

A9217.3. Analyze the operation and output of AC voltage controllers and cyclo converters under different control strategies..

A9217.4. Analyze the operation and performance of DC-DC converters using different control techniques.

A9217.5. Apply PWM and inverter techniques to control voltage in single-phase and three-phase inverters.

Course Syllabus

Unit-I:

Power Semiconductor Devices: BJT, power MOSFET, power IGBT, GTO – Operation and their switching characteristics. Silicon Controlled Rectifiers (SCR) - Basic operation, Static characteristics, Dynamic characteristics, two transistor analogy, Protection and ratings of SCR, Turn-on and turn-off methods.

Unit-II:

Phase Controlled Rectifiers: Phase control technique, Single-Phase Controlled Converter- Half controlled converter and fully controlled converter with R and RL loads, without and with freewheeling diode. Three-Phase Controlled Converter - half controlled converter and fully controlled converter with R and RL loads. Derivation of average load voltage and current, performance parameters, effect of source inductance. Dual Converters (principle of operation only).

Unit-III:

AC Voltage Controllers: Single-phase Full wave AC Voltage Controllers with R and RL loads, derivation of RMS load voltage, current and input power factor. Cyclo converter: Single phase midpoint cyclo converter with resistive and inductive load (principle of operation only), bridge configuration of single phase cyclo converter, principle of operation and waveforms.

Unit-IV:

Choppers: Classification, Control strategies, time ratio control and current limit control, step down chopper, step up chopper and step up/down chopper, fly back converter, forward converter, and derivation of load voltage expression. Morgan's chopper and Jones's chopper.

Unit-V:

Inverters: Basic series inverter, basic parallel inverter, single-phase half bridge and full bridge inverters, operation and waveforms, Three-phase inverters (120° and 180° operation). Voltage control techniques for inverters – Pulse width modulation techniques.

Books and Materials

Text Books:

1. M. H. Rashid . *Power Electronics: Circuits, Devices and Applications* , 4th ed., Pearson Education, 2017.
2. M. D. Singh, K. B. Khanchandani. *Power Electronics* , 3rd ed., Tata McGraw-Hill publishing company, New Delhi, 2008.

Reference Books:

1. P. S. Bimbra. *Power Electronics* , 7th ed., Khanna Publishing, New Delhi, 2022.
2. Vedam Subramanyam *Power Electronics: Devices, Converters, Application* , 2nd ed., New Age International (P) Limited, New Delhi, 2018.

A9422 – Digital System Design

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course provides a foundational understanding of digital systems and logic design, essential for modern electronic and computing applications. It covers number systems, Boolean algebra, and logic gates, progressing into the design and analysis of combinational and sequential circuits. Emphasis is placed on logic simplification using Karnaugh Maps, as well as the implementation of logic functions using NAND and NOR gates. The course also introduces memory elements such as RAM and ROM, and provides exposure to Programmable Logic Devices, enabling custom logic design.

Course Pre/Co-requisites

A9412 – Analog Devices and Circuits

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 9: Industry, Innovation, and Infrastructure
SDG 11: Sustainable Cities and Communities

Course Outcomes

After the completion of the course, the student will be able to:

A9422.1. Apply Boolean algebra and minimization techniques to simplify a Boolean function.

A9422.2. Construct combinational logic circuits using logic gates to implement specified Boolean functions.

A9422.3. Analyze the behavior of latches and flip-flops for designing sequential logic.

A9422.4. Develop synchronous sequential circuits using flip-flops and combinational logic.

A9422.5. Implement digital systems using Programmable Logic Devices for flexible and efficient circuit design.

Course Syllabus

Unit-I:

Boolean Algebra and Logic Gates: Introduction, basic definitions, axiomatic definition of Boolean algebra, basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms (SOP, POS), Digital logic gates, NAND-NOR realization.

Unit-II:

Gate-Level Minimization Techniques: Introduction, The Map method (Karnaugh Map) - 2, 3, and 4 variable K-map, Sum-of-Products and Product-of-Sums Simplification, Don't care conditions.

Unit-III:

Combinational Logic: Introduction, combinational circuits, analysis of combinational circuits, design procedure, binary adder-subtractor, magnitude comparator, decoders, encoders, multiplexers.

Unit-IV:

Sequential Logic: Introduction, sequential circuits, storage elements – latches and flip-flops, flip-flop conver-

sions (JK to SR, JK to D, D to T), Design of counters - Synchronous and asynchronous counters, Shift registers – register with parallel load and serial-in serial-out shift register.

Unit-V:

Memory and Programmable Logic Devices: Random Access Memory (RAM), Read-Only Memory (ROM), Programmable ROM (PROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL).

Books and Materials

Text Books:

1. Mano, M. Morris, and Michael D. Ciletti. Digital Design with an Introduction to the Verilog HDL. 6th ed., Pearson Education/PHI, 2017.

Reference Books:

1. Tocci, Ronald J., Neal S. Widmer, and Gregory L. Moss. Digital Systems: Principles and Applications. 10th ed., Pearson Education International, 2009.
2. Roth, Charles H., Jr., and Larry L. Kinney. Fundamentals of Logic Design. 6th ed., Cengage Learning, 2009.

A9218 – Electromagnetic Field Theory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	15	0	60	120	4	40	60	100

Course Description

Course Overview

This course introduces the principles of electric and magnetic fields in static and time-varying conditions, covering their behaviour in free space and material media. Students will learn to compute field parameters, analyze field interactions, and apply electromagnetic theory to practical engineering problems such as capacitance, inductance, forces, and energy transfer. Emphasis is placed on analytical methods, problem-solving, and applications in electrical systems.

Course Pre/Co-requisites

This course has no specific pre requisites or co-requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9218.1. Apply electrostatic principles to determine electric field intensity for different charge distributions.

A9218.2. Apply magneto static principles to compute magnetic field intensity for various conductor geometries and current arrangements.

A9218.3. Analyze field interactions in dielectric and magnetic materials to evaluate capacitance, inductance, and boundary conditions.

A9218.4. Apply electromagnetic principles to determine the force and torque acting on current-carrying conductors.

A9218.5. Analyze time-varying electromagnetic fields to evaluate induced voltages, displacement currents, and energy transfer in electrical systems.

Course Syllabus

Unit-I:

Static Electric Fields: Co-ordinate Systems, coulomb's Law, electrostatic fields, definition of Electric Field Intensity (EFI), EFI due to a line and a surface charge,Gauss's law, applications of Gauss's Law, Work done in moving a point charge in an electrostatic field, Electric Potential, Relation between EFI and Electric potential,Maxwell's first and second equations- Numerical Problems.

Unit-II:

Static Magnetic Fields: Biot-Savart's law, Magnetic Field intensity (MFI) due to a finite and infinite wire carrying a current I, circular and rectangular loop carrying a current I, Ampere's circuital law and its applications. MFI due to an infinite sheet of current, a long current carrying filament and co-axial cable,Maxwell's third and fourth equations for static magnetic fields- Numerical Problems.

Unit-III:

Electric and Magnetic Fields in Materials: Laplace's and Poison's equations, solution of Laplace's equation in one variable, capacitance, capacitance of parallel plate, spherical and co-axial capacitors with composite dielectrics, boundary conditions for electric fields, equation of continuity. Self and Mutual inductance, self-inductance of a solenoid- Numerical Problems.

Unit-IV:

Force in Magnetic Fields: Magnetic force, Lorentz force equation, Force on a long current carrying conductor in a magnetic field, torque on a current loop placed in a magnetic field, scalar Magnetic Potential and its limitations- Numerical Problems.

Unit-V:

Time Varying Fields: Faraday's laws of electromagnetic induction, integral and point forms, Statically and Dynamically induced EMFs, modification of Maxwell's equations for time varying fields, displacement current, Poynting Theorem and Poynting vector- Numerical Problems.

Books and Materials

Text Books:

1. William H. Hayt, John. A. Buck *Engineering Electromagnetics* , 7th ed., Tata Mc Graw Hill Companies, New Delhi. 2006.
2. Sadiku *Electro Magnetic Fields* , 4th ed., , Oxford Publications India, New Delhi.2005.

Reference Books:

1. David J. Griffiths *Introduction to Electro Dynamics* , 3rd ed., Prentice Hall of India, New Delhi. 2007.
2. John. D. Kraus, D. A. Fleish *Electromagnetics with Applications* , 5th ed., Tata Mc Graw Hill Inc., New Delhi, India.

A9219 – Electrical Machines-II Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This Course gives hands-on practice adequately supported by required hardware. It deals with A.C. Machines where students will learn construction, operation and characteristics. Performance of these electrical machines will be verified by conducting various experiments in the laboratory.

Course Pre/Co-requisites

A9216 - Electrical Machines – II

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

Course Outcomes

After the completion of the course, the student will be able to:

A9219.1. Apply synchronous impedance method and experimental techniques to determine regulation and sequence reactances of synchronous machines.

A9219.2. Analyze equivalent circuits and performance characteristics of single-phase and three-phase induction motors through various tests.

A9219.3. Perform synchronization of alternators and evaluate efficiency of three-phase alternators using practical experiments.

A9219.4. Apply speed control methods on slip ring induction motors and analyze results from no-load, blocked rotor, and brake tests.

A9219.5. Verify transformer connections, perform tests to separate core losses, and analyze transformer performance parameters.

Course Syllabus

List of Experiments:

1. Regulation of a three-phase alternator by synchronous impedance method.
2. Determination of sequence reactance's of Synchronous machine.
3. Equivalent Circuit of a single-phase Induction motor.
4. Determination of Xd and Xq of a salient pole synchronous machine.
5. Synchronization of alternators.
6. Brake test on a single-phase Induction motor.
7. Efficiency of Three phase alternator.
8. Speed control of slip ring Induction Motor by Variable rotor resistance method.
9. No-load & Blocked rotor tests on a three phase Induction motor.
10. Brake Test on a three phase Induction motor.

11. Verification of Relationship between Voltages and Currents of a Three Phase Transformer (Star-Delta, Delta-Delta, Delta-star, Star-Star).
12. Separation of core losses of a Single-phase Transformer.

Laboratory Equipment/Software/Tools Required:

1. Three Phase Induction Motors
2. Three Phase Alternators
3. AC Voltmeter and Ammeters
4. Single Phase Induction Motors
5. UPF and LPF Watt meters

Books and Materials

Text Books:

1. Gupta, J. B., *Theory and Performance of Electrical Machines* , 15th ed., S. K. Kataria & Sons, 2015 (reprint 2024).
2. Theraja, B. L., and A. K. Theraja.*A Textbook of Electrical Technology*, S. Chand Publishing, 2014.

Reference Books:

1. Fitzgerald, A. E., Charles Kingsley Jr., and Stephen D. Umans *Electric Machinery*, 7th ed., McGraw-Hill, 2013.
2. Bimbra, P. S. *Electrical Machinery* , 7th ed., Khanna Publishing House, 2021.

A9220 – Power Electronics Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course offers the exploration of power electronic devices and converter topologies. Through practical experiments, students explore SCR, MOSFET, and IGBT characteristics, analyzing various single-phase and three-phase converters, choppers, and inverters. MATLAB simulations enhance understanding, enabling students to design and evaluate these systems for diverse load conditions, emphasizing their applications in modern electrical systems.

Course Pre/Co-requisites

A9412 - Analog Devices and Circuits

Relevant Sustainable Development Goals (SDGs)

SDG 7: Affordable and Clean Energy
SDG 9: Industry, Innovation, and Infrastructure
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action

Course Outcomes

After the completion of the course, the student will be able to:

A9220.1. Apply practical techniques to study and analyze the switching characteristics of power semiconductor devices such as SCR, MOSFET, and IGBT.

A9220.2. Analyze the performance of single-phase half-controlled and full-controlled converters with resistive and inductive loads through experimentation.

A9220.3. Apply control methods and evaluate the operation of AC voltage controllers, DC choppers, and single-phase series inverters in hardware setups.

A9220.4. Simulate and analyze full-controlled converters, buck-boost choppers, flyback/forward converters, and cyclo converters using MATLAB/Simulink.

A9220.5. Analyze the operation and performance of single-phase and three-phase PWM inverters and three-phase inverters through MATLAB/Simulink simulations.

Course Syllabus

List of Experiments:

1. Study of SCR, MOSFET and IGBT Characteristics.
2. Analysis of Single-Phase Half-controlled Converter with R and RL loads.
3. Analysis of Single-Phase Full-controlled Converter with R and RL loads.
4. Study of DC Jones Chopper.
5. Single Phase AC Voltage Controller with R and RL Loads.
6. Single Phase Series inverter with R and RL loads.
7. Simulation of Three-Phase Full Controlled Converter using MATLAB/Simulink.

8. Simulation of Buck-Boost Chopper with R and RL Load using MATLAB/Simulink.
9. Simulation of Fly back/Forward Converter using MATLAB/Simulink.
10. Simulation of Single-Phase Cycloconverter with R and RL loads using MATLAB/Simulink.
11. Simulation of Single Phase PWM inverter using MATLAB/Simulink.
12. Simulation of Three-Phase Inverter using MATLAB/Simulink.

Laboratory Equipment/Software/Tools Required:

1. Desktops with MATLAB/SIMULINK
2. SCR, MOSFET and IGBT kit
3. Regulated Power Supply and loads
4. Jones chopper kit, Regulated Power Supply and loads
5. AC voltage controller kit, AC supply and loads
6. Full converter kit, AC supply and loads
7. Cyclo converter kit, AC supply and loads
8. Series inverter kit, Regulated Power Supply and loads
9. Half converter kit, Regulated Power Supply and loads

Books and Materials

Text Books:

1. M. H. Rashid. *Power Electronics: Circuits, Devices and Applications* , 4th ed., Pearson Education, 2017.
2. M. D. Singh, K. B. Khanchandani. *Power Electronics* , 3rd ed., Tata McGraw-Hill publishing company, New Delhi, 2008.

Reference Books:

1. P. S. Bimbra. *Power Electronics* , 7th ed., Khanna Publishing, New Delhi, 2022.
2. Vedam Subramanyam. *Power Electronics: Devices, Converters, Application* , New Age International (P) Limited, New Delhi, 2018.
3. Ned Mohan, Tore M. Undeland, William P. Robbins. *Power Electronics: Converters, Applications, and Design*, 3rd ed., Wiley, 2002.

A9423 – Digital System Design Laboratory

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

Verilog HDL is an essential course to start career in VLSI design. Verilog HDL language is used for the design of digital integrated circuits. This course provides the knowledge of constructs and conventions. This course describes four levels of abstraction - behavioural, dataflow, gate level, and switch level. This course also emphasizes on synthesis and simulation constructs of Verilog HDL. Moreover, the students will get acquainted with cadence digital design tools and other open-source EDA tools.

Course Pre/Co-requisites

A9412 – Analog Devices and Circuits

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 9: Industry, Innovation, and Infrastructure
SDG 11: Sustainable Cities and Communities

Course Outcomes

After the completion of the course, the student will be able to:

A9423.1. Build combinational circuits using gate primitives and module instantiation of Verilog HDL.

A9423.2. Construct combinational circuits using data flow modeling of Verilog HDL.

A9423.3. Develop sequential circuits using behavioral modeling of Verilog HDL.

A9423.4. Implement finite state machines using Verilog HDL.

A9423.5. Design the memory circuits using Verilog HDL.

Course Syllabus

Introduction to HDL: Hierarchical modeling concepts, lexical conventions, data types, modules and ports, different types of modeling (Gate level, data ow, and behavioral).

Structural Modeling: Gate primitives in Verilog, Module instantiation.

Data Flow Modeling: Expressions, operands and operators, continuous assignment statements.

Behavioral Modelling: Initial and always blocks, procedural statements, conditional, case, and loop statements.

List of Experiments:

1. Develop Verilog HDL modules for Adders using structural modeling.
2. Develop Verilog HDL modules for Subtractors using structural modeling.
3. Develop Verilog HDL modules for Multiplexers using structural modeling
4. Develop Verilog HDL modules for Decoders using structural modeling.
5. Develop Verilog HDL modules for latches and flip-flops with gate level modeling.
6. Develop Verilog HDL modules for adders using data flow modeling.
7. Develop Verilog HDL modules for magnitude comparator using data flow modeling.

8. Develop Verilog HDL modules for flip-flops using behavioral modeling.
9. Develop Verilog HDL modules for counters.
10. Develop Verilog HDL modules for shift registers.
11. Develop a Verilog HDL module for ROM.
12. Develop a Verilog HDL module for RAM.

Laboratory Equipment/Software/Tools Required:

1. Computer installed with operating system
2. Xilinx ISE/Cadence Digital Design Tools or any other equivalent

Books and Materials

Text Books:

1. Mano, M. Morris, and Michael D. Ciletti. *Digital Design.* 4th ed., Pearson Education/PHI, India, 2007.
2. Kumar, A. *Fundamentals of Digital Circuits.* Prentice Hall India, 2016.

Reference Books:

1. Floyd, Thomas L. *Digital Fundamentals.* 11th ed., Pearson, 2015.
2. Roth, Charles H., and Larry L. Kinney. *Fundamentals of Logic Design.* 7th ed., Cengage Learning, 2013.
3. Tocci, Ronald J., Neal S. Widmer, and Gregory L. Moss. *Digital Systems: Principles and Applications.* 11th ed., Pearson, 2017.

A9221 – Python for Engineers

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		PI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	30	0	30	1	40	60	100

Course Description

Course Overview

This course introduces students to the foundational concepts of Python programming through practical implementation. It emphasizes hands-on coding to develop proficiency in basic syntax, data types, and control structures. Students explore core features including string manipulation, data structures, and functions. Modules on exception handling, modular programming, and data processing using libraries like NumPy, Pandas, and Matplotlib are included. The course fosters problem-solving abilities applicable to real-world scenarios

Course Pre/Co-requisites

This course has no specific pre-requisites and co-requisites.

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure

Course Outcomes

After the completion of the course, the student will be able to:

A9221.1. Use Python basics, control statements, and I/O operations to solve simple problems.

A9221.2. Apply string operations and regular expressions to process and manipulate text.

A9221.3. Analyze and work with Python data structures like lists, tuples, sets, and dictionaries.

A9221.4. Implement modular Python programs using functions, modules, exception handling, and file operations

A9221.5. Evaluate and perform basic data analysis using NumPy and Pandas.

Course Syllabus

List of Experiments:

1. Introduction to Python Lab: Installation and Simple Output Display.
   a. Write a Python program to print your Name, Roll Number, and Branch.
   b. Write a Python program to read a string "Python Programming" and display it on the screen.
   c. Write a Python program to read integer, float & string values and display them on the screen.
2. Programs using Input Output Statements, Variables and Expressions.
   a. Write a Python program to read a float value and convert Fahrenheit to Centigrade.
   b. Write a Python program to find the area and perimeter of a triangle.
   c. Write a Python program to read the Marks in 5 Subjects and Display the average.
3. Programs using various operators in Python.
   a. Write a Python program for demonstrating the usage of comparison operators.
   b. Write a Python program to swap / interchange two numbers.

c. Write a Python program for demonstrating the usage of unary, shift, logical, membership and identity operators.

4. Programs using Conditional Statements.
   a. Write a Python program to check a given number is Even or Odd.
   b. Write a Python program to find the greatest of 3 integer numbers.
   c. Write a Python program to demonstrate nested if statement.
5. Programs using Iterative Statements Part-I.
   a. Write a Python program to reverse the digits of a given number.
   b. Write a Python program to find the factorial of a given number.
   c. Write a Python program to display factors of a given integer number.
6. Programs using Iterative Statements Part-II.
   a. Write a Python program to print Fibonacci numbers.
   b. Write a Python program to display all prime numbers between 0 to n.
7. Programs using Strings and Its Operations.
   a. Write a program that asks the user to enter a string and perform the following:
      i. The total number of characters in the string.
      ii. Repeat the string 10 times.
      iii. The first character of the string.
      iv. The first three characters of the string.
      v. The last three characters of the string.
      vi. The string in backwards.
      vii. The seventh character of the string if exists otherwise display a message “Not exist”.
      viii. The string with its first and last characters removed.
      ix. The string into capital case.
      x. The string with every letter replaced by a space.
   b. Write a Python program to demonstrate string concatenation, repetition, and membership testing.
   c. Write a Python program to demonstrate built-in string functions: upper(), lower(), strip(), find().
   d. Write a Python program to count the number of vowels in a given string.
8. Programs using Python Data Structures (Lists).
   a. Write a Python program to perform the following operations on a list of integers:
      i. Print the total number of items in the list.
      ii. Print the last item in the list.
      iii. Print the list in reverse order.
      iv. Print Yes if the list contains a 5 and No otherwise.
      v. Print the number of occurrences of an element in the list.
      vi. Remove the first and last items from the list and sort the remaining items.
      vii. Print how many integers in the list are less than a given value.
      viii. Print the average of the elements in the list.
      ix. Print the largest and smallest value in the list.

x. Program which applies list comprehensions to generate even numbers.

9. Programs using Python Data Structures (Tuples and Sets).
   a. Write a Python program to demonstrate various operations on tuples.
   b. Write a Python program to demonstrate various operations on sets.
10. Programs using User Defined Functions.
   a. Define a lambda function to compute square, rectangle and cube.
   b. Write a Python program to find factorial of a given number using function.
   c. Write a Python program to find factorial of a given number using Recursive function.
11. Programs using Modules.
   a. Write a Python program to display the date and time using the time module.
   b. Write a Python program to check whether a given year is a leap year or not using the calendar module.
12. Programs on Exception Handling.
   a. Write a Python program to read two integers from the user and perform division, handling ZeroDivisionError and ValueError using try-except-finally.
   b. Write a Python program to open a file and read its contents, handling FileNotFoundError.
13. Programs using NumPy, Pandas and Matplotlib.
   a. To create NumPy arrays and perform indexing, slicing.
   b. To reshape arrays and apply basic arithmetic operations.
   c. To compute mean, median, and standard deviation using NumPy functions.
   d. To create and manipulate Pandas Series and DataFrames.
   e. To read CSV data using Pandas and handle missing data.
   f. Write a Python program using Matplotlib to plot a simple line chart showing the growth of a plant over 5 days. Label the axes and give a suitable title to the graph.

Laboratory Equipment/Software/Tools Required:

1. A computer System with Ubuntu Operating System
2. Jupyter notebook or Pycharm IDE, Python Run Time System.

Books and Materials

Text Books:

1. Thareja, Eema. *Python Programming: Using Problem Solving Approach.* 1st ed., Oxford University Press, 2019.
2. Gowrishankar, S., and Veena A. *Introduction to Python Programming.* 1st ed., Chapman & Hall/CRC Press, 2018.

Reference Books:

1. Severance, Charles. *Python for Everybody: Exploring Data Using Python 3.* 1st ed., Shroff Publishers, 2017.
2. Budd, Timothy A. *Exploring Python.* McGraw-Hill Education, 2010.
3. Downey, Allen B. *Think Python: How to Think Like a Computer Scientist.* O'Reilly Media, 2016.

A9024 – Community Driven Product Evaluation

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
0	0	0	45	45	1	40	60	100

Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with ordinary differential equations of first and higher order and Laplace transforms, vector calculus. In addition, this course can be applied in many areas of engineering such as wireless communication, signal processing, robotics and animation.

Course Pre/Co-requisites

A9023 - Technology Entrepreneurship

Relevant Sustainable Development Goals (SDGs)

SDG 4: Quality Education
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 17: Partnerships for the Goals

Course Outcomes

After the completion of the course, the student will be able to:

A9024.1. Apply structured evaluation frameworks to assess technical, functional, and social impact of products.

A9024.2. Conduct community-centered product testing and collect actionable feedback.

A9024.3. Benchmark products against industry standards and competitor solutions.

A9024.4. Analyze evaluation data to identify strengths, weaknesses, and areas for improvement.

A9024.5. Integrate knowledge from all prior courses to produce a comprehensive commercialization or patent readiness report.

Course Syllabus

Unit-I:

Product Evaluation Fundamentals: Purpose, scope, and importance of product evaluation in community contexts. Key Performance Indicators (KPIs), usability, and sustainability metrics. Ethical considerations in testing with communities.

Unit-II:

Standards, Compliance and Benchmarking: Relevant industry, safety, and environmental standards. Social impact and sustainability assessment frameworks. Competitive benchmarking and market gap analysis.

Unit-III:

Community Centered Testing and Data Collection: Designing and executing real-world product trials. Feedback mechanisms: surveys, interviews, observation, analytics. Collecting and categorizing qualitative and quantitative data.

Unit-IV:

Data Analysis and Product Improvement Planning: Analytical tools for interpreting evaluation results. Identifying design gaps and improvement opportunities. Translating insights into actionable product enhancement plans.

Unit-V:

Integrated Product Documentation: Consolidating insights from design thinking, product development, entrepreneurship, and evaluation. preparing a comprehensive commercialization or patent readiness dossier. and presenting outcomes to a review panel for validation and approval.

Activity Plan

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
1	Unit-I: Evaluation Fundamentals	Understand purpose, scope & importance of product evaluation	Concept briefing	Discussion: "Why evaluation is crucial for community-driven products"	Reflection note on role of evaluation in product lifecycle	CO1
2	Unit-I: KPIs & Metrics	Learn KPIs, usability & sustainability measures	Concept briefing + Case examples	Teams define KPIs for a sample product	Submit KPI framework for selected case	CO1
3	Unit-I: Ethics in Evaluation	Apply ethical considerations in testing	Problem-based learning + Collaborative exchange	Debate: "Ethics vs. Innovation speed in testing"	Short essay on ethical challenge in testing	CO1
4	Unit-II: Standards & Compliance	Learn relevant industry & safety standards	Demo session + Case study	Review product compliance requirements from standards body	Submit compliance checklist for a product	CO2, CO3
5	Unit-II: Benchmarking	Apply benchmarking frameworks	Hands-on session + Benchmarking activity	Benchmark 2 community products against market leaders	Submit benchmarking chart	CO3
6	Unit-II: Market Gap Analysis	Identify market gaps & opportunities	Hands-on session	Teams map competitor strengths vs weaknesses	Submit market gap report	CO3
7	Unit-III: Community-Centered Testing	Design product trials with stakeholders	Hands-on workshop + Role-play	Simulate community feedback session	Submit trial design protocol	CO2

Week	Unit	Objective	Teaching Method	In-Class Activities	Assignments / Assessments	CO Mapping
8	Unit-III: Feedback Mechanisms	Practice data collection methods	Practical session + Peer feedback	Run mock survey/interview for a prototype	Submit collected sample data	CO2
9	Unit-IV: Data Analysis Tools	Analyze evaluation data	Analytical lab + Software demo	Use basic data tools (Excel/SPSS/PowerBI) to interpret results	Submit initial analysis report	CO4
10	Unit-IV: Product Improvement	Translate insights into action	Product improvement exercise	Teams identify weaknesses & propose enhancements	Submit product improvement plan	CO4
11	Unit-V: Integrated Documentation	Consolidate learnings from all prior courses	Documentation	Draft commercialization or patent dossier	Submit draft dossier	CO5
12	Unit-V: Final Showcase	Present integrated evaluation outcomes	Showcase + Expert panel review	Final presentations with reports, feedback loop	Submit final commercialization/patent readiness dossier	CO5

Books and Materials

Text Books:

1. Deependra Sharma *Entrepreneurship in India*, Routledge, 2023.
2. Cooper, Robert G *Winning at New Products: Creating Value Through Innovation*, Basic Books, 2011.

Reference Books:

1. Dr. S. Glory Swarupa, Swapna Vanamala *Innovation, Incubation and Intellectual Property Rights: Experiences of Developing Countries*, 2023.

Vision

To be a pioneer institute and leader in engineering education to address societal needs through education and practice.

Mission

To adopt innovative student centric learning methods.
To enhance professional and entrepreneurial skills through industry institute interaction.
To train the students to meet dynamic needs of the society.
To promote research and continuing education.

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We at Vardhaman College of Engineering, endeavor to uphold excellence in all spheres by adopting the best practices in effort and effect.

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