



VARDHAMAN
COLLEGE OF ENGINEERING

CURRICULUM
For
Bachelor of Technology
Mechanical 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

To be a premier center for producing competent mechanical engineers to cater the ever changing industrial demands and societal needs.

Department Mission

M1: To impart knowledge and skills in basic and applied areas of Mechanical Engineering through innovative learner-centric approach.

M2: To associate with industries and research organizations for gaining real-time practical knowledge.

M3: To facilitate continuous learning based on the dynamic needs of the society.

Program Educational Objectives (PEOs)

PEO1: Graduates make their way to the society with proper scientific and technical knowledge to identify, formulate and solve Mechanical Engineering problems.

PEO2: Graduates adapt to a rapidly changing environment in the areas of Mechanical Engineering and explore a possible profession in industry, academic, research and self-employment opportunities.

PEO3: Graduates excel in a career by their team-working ability and communicate effectively to complete the task with minimal resources.

PEO4: Graduates commit to professional and ethical practices encouraging diversity, continuous improvement and lifelong learning.

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:** Demonstrate knowledge in the area of design, analysis and fabrication of mechanical systems.
- PSO2:** Apply learned concepts and management skills to associate professionally in industry or as an entrepreneur.

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
				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	A9301	Engineering Drawing	ES	15	-	60	15	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	A9302	Engineering Workshop	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				180	15	180	240	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
				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	A9303	Engineering Mechanics	ES	45	-	-	45	90	3	40	60	100
4	A9503	Data Structures	ES	45	-	-	45	90	3	40	60	100
5	A9209	Basic Electrical and Electronics Engineering	ES	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9008	Engineering Physics Laboratory	BS	-	-	30	-	30	1	40	60	100
7	A9504	Data Structures Laboratory	ES	-	-	30	-	30	1	40	60	100
8	A9305	Computer Aided Machine Drawing	ES	-	-	30	-	30	1	40	60	100
Community Related Project Work												
9	A9022	Product Design and Development	PW	-	-	-	45	45	1	40	60	100
Total				225	15	90	285	615	20	360	540	900



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
				L	T	P	SL					
Theory Courses												
1	A9014	Business Economics and Financial Analysis	HS	45	-	-	45	90	3	40	60	100
2	A9306	Material Science and Metallurgy	PC	45	-	-	45	90	3	40	60	100
3	A9307	Production Technology	PC	45	-	-	45	90	3	40	60	100
4	A9308	Mechanics of Solids	PC	45	15	-	60	120	4	40	60	100
5	A9309	Thermodynamics	PC	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9310	Production Technology Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9311	Material Science and Mechanics of Solids Laboratory	PC	-	-	30	-	30	1	40	60	100
8	A9511	Python Programming Laboratory	PC	-	-	30	-	30	1	40	60	100
Skill Development Course												
9	A9312	Drafting and Modelling	PC	-	-	30	-	30	1	40	60	100
Community Related Project Work												
10	A9023	Technology Entrepreneurship	PW	-	-	-	45	45	1	40	60	100
Total				225	15	120	285	645	21	400	600	1000

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
				L	T	P	SL					
Theory Courses												
1	A9004	Probability Distributions and Statistics	BS	45	-	-	45	90	3	40	60	100
2	A9313	Kinematics of Machinery	PC	45	-	-	45	90	3	40	60	100
3	A9314	Thermal Engineering-I	PC	45	-	-	45	90	3	40	60	100
4	A9315	Fluid Mechanics and Hydraulic Machines	PC	45	-	-	45	90	3	40	60	100
5	A9316	Metrology and Machine Tools	PC	45	-	-	45	90	3	40	60	100
Practical Courses												
6	A9317	Fluid Mechanics and Hydraulic Machines Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9318	Thermal Engineering Laboratory	PC	-	-	30	-	30	1	40	60	100
8	A9319	Metrology and Machine Tools Laboratory	PC	-	-	30	-	30	1	40	60	100
9	A9006	Computational Mathematics Laboratory	BS	-	-	30	-	30	1	40	60	100
Skill Development Course												
10	A9320	Rapid Prototyping	PC	-	-	30	-	30	1	40	60	100
Community Related Project Work												
11	A9024	Community Driven Product Evaluation	PW	-	-	-	45	45	1	40	60	100
Total				225	0	150	270	645	21	440	660	1100
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
				L	T	P	SL					
Theory Courses												
1	A9321	Dynamics of Machinery	PC	45	-	-	45	90	3	40	60	100
2	A9322	Thermal Engineering-II	PC	45	-	-	45	90	3	40	60	100
3	A9323	Design of Machine Elements	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	A9324	Dynamics of Machinery 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	A9325	Heating, Ventilation, and Air Conditioning-HVAC	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
				L	T	P	SL					
Theory Courses												
1	A9326	Heat Transfer	PC	45	-	-	45	90	3	40	60	100
2	A9327	Machine Design	PC	45	-	-	45	90	3	40	60	100
3	A9328	Finite Element Methods	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	A9329	Heat Transfer Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9330	Computer Aided Engineering Laboratory	PC	-	-	30	-	30	1	40	60	100
Skill Development Course												
8	A9331	Industrial Automation	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
				L	T	P	SL					
Theory Courses												
1	A9332	Computer Integrated Manufacturing	PC	45	-	-	45	90	3	40	60	100
2	A9333	Instrumentation and Control Systems	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	A9334	Instrumentation Laboratory	PC	-	-	30	-	30	1	40	60	100
7	A9335	Computer Integrated Manufacturing 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
				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	L – Lecture Hours
HS – Humanities & Social Sciences	T – Tutorial Hours
ES – Engineering Sciences	P – Practical Hours
PC – Professional Core	TW – Team Work
PE – Professional Elective	SL – Self Learning
OE – Open Elective	H – Hours
PW – Project Work	C – Credits
VA – Value Added Course	CIE – Continuous Internal Evaluation
CI – Classroom Instruction	SEE – Semester End Examination
LI – Laboratory Instruction	SDG – Sustainable Development Goals

List of Professional Electives

Domain: Manufacturing			
Year & Semester	Professional Elective #	Course Code	Title of the Course
III B.Tech. I Semester	Professional Elective – I	A9351	Additive Manufacturing
III B.Tech. II Semester	Professional Elective – II	A9355	Operations Research
IV B.Tech. I Semester	Professional Elective – III	A9359	Robotics
IV B.Tech. I Semester	Professional Elective – IV	A9363	Supply Chain Management
IV B.Tech. II Semester	Professional Elective – V	A9367	Total Quality Management
IV B.Tech. II Semester	Professional Elective – VI	A9371	Production Planning and Control

Domain: Thermal			
Year & Semester	Professional Elective #	Course Code	Title of the Course
III B.Tech. I Semester	Professional Elective – I	A9352	Automobile Engineering
III B.Tech. II Semester	Professional Elective – II	A9356	Turbomachinery
IV B.Tech. I Semester	Professional Elective – III	A9360	Refrigeration and Air Conditioning
IV B.Tech. I Semester	Professional Elective – IV	A9364	Fluid Power Systems
IV B.Tech. II Semester	Professional Elective – V	A9368	Computational Fluid Dynamics
IV B.Tech. II Semester	Professional Elective – VI	A9372	Power Plant Engineering

Domain: Materials and Design			
Year & Semester	Professional Elective #	Course Code	Title of the Course
III B.Tech. I Semester	Professional Elective – I	A9353	Composite Materials
III B.Tech. II Semester	Professional Elective – II	A9357	Mechanical Vibrations
IV B.Tech. I Semester	Professional Elective – III	A9361	Engineering Tribology
IV B.Tech. I Semester	Professional Elective – IV	A9365	Design of Jigs and Fixtures
IV B.Tech. II Semester	Professional Elective – V	A9369	Advanced Mechanics of Solids
IV B.Tech. II Semester	Professional Elective – VI	A9373	Smart Materials and Applications

Domain: Emerging / Interdisciplinary			
Year & Semester	Professional Elective #	Course Code	Title of the Course
III B.Tech. I Semester	Professional Elective – I	A9354	Electric and Hybrid Vehicles
III B.Tech. II Semester	Professional Elective – II	A9358	Renewable Energy Sources
IV B.Tech. I Semester	Professional Elective – III	A9362	Fuzzy Logic and Neural Networks
IV B.Tech. I Semester	Professional Elective – IV	A9366	Mechatronics System Development
IV B.Tech. II Semester	Professional Elective – V	A9370	Machine Learning for Mechanical Systems
IV B.Tech. II Semester	Professional Elective – VI	A9374	Industry 4.0

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 electro-chemical 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- Dulong's 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.

A9301 – Engineering Drawing

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
15	0	60	15	90	3	40	60	100

Course Description

Course Overview

This course introduces the foundational concepts of Engineering Drawing, emphasizing the importance of visual communication in engineering. It covers engineering curves, orthographic projections of points, lines, planes, and solids, sectional views and lateral surface development of regular solids. The course also includes isometric projections and the interpretation and conversion between orthographic and isometric views. Through systematic drawing methods, students develop the skills to represent three-dimensional objects in two-dimensional form accurately and 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:

- A9301.1. Construct various types of engineering scales and curves used in technical drawings.
- A9301.2. Interpret and create orthographic projections of points, lines, and planes with varying inclinations.
- A9301.3. Generate orthographic views of regular solids, inclined to one or both reference planes.
- A9301.4. Analyze sectional views of regular solids to construct true shape of the section, and lateral surface development.
- A9301.5. Produce isometric views of objects and convert between isometric and orthographic projections.

Course Syllabus

Unit-I:

Introduction to Engineering Drawing: Principles of engineering drawing and its significance; construction of engineering curves – ellipse, parabola, and hyperbola (general method only); cycloidal curves – cycloid, epicycloid, hypocycloid.

Unit-II:

Orthographic Projections – I: Principles of orthographic projection; projections of points located in different quadrants; projections of lines inclined to one reference plane and to both principal reference planes; projections of planes – inclined to one or both reference planes.

Unit-III:

Orthographic Projections – II: Orthographic projections of regular solids – prisms, cylinders, pyramids, and cones; solids inclined to one reference plane and inclined to both principal reference planes; visualization and interpretation of three-dimensional solids through two-dimensional projection views.

Unit-IV:

Sectional Views and Development: Section of Solids – sectional views and true shape of the section. Lateral surface development of regular solids – prisms, cylinders, pyramids, and cones; methods of development; applications in pattern making and sheet metal work.

Unit-V:

Isometric Projections: Concept of isometric projection and isometric scale; isometric projection of lines, regular plane figures, and solids – prism, cylinder, pyramid, and cone; conversion of isometric views to orthographic views and vice versa; enhancement of 3D visualization skills.

Books and Materials

Text Books:

1. Bhatt, N. D. *Engineering Drawing*, 53rd ed., Charotar Publishing House, 2019.
2. Agrawal, Basant, and C. M. Agrawal. *Engineering Graphics*, 3rd ed., Tata McGraw Hill Education, 2010.

Reference Books:

1. Narayana, K. L., and P. Kanniah. *Textbook on Engineering Drawing*, 3rd ed., SciTech Publishers, 2020.
2. Shah, M. B., and B. C. Rana. *Engineering Drawing and Computer Graphics*, 2nd ed., Pearson Education, 2009.

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
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 $(1 + 2 + 3 + \dots + n)$.
- 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 n th 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
- Write a C program to add two complex numbers by passing structure to a function.
 - Write a C program to add two distances (in inch-feet system) using structures.
11. Pointers
- Write a C program to swap two integers using the following methods:
 - Call by Value
 - Call by Reference
 - Write a C program to demonstrate pointer arithmetic.
 - Write a program to display values in reverse order from an array using a pointer.
 - Write a program through a pointer variable to find sum of n elements from an array.
 - Write a C program to check the given string is palindrome or not using pointer.
 - Write a C program to print n city names using pointers and strings.
12. Files
- Write a C program to merge two files into a third file.
 - Write a C program to reverse the contents of a file.
 - Write a C program to use random access functions in files.
 - 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
- Write a C program that uses a non-recursive function to search for a key value in a list of integers using linear search.
 - 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
- Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.
 - Write a C program that sorts the given array of integers using selection sort in descending order.
 - Write a C program that sorts the given array of integers using quick sort in ascending order.
 - Write a C program that sorts the given array of integers using insertion sort in ascending order.
15. Miscellaneous
- Write a program that shows the binary equivalent of a given positive number between 0 to 255.
 - Write a C program to calculate the following, where x is a fractional value:

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

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

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

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)*.

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 Promoters & 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.

A9021 - Community Centered Design Thinking

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL			H	C	CIE
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.

A9303 – Engineering Mechanics

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

Engineering Mechanics is a branch of Physical Science which uses the Laws of Mechanics to predict forces and torques and its effects on the motion of rigid bodies. The course covers a basic introduction to both statics and dynamics. This course is the key prerequisite course to sequences of courses dealing with mechanics of solids, Kinematics and Dynamics of Machinery and Design of Machine Members.

Course Pre/Co-requisites

A9001 - Matrices and Calculus

Relevant Sustainable Development Goals (SDG(s))

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:

- A9303.1. Apply fundamental principles of force systems, including resultants, moments, and equilibrium in 2D and 3D force systems.
- A9303.2. Analyze different types of frictional forces, including static and dynamic friction, and solve problems involving ladder and wedge friction.
- A9303.3. Determine the centroid and center of gravity of simple and composite bodies using first principles and Pappus's theorems.
- A9303.4. Calculate moment of inertia and mass moment of inertia for standard and composite sections, applying theorems of moments of inertia.
- A9303.5. Apply principles of work-energy and impulse-momentum to analyze the motion of particles and evaluate results of central collisions.

Course Syllabus

Unit-I:

Introduction to Engineering mechanics: Basic Concepts, Resultants of Force System, Parallelogram law, Forces and components, Resultant of coplanar Concurrent Forces, Components of forces in Space, Moment of Force, principle of moments, Coplanar Applications, Couples, Resultant of any Force System. Equilibrium of Force Systems, Free Body Diagrams, Equations of Equilibrium, Equilibrium of planar Systems.

Unit-II:

Friction: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Ladder friction, wedge friction. **Centroid and center of gravity:** Centroid of simple figures from first principle, centroid of composite sections, Pappus theorems. Centre of Gravity and its implications, centre of gravity of composite sections.

Unit-III:

Moment of inertia: Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite Sections. Mass moment inertia of circular plate, Cylinder, Cone, Sphere, mass moment of inertia of composite bodies.

Unit-IV:

Dynamics of a Particle: Rectilinear motion, Plane curvilinear motion: Rectangular and Polar coordinates. Relative and constrained motion, Newton's law of motion for a particle (rectangular, path, and polar coordinates). Work -kinetic energy, power, potential energy. Impulse and momentum: Linear, Angular, Elastic Impact (Direct and oblique).

Unit-V:

Kinetics of Rigid Bodies: Introduction, Types of motion, Instantaneous centre of rotation in plane motion and simple problems, D' Alembert's principle and its applications in plane motion and connected bodies. **Work-Energy Method:** Work-Energy principle and its application in plane motion of connected bodies or Systems, Work energy Applied to particle motion, Kinetics of rigid body rotation.

Books and Materials

Text Books:

1. Singer, Ferdinand. *Engineering Mechanics*, 5th edition, Harper and Bros, 2013.
2. Hibbeler, R.C. *Engineering Mechanics*, 14th edition, Prentice Hall, 2016.

Reference Books:

1. Beer, Ferdinand P. *Vector Mechanics for Engineers Statics*, 12th edition, McGraw Hill, 2019.
2. Meriam, J.L., and L.G. Kraige. *Engineering Mechanics-Statics*, 8th edition, Wiley, 2016.
3. Bhavikati, S.S., and K.G. Rajasekhara. *Engineering Mechanics*, 4th edition, Newage Publications, 2018.

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.

A9209 – Basic Electrical and Electronics Engineering

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

Course Description

Course Overview

This course is designed to introduce Mechanical Engineering students to the fundamental concepts of Electrical and Electronics Engineering. It covers key topics such as Electric circuits, DC motors and generators, their performance and speed control methods, and the operation of AC machines like transformers and induction motors. The course also includes an introduction to diodes, SCRs, and basic rectifier circuits, providing students with the necessary skills to apply electrical principles in mechanical 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:

- A9209.1. Use circuit laws and reduction methods to determine voltages, currents, and other parameters in simple DC and AC circuits.
- A9209.2. Apply the principles of DC machines to determine its parameters and characteristics..
- A9209.3. Apply the concept of AC machines to determine the parameters and characteristics of transformers and induction machines.
- A9209.4. Apply electrical drive principles to select and operate drives for mechanical systems based on load requirements.
- A9209.5. Apply the switching principle of diode and SCR to understand the significance of rectifier circuits for practical applications.

Course Syllabus

Unit-I:

Electric Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Ohms Law, KVL and KCL, Mesh and Nodal Analysis, Superposition Theorems- Numerical Problems. Representation of sinusoidal waveforms, Average and RMS values, form factor and peak factor- conceptual description only.

Unit-II:

DC Machines: DC Motors - Principle of operation - Types-Torque equation, Characteristics of DC Shunt Motor, Speed control of D.C. Motors (Armature and field control), Losses and Efficiency, Braking Methods - Regenerative, Dynamic, Plugging - Applications of DC Motors.

Unit-III:

AC Machines: Transformers - Principle of operation of Single-Phase Transformer, construction, EMF equation, Losses, Regulation and Efficiency. Three Phase Induction Motor - Construction and Principle of Operation, Torque-Speed Characteristics, Types of Braking.

Unit-IV:

Electrical Drives: Introduction to Electrical drives, Advantages of electrical drives, Parts of electrical drives, Choice of electrical drives, Fundamental torque equations, Speed torque conventions and multi-quadrant operation, Components of load torques, Nature and classification of load torque, Steady state stability, Load equalisation, Thermal model of motor for heating and cooling, Classes of motor duty, Determination of motor rating.

Unit-V:

Electronic Circuits: Diodes - Operation, V-I characteristics, Rectifiers - Half wave, Full wave and Bridge rectifiers. SCR - Construction and Operation, V-I Characteristics, Fully Controlled Rectifier, Single phase fully controlled converter fed DC motor (CCM).

Books and Materials

Text Books:

1. B. L. Theraja, A. K. Theraja (2002), *A Textbook of Electrical Technology*, , 23rd ed., S. Chand Publishers, New Delhi.
2. S. Salivahanan, N Suresh Kumar, A. Vallavaraj (2007), *Electronic Devices and Circuits*,, Tata Mc Graw Hill, India.
3. G. K. Dubey, “*Fundamental of Electric Drives*,” , 2nd ed., Narosa Publishing House, New Delhi, 2002.

Reference Books:

1. T. K. Nagasarkar, M. S. Sulkija (2007), *Basic Electrical Engineering*,, 2nd ed., Oxford University Press, New Delhi.
2. A. E. Fitzgerald, C. Kingsley, S. Umans (2002), *Electric Machinery*,, 5th reprint, Tata Mc Graw Hill Companies, New Delhi
3. J. Millman, C. Halkias, and SatyabrathaJit (2011), *Electronic Devices and Circuits*,, 3rd reprint, Tata Mc Graw Hill, New Delhi.

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 semi-conductors, 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.

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 applications.
- 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.

A9305 Computer Aided Machine Drawing

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

Course Description

Course Overview

Machine drawing is used to communicate the necessary technical information required for manufacture and assembly of machine components. These drawings follow rules laid down in national and International Organizations for Standards (ISO). Hence knowledge of the different standards is very essential. Students have to be familiar with industrial drafting practices and thorough understanding of production drawings to make them fit in industries. The following topics have been covered to fulfil the above objectives. Classification of Machine Drawings, Principles of Drawings, Sectioning, Dimensioning, Limits, Fits and Tolerance, Symbols and Conventional Representation, Screw Fasteners, Key Joints, Coupling and its Types, Riveted Joints, Structural Applications, Assembly Drawings, Introduction of Computer Aided Drafting, Introduction of Solid 3D Modeling.

Course Pre/Co-requisites

A9301 - Engineering Drawing

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:

- A9305.1. Develop the concept of projection principles to draw machine components using AutoCAD.
- A9305.2. Prepare 2D drawings of joints like cotter, pin, riveted, welded, and couplings.
- A9305.3. Interpret detailed-part drawings of machine components as per BIS standards.
- A9305.4. Model and assemble machine components using Fusion 360.
- A9305.5. Develop 3D assemblies of valves, engine parts, and machine tool parts.

Course Syllabus

Machine components: Selection of Views, additional views for the following machine elements and parts with every drawing proportion.

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys and Cotter Joints.
3. Pin Joints.
4. Riveted joints for plates.
5. Shaft couplings.
6. Welded Joints.

Modelling and Assembly Drawing:

1. **Steam Engine parts**

Stuffing box, cross head, eccentric, connecting rod, piston assembly.

2. Machine tool parts

Screw jack, Machine Vice, Plummer block, Lathe-Tailstock, Tool post.

3. Valves:

Non-return Valve, spring loaded safety valve, Feed check valve.

Laboratory Equipment/Software/Tools Required:

AUTOCAD, FUSION 360 or Equivalent

Books and Materials

Text Books:

1. Sidheshwar, N., and P. Kannaiah. *Machine Drawing*, 3rd edition, Tata McGraw Hill Education (P) Ltd, 2009.
2. Narayana, K.L., P. Kannaiah, and K. Venkata Reddy. *Machine Drawing*, 3rd edition, New Age Publishers, 2006.

Reference Books:

1. Dhawan. *Machine Drawing-A Textbook of Machine Drawing*, 4th edition, S. Chand Publications, 2008.
2. Sidheshwar, N., P. Kannaiah, and V.V.S. Sastry. *Machine Drawing*, 21st edition, Tata McGraw Hill Education (P) Ltd, 1999.

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

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., International 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.

A9306 - Material Science and Metallurgy

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 comprehensive knowledge of the structure, properties, and behavior of engineering materials. It covers crystallography, defects in solids, grain boundaries, and alloy constitution. Students learn equilibrium phase diagrams, transformations, and the Fe - Fe₃C system. The course emphasizes heat treatment processes, TTT diagrams, and hardenability. It also explores cast irons, steels, non-ferrous metals, ceramics, nanomaterials, and composites. Focus is placed on understanding structure–property relationships, strengthening mechanisms, and material selection. By the end, students gain a solid foundation to analyze and apply material behavior in mechanical, thermal, and manufacturing applications.

Course Pre/Co-requisites

A9007 - Applied Physics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9306.1. Implement crystallographic principles to construct and describe lattice types, unit cells, crystal orientations, and defect structures.
- A9306.2. Evaluate phase diagrams using the Lever Rule and identify transformations in alloy systems such as eutectic and peritectic reactions.
- A9306.3. Execute standard heat treatment processes and assess their impact on microstructure and properties of ferrous alloys.
- A9306.4. Compare the structures and properties of various cast irons and steels for different engineering applications.
- A9306.5. Select appropriate non-ferrous metals, ceramics, and composites for specific applications based on structural and functional properties.

Course Syllabus

Unit-I:

Structure of Materials: Lattices, basic idea of symmetry. Bravais lattices, unit cells, crystal structures, crystal planes and directions, co-ordination number. Imperfections in solids: point defects, line defects, surface defects. Grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys, determination of grain size. Constitution of Alloys: Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds, different strengthening mechanism of alloys

Unit-II:

Equilibrium Diagram: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid-state allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of Fe - Fe₃C, equilibrium phase diagram. sections.

Unit-III:

Heat treatment of alloys: Effect of alloying elements on Fe - Fe₃C system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Hardenability, surface hardening methods, Age hardening treatment, Cryogenic treatment of alloys. Special metals and alloys- Super alloys, maraging steels.

Unit-IV:

Cast iron and steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, tool and die steels.

Unit-V:

Non-Ferrous metals and alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys. Ceramic materials: Crystalline ceramics, glasses, cermets, abrasive materials, nanomaterials - definition, properties and applications of the above. Composite materials: Classification of composites, particle - reinforced materials, fibre reinforced materials, metal ceramic mixtures, metal matrix composites and C - C composites. Methods of manufacturing of composites.

Books and Materials

Text Books:

1. Raghavan, V. *Physical Metallurgy: Principles and Practice*, 3rd edition, PHI Learning Pvt Limited, 2015.
2. Dieter, George. *Mechanical Metallurgy*, 3rd edition, McGraw-Hill, 2017.

Reference Books:

1. Callister, William D., Jr. *Materials Science and Engineering*, 10th edition, Wiley Edition, 2018.
2. Avner, Sidney H. *Introduction to Physical Metallurgy*, 2nd edition, Tata McGraw-Hill, 2009.
3. Singh, Vijendra. *Physical Metallurgy*, 1st edition, Standard Publishers, 2000.

A9307 Production Technology

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 comprehensive introduction to fundamental and advanced manufacturing processes, with a focus on both traditional and modern techniques. Students will explore the principles and applications of casting, welding, forming, additive manufacturing, and non-destructive testing. The syllabus covers process design, defect analysis, and quality control, emphasizing practical insights into material behavior, process optimization, and industry-relevant applications. By integrating theoretical concepts with real-world case studies, the course equips students with the knowledge to select, design, and evaluate manufacturing processes for diverse engineering materials and components. Topics include sand casting, advanced welding methods, hot/cold working, extrusion, sheet metal operations, additive manufacturing, and non-destructive evaluation techniques. The curriculum is designed to bridge theory and practice, preparing students for challenges in production environments and emerging manufacturing technologies.

Course Pre/Co-requisites

This course has no specific prerequisites and co-requisite.

Relevant Sustainable Development Goals (SDG(s))

SDG 8: Decent Work and Economic Growth

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:

- A9307.1. Identify the process of making patterns, preparation of sand mould, various special casting processes and casting defects.
- A9307.2. Select appropriate joining methods to join work pieces by using different welding techniques.
- A9307.3. Analyze various metal forming processes for the various applications.
- A9307.4. Analyze the properties and bonding techniques of plastics by using plastic molding techniques.
- A9307.5. Illustrate the various non-destructive testing methods for a specific application.

Course Syllabus

Unit-I:

Casting: Steps involved in sand casting process, gating system, sprue and riser design, casting defects. Special casting processes: Centrifugal, Die-casting, Investment casting.

Unit-II:

Welding: Gas welding, ARC welding, TIG and MIG welding, Plasma arc welding, resistance welding, Thermit welding. Advanced welding processes & joining processes: Solid state joining methods, Laser welding, Electron beam welding, Soldering and Brazing. Heat affected zones in welding, welding defects, causes and remedies.

Unit-III:

Hot working and cold working: Strain hardening, recovery, recrystallisation and grain growth, Comparison of hot working and cold working. Rolling: Theory of rolling, types of Rolling mills, rolling defects, Drawing: wire drawing and Tube drawing, Forging: Types of forging, forging defects. Sheet metal operations. Forces and power requirements in the above processes

Unit-IV:

Extrusion: Forward extrusion and backward extrusion, impact extrusion and hydrostatic extrusion. Additive manufacturing: Introduction, methods of AM, types of plastics and plastic processing methods.

Unit-V:

Non-destructive testing: Various non-destructive testing methods like visual inspection, liquid dye penetrant, Magnetic particle testing, ultrasonic testing, radiography, computer aided tomography. Interpretation of defects in cast, welded and hot / cold worked and AM products.

Books and Materials

Text Books:

1. Rao, P. N. *Manufacturing Technology*, vol. 1, 5th edition, Tata McGraw-Hill Education (P) Ltd, 2023.
2. Ghosh, A., and Malik, A. K. *Manufacturing Science*, 2nd edition, Tata McGraw-Hill Education (P) Ltd, 2014.

Reference Books:

1. Jain, R. K. *Production Technology*, 19th edition, Khanna Publishers, 2024.
2. Raghuvanshi, S. *A Course in Workshop Technology*, vol. 2, 3rd edition, Dhanpat Rai & Co, 2011.
3. Heine, Richard W., Carl R. Loper, and Philip C. Rosenthal. *Principles of Metal Casting*, 1st edition, Tata McGraw-Hill Education, 2001.

A9308 - Mechanics of Solids

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 will provide the fundamental background needed to understand the material behavior under various types of loads. This deals stress and strain concepts, axially loaded members, thermal, shear and bending stresses, deflections in beams, stresses in thin and thick cylinders under internal and external pressure. This course forms the basis for the study of advanced courses like Design of Machine Members, Finite Element Methods and Advanced Mechanics of Solids.

Course Pre/Co-requisites

A9303 - Engineering Mechanics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9308.1. Apply the fundamental concepts of stress, strain, and elastic constants to analyze bars of uniform and varying sections, composite members, and thermal stresses.
- A9308.2. Construct shear force and bending moment diagrams for various types of beams under different loading conditions and relate them to the rate of loading.
- A9308.3. Evaluate bending and shear stresses in beams of different cross sections and design simple beam sections for strength.
- A9308.4. Analyze principal stresses and strains using analytical methods and Mohr's circle, and apply theories of failure to predict safe loading conditions.
- A9308.5. Examine torsional behavior of shafts and stresses in thin and thick cylinders under internal and external pressures using torsion theory and Lamé's equations

Course Syllabus

Unit-I:

Simple stresses and strains: Elasticity and plasticity, Types of stresses and strains, Hooke's law, Stress – strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them, Bars of varying sections, Composite bars, Temperature stresses. Strain energy and Resilience: Gradual, sudden, impact and shock loadings.

Unit-II:

Shear Force and Bending Moment: Definition of beam, Types of beams, Concept of shear force and bending moment, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads and Uniformly Distribute Load, uniformly varying loads and combination of these loads, Point of contra flexure, Relation between S.F., B.M and rate of loading at a section of a beam.

Unit-III:

Flexural Stresses: Theory of simple bending, Assumptions, Derivation of pure bending equation, Determination of bending stresses. Section modulus for rectangular and circular sections of Solid and Hollow: I, T, Angle and Channel sections, Design of simple beam sections. **Shear Stresses:** Derivation of formula, Shear stress distribution across various beams sections: Rectangular, Circular, Triangular, I, T and Angle sections.

Unit-IV:

Principal Stresses and Strains: Introduction, Stresses on inclined sections of a bar under axial loading, Compound stresses, Normal and tangential stresses on an inclined plane for biaxial stresses, two perpendicular normal stresses accompanied by a state of simple shear, Mohr's circle of stresses, Principal stresses and strains, Analytical and graphical solutions. **Theories of Failure:** Introduction, Various theories of failure: Maximum Principal Stress Theory, Maximum Shear Stress Theory, Maximum Principal Strain Theory, Maximum Strain Energy Theory, Distortion Energy Theory (Von Mises Theory).

Unit-V:

Torsion of Circular Shafts: Theory of pure torsion, Derivation of Torsion equations, Assumptions made in the theory of pure torsion, Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion and end thrust. **Thick cylinders:** Derivation of formula for longitudinal and circumferential stresses hoop, longitudinal and volumetric strains, changes in diameter, and volume of thin cylinders. A thick cylinder lame's equation, cylinders subjected to inside and outside pressures.

Books and Materials

Text Books:

1. Ramamrutham, S. *Strength of Materials*, 19th ed., Dhanpat Rai Publications, 2023.
2. Timoshenko, S. P. *Strength of Materials*, vol. 1, 3rd ed., 2002.

Reference Books:

1. Rattan, S. S. *Strength of Material*, 3rd ed., Tata McGraw-Hill, 2017.
2. Bhavikatti, S. S. *Strength of Materials*, 5th ed., Vikas Publishing House, 2021.
3. Bansal, R. K. *Strength of Materials*, 10th ed., Laxmi Publications, 2007.
4. Popov, Egor P., and Toader A. Balan. *Engineering Mechanics of Solids*, 2nd ed., PHI Learning, 2010.

A9309 - Thermodynamics

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 engineering thermodynamics, focusing on the principles governing energy transformation and interaction in thermal systems. It introduces key thermodynamic concepts, including systems, properties, and processes, using both macroscopic and microscopic perspectives. Core topics include the First and Second Laws of Thermodynamics, energy and entropy analysis, and their application to both closed and open systems. Students will study the behavior of pure substances, phase changes, and steam properties, along with thermodynamic relations and property evaluation methods. The course culminates in the analysis of air-standard power cycles such as Otto, Diesel, Dual, Brayton, and Rankine cycles, with performance evaluation through pressure-volume and temperature-entropy diagrams.

Course Pre/Co-requisites

A9002 - Ordinary Differential Equations and Vector Calculus

A9007 - Engineering Physics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9309.1. Describe thermodynamic systems and processes using basic concepts and laws.
- A9309.2. Analyze steady and unsteady systems using the First Law of Thermodynamics.
- A9309.3. Apply Second Law to evaluate the efficiency of heat engine, refrigerator and heat pump.
- A9309.4. Interpret the behavior of pure substances and apply thermodynamic relations.
- A9309.5. Compare air standard power cycles in terms of thermal efficiency and performance.

Course Syllabus

Unit-I:

Basic Concepts: Macroscopic and microscopic approaches, thermodynamic systems, boundary, surroundings, thermodynamic property, intensive and extensive properties, concept of continuum, thermodynamic equilibrium, state, path, process and cycle, quasi static, reversible and irreversible processes, Energy and its forms, concepts of heat and work, equality of temperature and Zeroth Law of thermodynamics, thermodynamic temperature scales.

Unit-II:

First Law of Thermodynamics: First Law of Thermodynamics; internal energy and enthalpy; Perpetual Motion Machine of the First Kind (PMM-I); steady flow energy equation; application of the first law to non-flow and steady flow processes; throttling and free expansion processes; limitations of the first law of thermodynamics.

Unit-III:

Second Law of Thermodynamics: Kelvin-Planck and Clausius statements; heat engine, heat pump, and refrigerator; Perpetual Motion Machine of the Second Kind (PMM-II); Carnot cycle and Carnot heat engine; Carnot theorem and its corollaries; entropy; Clausius inequality; principle of entropy increase; availability and unavailable energy.

Unit-IV:

Properties of Pure Substances and Thermodynamic Relations: Properties of pure substances; phase transformation; saturated and superheated steam; solid-liquid-vapour equilibrium; dryness fraction; properties of dry, wet, and superheated steam; Mollier diagram. Maxwell's equations; Tds equations; difference in heat capacities; ratio of heat capacities; energy equation; Joule-Thomson effect; Clausius-Clapeyron equation.

Unit-V:

Power Cycles: Air standard cycles: Otto, Diesel, and Dual combustion cycles – description and representation on P-V and T-S diagrams; thermal efficiency; mean effective pressure on air-standard basis; comparison of cycles; Brayton cycle and Rankine cycle.

Books and Materials

Text Books:

1. Nag, P. K. *Engineering Thermodynamics*, 6th edition, McGraw Hill Education India, 2020.
2. Van Wylen, G. J., and R. E. Sonntag. *Fundamentals of Classical Thermodynamics*, 4th edition, Wiley (India), 1994.

Reference Books:

1. Çengel, Yunus A., Michael A. Boles, and Mehmet Kanoglu. *Thermodynamics: An Engineering Approach*, 10th edition, McGraw Hill Higher Education, 2025.
2. Jones, J. B., and R. E. Dugan. *Engineering Thermodynamics*, 1th edition, Prentice Hall of India, 2009.

A9310 - Production Technology 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 aim of this course is to conduct experiments chiefly encompass Metal casting, Welding, Press working and processing of Plastics. It inculcates knowledge and skill to the students starting from preparing a wooden pattern to completion of a casting which also comprises different Sand testing techniques. Also, students can understand broadly Welding and press working skills employed in Industries. One of the most outstanding features of plastics is the ease with which they can be processed. Production Technology lab also throws light on processing of plastics by Blow and Injection molding machines.

Course Pre/Co-requisites

A9302 - Engineering Workshop

Relevant Sustainable Development Goals (SDG(s))

SDG 8: Decent Work and Economic Growth

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:

- A9310.1. Demonstrate practical understanding of Moulding, melting and casting.
- A9310.2. Understand the Pattern design and making, casting drawing.
- A9310.3. Demonstrate practical understanding of Spot welding, TIG welding.
- A9310.4. Apply practical understanding of Hydraulic press, deep drawing and extrusion operation.
- A9310.5. Illustrate practical exposure of ARC welding lap and butt joint.

Course Syllabus

List of Experiments:

1. To prepare a wooden pattern of given model.
2. To determine the Compressive Strength of the Moulding Sand.
3. To test the permeability of given Moulding sand.
4. To Prepare a Casting for the given Solid Pattern using Sand Moulding Process.
5. To join the given two work pieces as a Lap Joint and Butt Joint using Arc welding process.
6. To join GI (Galvanized iron) sheets using Resistance spot welding.
7. To join given work pieces by using Gas welding Process.
8. To prepare Butt Joint Using Tungsten Inert Gas Welding process.
9. To conduct punching and blanking operations on sheet metal by using hydraulic press.
10. To prepare a V-shape bend on G.I sheet metal by using fly press.
11. To produce a component by using Injection Moulding machine.
12. To produce a Hollow component using Blow Moulding machine.

Laboratory Equipment/Software/Tools Required:

1. Wood turning lathe machine
2. Universal sand strength testing machine
3. Permeability test setup
4. Furnace and Foundry tools
5. Arc welding machine
6. Resistance spot welding
7. Oxyacetylene gas welding setup
8. TIG Welding Set Up
9. Hydraulic Press
10. Mechanical fly press
11. Injection moulding set up
12. Blow moulding machine

A9311 - Material Science and Mechanics of Solids 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 combined laboratory introduces students to mechanical and microstructural properties of engineering materials. It covers the testing of strength, hardness, impact, and deformation of materials under various load conditions, as well as the study of microstructures through metallographic techniques. The lab aims to develop skills in evaluating material behavior and understanding structure-property relationships essential for material selection and engineering design.

Course Pre/Co-requisites

A9303 - Engineering Mechanics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9311.1. Understand and evaluate material behaviour under axial and torsional loading.
- A9311.2. Analyse deflection and stiffness of structural members and springs.
- A9311.3. Assess material performance under compressive and impact loading.
- A9311.4. Investigate the crystallography and phase structures of steel and their influence on properties.
- A9311.5. Evaluate microstructural differences and their impact on hardenability and alloy behaviour.

Course Syllabus

List of Experiments:

A. Mechanics of Solids Experiments (Major Focus)

1. Tensile strength of mild steel using Universal Testing Machine.
2. Modulus of rigidity using Torsion Testing Machine.
3. Young's modulus and stiffness of a simply supported beam and cantilever beam.
4. Brinell Hardness Test and Rockwell Hardness of a given specimen.
5. Vickers Hardness Test of given metal specimen.
6. Charpy Impact Test and Izod Impact Test for toughness.
7. Spring test to find stiffness and modulus of rigidity.
8. Compressive strength test using a compression testing machine.

B. Materials Science & Metallurgy Experiments

9. Preparation and study of crystal models for simple cubic, body-centred and face-centred cubic structures.
10. Preparation and study of the microstructure of low, medium and high carbon steels.
11. Microstructure Analysis of Cast Irons and Non-Ferrous Alloys.
12. To determine the hardenability of steel using the Jominy end quench method.

Laboratory Equipment/Software/Tools Required:

1. Universal Testing Machine
2. Torsion Testing Machine
3. Simply supported beam apparatus
4. Cantilever beam apparatus
5. Brinell Hardness testing Machine
6. Rockwell Hardness testing Machine
7. Vicker's Hardness testing Machine
8. Impact testing Machine
9. Spring Testing Machine
10. Compression Testing Machine
11. Disc Polishing Machine
12. Metallurgical Sample specimen set
13. Belt grinder
14. Emery papers
15. Chemicals
16. Muffle Furnace
17. Jominy End Quench Test
18. Trinocular Metallurgical Microscope

A9511 – Python Programming 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 Python programming lab is designed to develop strong problem-solving and coding skills through hands-on practice. It starts with basic concepts like installation, simple output, and input handling to build a clear understanding of the language. Students learn to work with variables, operators, and expressions to perform computations and make logical decisions using conditional statements. Iteration techniques are practiced to solve problems like reversing numbers, factorials, and Fibonacci series. The lab strengthens skills in string handling, including slicing, searching, and transformations. Core Python data structures such as lists, dictionaries, tuples, and sets are explored to manage and process data effectively. Emphasis is placed on writing reusable code through user-defined functions, recursive calls, and lambda expressions. Students work with Python modules to handle tasks like date, time, and calendars. Error handling is introduced to ensure safe and reliable programs. The course concludes with file operations for creating, reading, appending, and summarizing data, preparing students for real-world applications.

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 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:

- A9511.1. Interpret basic programming constructs and control statements to solve simple computational problems
- A9511.2. Apply string operations and regular expressions to process and manipulate text.
- A9511.3. Make use of data structures lists, tuples, sets, and dictionaries to store and organize data effectively.
- A9511.4 Implement modular programming concepts using functions, modules, and file handling techniques.
- A9511.5 Develop applications using exception handling constructs to handle runtime errors in software applications.

Course Syllabus

Theory:

1. **Python Fundamentals and Control Statements:** Introduction to Python, Features of Python, Identifiers, Reserved Words, Data Types, Variables and Constants, Input / Output Statements, Conditional Statements – if, if-else, if-elif-else; Iterative Statements – for, while; Jump / Transfer Statements – break, continue, pass.

2. **Strings and Regular Expressions:** Strings: String Definition, Indexing, Slicing, Multiline Strings, Escape Sequences, String Formatting, Mathematical Operations on Strings, Checking Membership, Comparison, String Manipulation Techniques, String Immutability, Built-in String Functions and Methods. Regular Expressions: Pattern Matching, Search, Replace, Match Objects, Grouping.
3. **Functions, Modules:** Functions: Introduction, Function Definition, Function Call, Types of Arguments, Return Statement, Recursive Functions, Anonymous Functions (Lambda). Modules: Importing, Creating and Using Modules, Standard Libraries.
4. **Exception Handling and File Handling:** Exception Handling – Errors in Python, types of exceptions, try, except, else, finally blocks, raise keyword, custom exception classes. File Handling – Introduction, File Types, Opening and Closing Files, Reading and Writing in Text and Binary Files, File Modes and Methods (read(), readline(), write(), etc.), File Path Operations, Copy and Merge.

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 of 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.
 - 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.
 - d. Write a python program to print Fibonacci numbers.
 - e. Write a python program to display all prime numbers between 0 to n.
6. Programs using Strings and its Operations.
 - a. Write a program that asks the user to enter a string and perform the following:
 - i. 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 it 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.
7. Programs using Python Data Structures (Lists).
- 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.
8. Programs using Python Data Structures (Dictionary).
- a. Write a python program for demonstrating the creation of dictionary, accessing dictionary elements, modifying dictionary elements, finding length and possible operations.
 - b. Write a python program to create a dictionary of students with keys as roll numbers and values as names. Perform operations like insert, update and modify student data.
 - c. Write a Python program with the following requirements: Create a dictionary that stores 10 usernames as keys and their corresponding passwords as values. Prompt the user to enter a username and a password. Check the entered credentials and:
 - (i) If the username does not exist, display: "Not a valid user."
 - (ii) If the username exists but the password is incorrect, display: "Invalid password."
 - (iii) If both are correct, display: "Welcome".
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 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 that prints the calendar of a particular month.
 - c. Write a Python program to check whether a given year is a leap year or not using the calendar module.
12. Programs using 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 that asks for user input and converts it to an integer, with exception handling for invalid data.
13. Programs on File Handling.
 - a. Write a Python program to read a text file, handling File Not Found Error.
 - b. Write a Python program to count the number of lines, words, and characters, and then write the summary of a file to a new output file with exception handling.
 - c. Create a text file named `student_data.txt`.
 - d. Accept student details (roll number, name, marks) from the user and write them to the file.
 - e. Read and display the contents of the file.
 - f. Append new records to the same file and display the updated contents.

Laboratory Equipment/Software/Tools Required:

1. Computer Systems (PCs) installed with Ubuntu OS (Open source/ Freeware)
2. Jupyter notebook or Pycharm IDE, Python Run Time System

Books and Materials

Text Books:

1. Reema Thareja. *Python Programming using Problem solving Approach*, 3rd Edition Oxford University Press, New Delhi India, 2017.
2. Gowrishankar S., Veena A.. *Introduction to Python Programming*, 1st Edition, CRC Press, Boca Raton, Florida, USA, 2018..

Reference Books:

1. Charles R. Severance.. *Python for Everybody: Exploring Data Using Python 3*, 1st Edition, , CreateSpace Independent Publishing Platform, United States, 2016.
2. Timothy A Budd. *Exploring Python*, 8th Edition, Tata McGraw Hill, New Delhi, 2019.
3. Allen B. Downey. *Think Python: How to Think Like a Computer Scientist*, 2nd Edition, O'Reilly Media, California, USA, 2016

A9312 - Drafting and Modelling

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 covers essential concepts such as parametric and feature-based modeling, user interface navigation, mouse operations, file management, and the creation of drawing profiles, with a focus on its application in industries like automotive and aerospace. It introduces the Sketcher workbench, including profile tools, constraints, 3D projections, sketch operations, and analysis tools. Students then progress to part modeling, learning material addition/removal (Pad, Pocket, Shaft), fillets, chamfers, holes, patterns, and datum features. The course also covers multibody concepts like Boolean operations, transformations, and design automation through parameters, formulas, and design tables. Finally, it introduces surfacing for plastic components using advanced tools like trim, split, adaptive sweep, and multi-section surfaces.

Course Pre/Co-requisites

A9301 - Engineering Drawing

A9305 - Computer Aided Machine Drawing

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:

- A9312.1. Understand and Navigate CATIA Interface.
- A9312.2. Create and Constrain 2D Sketches to create detailed 2D sketches using profile and operation tools, apply geometric and dimensional constraints.
- A9312.3. Develop 3D Models of Machined Components for model complex parts using material addition and removal features.
- A9312.4. Apply Multibody and Boolean Techniques in design transformations, parameters, and design tables for advanced part design and automation.
- A9312.5. Design and Modify Surface Models for Plastic Components.

Course Syllabus

Unit-I:

Introduction to CATIA: Concept of Parametric Modelling, Feature Based Modelling, User Interface, Mouse operations, File types and Management, drawing profiles. Major user industries of Catia.

Unit-II:

Sketcher: Profile toolbar, operation (corner, chamfer, re-limitations, transformations, project 3D element), constraints, types of constraints, workbench. sketch tools, tools (Sketch solving status, sketch analysis, output feature), visualization toolbar, user selection filter.

Unit-III:

Modelling of Machined Component (Part Modelling): Material Addition and Removal (Pad, Pocket, Shaft, Groove), Sketch and Positioned Sketch, Types of Fillets, Types of Chamfer, Types of Hole. Pattern (Rectangular, Circular, User), Thread/Tap, Datum Features (Plane, Axes, Points), Advance Design features,

Unit-IV:

Multibody concept: Copy Paste, paste special, insert body, Boolean Operations (Add, remove, Intersect), Transformation (Translation, Mirror, Scaling, Affinity). Standard example, Negative body concept (Boolean Operations) Advance Features-Parameters, Formula, Relations, Design Table.

Unit-V:

Surfacing Modeling based Plastic Component: Environment, Tool bars, Surface Creation (Extrude, Revolve, Sphere, Cylinder), Surface Modification, Surface Editing (Trim, Split, Shape Fillet, Close Surface, Thickness). Adaptive Sweep, Sweep (ALL), Multi-section Surface.

Laboratory Equipment/Software/Tools Required

Software's Used: CATIA V5 R11 or Equivalent

Books and Materials

Text Books:

1. Tickoo, Sham. *CATIA V5-6R2018 for Designers*, CAD/CIM Technologies, 2018.
2. Tickoo, Sham. *CATIA V5R17: For Engineers & Designers*, Dreamtech Press, 2008.

Reference Books:

1. Okudan, Gul E. A Multi-Criteria Decision-Making Methodology for Optimum Selection of a Solid Modeller for Design Teaching and Practice." *Journal of Engineering Design*, vol. 17, no. 2, 2006, pp. 159-175.
2. Larsson, Martin, and Jesper Jonsson. Examination and Implementation of Knowledge Based Engineering in Clearance Analysis: A Study of External Stores and Its Compatibilities on the Gripen Aircraft 2019.

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

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:

- 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

A9004 – Probability Distributions and Statistics

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 an undergraduate foundation in both probability distributions and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in the field of multidisciplinary engineering applications. The mathematical skills sustained from this course form a suitable base to analytical and theoretical concepts encountered in engineering profession.

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:

- A9004.1. Identify an appropriate probability distribution for a given discrete or continuous random variable.
- A9004.2. Make use of probability distributions to analyze and solve a given problem.
- A9004.3. Interpret correlation coefficient and perform regression analysis to fit the best curve.
- A9004.4. Inspect scientific hypothesis and estimate confidence intervals at different levels.
- A9004.5. Compute P-value of a test statistic using component of hypothesis test.

Course Syllabus

Unit-I:

Random Variables: Discrete and Continuous random variables, Discrete Probability Distributions, Continuous Probability Distributions, Mean and Variance of Random Variables.

Unit-II:

Probability Distributions: Discrete distributions: Binomial distribution, Poisson distribution. Continuous distributions: Uniform distribution, Normal distribution, areas under the Normal Curve, applications of the Normal Distribution.

Unit-III:

Correlation and Regression: Scatter diagram, Positive and Negative correlation, limits for coefficient of Correlation, Karl Pearson's coefficient of correlation, Spearman's Rank correlation, Regression Analysis: Concept, two lines of regression, Properties of regression coefficients. **Curve Fitting:** Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of the form by the method of least squares.

Unit-IV:

Estimation and Testing of Hypothesis for Large samples: Point estimation, Maximum error estimate, Interval Estimation, Introduction to Hypothesis, Level of significance, one tailed and two tailed test, Test concerning one mean and one proportion, Two means and two Proportions.

Unit-V:

Testing of Hypothesis for Small samples: Test for single mean, difference of means and paired t-test, Test for ratio of variances (F-test), Chi-square test for goodness of fit and independence of attributes.

Books and Materials

Text Books:

1. Gupta, S.C. and Kapoor, V. K. *Fundamentals of Mathematical statistics* , 10th ed., S Chand & Sons, New Delhi, 2000.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye *Probability & Statistics for Engineers & Scientists* , 9th ed., Pearson Publishers, 2016.

Reference Books:

1. Grewal, B.S. *Higher Engineering Mathematics* , 43rd ed., Khanna Publications, 2015.
2. T.T. Soong *Fundamentals of Probability and Statistics for Engineers* , John Wiley & Sons, 2004.
3. Miller and Freund's *Probability and Statistics for Engineers* , 8th ed., Pearson Educations, 2011.

A9313 - Kinematics of Machinery

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 deals with the fundamental concepts and principles applied by engineers in the design of structures and to provide in-depth knowledge in basic mechanisms. It builds upon the mathematics and physics courses, extending to learn the systematic way of solving problems and kinematics to understand what happens to a body when force(s) is/are applied to it. It aims also to engage students to understand the different methods of obtaining a mechanism and utilize analytical, mathematical and graphical aspects of kinematics for effective design.

Course Pre/Co-requisites

A9303 - Engineering Mechanics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9313.1. Identify the principles of kinematic links, pairs, and their classification, Inversions and planar mechanisms.
- A9313.2. Select planar four bar and slider crank mechanisms for specified kinematic conditions.
- A9313.3. Analyze the planar mechanisms for position, velocity and acceleration.
- A9313.4. Choose the cams and followers for specified motion profiles.
- A9313.5. Evaluate gear tooth geometry and select appropriate gears for the required applications.

Course Syllabus

Unit-I:

Mechanisms: Elements or Links, Classification, Rigid Link, flexible and fluid link, Types of kinematic pairs, sliding, turning, rolling, screw and spherical pairs, lower and higher pairs, closed and open pairs, constrained motion completely, partially or successfully constrained and incompletely constrained.

Machines: Mechanism and machine, kinematic chain, inversion of mechanism, inversions of four bar chain, Beam Engine, Coupling rod of a locomotive, Watt's indicator mechanism inversions of single slider crank chain - Pendulum pump, Oscillating cylinder engine, Rotary I.C. Engine, Crank and slotted lever quick return motion mechanism, Whitworth quick return motion mechanism and inversions of double slider crank chain- Elliptical trammel, Scotch yoke mechanism, Oldham's coupling.

Unit-II:

Straight Line Motion Mechanisms: Straight line motion - Exact and approximate straight line mechanisms and its types, Peaucellier, Hart and Scott Russel, Grasshopper, Watts, Tchebicheff and Robert Mechanisms and Pantograph. Kinematics: Velocity and acceleration, Motion of link in machine, Determination of Velocity and acceleration diagrams, Graphical method, Application of relative velocity method four bar chain.

Plane Motion of Body: Instantaneous center of rotation, centroids and axodes, relative motion between two bodies, three centre's in-line theorem, Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

Unit-III:

Analysis of Mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider, Acceleration diagram for a given mechanism, Klein's construction, Introduction to Coriolis acceleration. **Steering Mechanisms:** Conditions for correct steering, Davis Steering gear, Ackerman's steering gear, velocity ratio. Hooke's Joint: Single and double Hooke's joint, Universal coupling, application, simple problems.

Unit-IV:

Cam's and Followers: Definitions of cam and followers, their uses, Types of followers and cams, Terminology, Types of follower motion, Uniform velocity, Simple harmonic motion and uniform acceleration and retardation Displacement, Velocity and acceleration diagrams. Construction of Cam profiles- Cam with knife edge follower, roller follower and flat faced follower. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Unit-V:

Higher Pairs: Friction wheels and toothed gears, types, law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding, phenomena of interferences, Methods of interference. Introduction to Helical, Bevel and worm gearing. **Gear Trains:** Introduction, Train value, Types, Simple, Compound and reverted wheel train, Epicyclic gear Train. Methods of finding train value or velocity ratio.

Books and Materials

Text Books:

1. Rattan, S. S. *Theory of Machines and Mechanisms*, 4th edition, Tata McGraw-Hill Education, 2017.
2. Bevan, Thomas. *Theory of Machines*, 3rd edition, CBS Publishers, 2012.

Reference Books:

1. Singh, V. P. *Theory of Machines*, 3rd edition, Dhanpat Rai & Co, 2019.
2. Bansal, R. K. *Theory of Machines*, 6th edition, Laxmi Publications, 2022.
3. Norton, R. L. *Kinematics and Dynamics of Machinery*, 2nd edition, Tata McGraw-Hill Education, 2019.
4. Ghosh, A. and Mallick, A. K. *Theory of Mechanisms and Machines*, 3rd edition, Affiliated East-West Press, 1998.
5. Khurmi, R. S. and Gupta, J. K. *Theory of Machines*, 14th edition, S. Chand Publishing, 2016.
6. Lal, Jagadish. *Theory of Mechanisms and Machines*, 2nd edition, Metropolitan Book Co., 2006.

A9314 - Thermal Engineering - 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 introduces the working principles and analysis of Internal Combustion (IC) engines, air compressors, and gas turbines. Students will explore thermodynamic cycles, combustion processes, and energy conversion mechanisms relevant to thermal systems. Emphasis is placed on cycle analysis, performance testing, and compressor and turbine operations, forming a foundation for advanced thermal system design.

Course Pre/Co-requisites

A9309 - Thermodynamics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9314.1. Interpret the operating principles and classification of IC engines and assess losses in actual cycles with respect to ideal cycles.
- A9314.2. Differentiate combustion characteristics and influencing variables in SI and CI engines, including modern ignition and injection systems.
- A9314.3. Examine engine test results and derive performance parameters using standard measurement techniques and heat balance analysis.
- A9314.4. Compute the work input and efficiency of reciprocating and centrifugal air compressors under different operating conditions.
- A9314.5. Evaluate the performance and efficiency of gas turbines by analyzing Brayton cycle improvements and material considerations.

Course Syllabus

Unit-I:

IC Engines: Classification and working principles of IC engines; valve timing and port timing diagrams; air-standard and actual cycles – time loss factor, heat loss factor, exhaust blowdown loss, volumetric efficiency and losses due to rubbing friction; supercharging and turbocharging – working principles and applications; introduction to exhaust emissions and emission norms.

Unit-II:

Combustion in IC Engines: Combustion in SI engines – normal and abnormal combustion, importance of flame speed and effect of engine variables, types of abnormal combustion, pre-ignition and knocking, fuel requirements and fuel rating, anti-knock additives, combustion chamber – requirements and types; combustion in CI engines – stages of combustion, delay period and its significance, effect of engine variables, diesel knock, need for air motion, types of combustion chambers, types of nozzles used, fuel requirements and fuel rating;

modern ignition systems – electronic ignition and spark timing control; multipoint fuel injection (MPFI) and common rail direct injection (CRDI) systems.

Unit-III:

Testing and Performance of IC Engines: Performance parameters – indicated power, brake power, friction power, thermal efficiency and mechanical efficiency; measurement of cylinder pressure, fuel consumption, air intake and exhaust gas composition; preparation of performance test report and heat balance sheet.

Unit-IV:

Air Compressors: Classification of air compressors; reciprocating compressors – principle of operation, work required, isothermal efficiency, volumetric efficiency, effect of clearance volume, multistage compression with intercooling and minimum work condition; centrifugal compressors – constructional details, principle of operation, velocity and pressure variation, impeller blade shape, slip factor, air power input factor, pressure and adiabatic coefficients, velocity diagrams and power required.

Unit-V:

Gas Turbines: Simple open cycle gas turbine plant and ideal Brayton cycle; actual cycle with losses; cycle improvements through regeneration, intercooling and reheating; optimum pressure ratio for maximum efficiency; materials for turbine blades and blade cooling techniques.

Books and Materials

Text Books:

1. Ganesan, V. *Internal Combustion Engines*, 4th edition, Tata McGraw Hill Education, 2012.
2. Rathore, M. M. *Thermal Engineering*, 23rd edition, Tata McGraw Hill Education, 2021.

Reference Books:

1. Heywood, John B. *Internal Combustion Engine Fundamentals*, 2nd edition, McGraw Hill Education, 2018.
2. Mathur, M. L. and Sharma, R. P. *IC Engines*, 8th edition, Dhanpat Rai Publications, 2010.
3. Rajput, R. K. *Thermal Engineering*, 8th edition, Laxmi Publications, 2010.

A9315 - Fluid Mechanics and Hydraulic Machines

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 objective of this course is to equip students with fundamental knowledge of fluid mechanics, including fluid properties, pressure measurement, and flow characteristics. It covers the principles of fluid statics, kinematics, and dynamics, along with energy and momentum equations. The course also introduces concepts of closed conduit flow, flow measurement devices, and the impact of jets. Additionally, it provides insights into the working and performance of hydraulic turbines and pumps. By the end of the course, students will be able to analyze and design efficient fluid systems and hydraulic machines used in various engineering applications.

Course Pre/Co-requisites

A9303 - Engineering Mechanics

Relevant Sustainable Development Goals (SDG(s))

SDG 6: Clean Water and Sanitation

SDG 9: Industry, Innovation, and Infrastructure

SDG 13: Climate Action

Course Outcomes

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

- A9315.1. Utilize the laws of fluid statics to estimate pressure using instruments such as piezometers and differential manometers.
- A9315.2. Examine various flow regimes by evaluating streamline behavior and applying energy and momentum principles.
- A9315.3. Determine pressure losses in piping networks using theoretical formulas like Darcy-Weisbach and recognize losses in compound flows.
- A9315.4. Interpret the interaction of jets with vanes through velocity diagrams and compute the power transmitted and efficiency.
- A9315.5. Use operational concepts to evaluate the efficiency and functionality of hydraulic turbines and pumping systems.

Course Syllabus

Unit-I:

Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - Vapor pressure and their influence on fluid motion-atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

Unit-II:

Fluid dynamics: Fluid kinematics: Streamline, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows. Fluid dynamics: Surface and body forces – Euler’s and Bernoulli’s equations for flow along a streamline, momentum equation and its application on force on pipe bend.

Unit-III:

Impact of jets: Closed conduit flow: Reynold's experiment, Darcy-Weisbach equation, Minor losses in pipes, pipes in series and pipes in parallel, total energy line and hydraulic gradient line. Measurement of flow: Pitot tube, venturi meter and orifice meter. Impact of jets: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Unit-IV:

Hydraulic turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, Performance of turbines.

Unit-V:

Hydraulic pumps: Classification, Centrifugal pumps: working, work done – manometric head - losses and efficiencies specific speed - performance characteristic curves. Reciprocating pumps: Working, Classification, Discharge, slip.

Books and Materials

Text Books:

1. Modi, P. N. and Seth, S. M. *Hydraulics and Fluid Mechanics including hydraulic machines*, 21st edition, RajSons Publications, 2017.
2. Som, S. K. and Biswas, G. *Introduction to Fluid Mechanics and Fluid Machines*, 3rd edition, Tata McGraw Hill Education, 2012.

Reference Books:

1. White, Frank M. *Fluid Mechanics*, 8th edition, McGraw Hill Education, 2016.
2. Munson, Bruce R., et al. *Fluid Mechanics*, 8th edition, John Wiley & Sons, 2021.
3. Kumar, D. S. *Fluid Mechanics and Fluid Power Engineering*, 9th edition, S. K. Kataria & Sons, 2020.

A9316 - Metrology and Machine Tools

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

Course Description

Course Overview

The purpose of this course is to learn about the machines like lathe, shaper, slotter, planer, milling machine, drilling machine, grinding machine etc. This course helps the students to operate the machines and to do machining for different applications. Students will come to know about metal cutting theory, different cutting tools and tool angles also. In metrology student will learn basics of linear and angular measurement instruments, Surface roughness, limits and tolerances etc.

Course Pre/Co-requisites

A9307 - Production Technology

Relevant Sustainable Development Goals (SDG(s))

SDG 8: Decent Work and Economic Growth

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:

- A9316.1. Utilize precision measuring instruments to ensure dimensional accuracy.
- A9316.2. Execute fundamental machining operations on lathes and milling machines.
- A9316.3. Operate and maintain various machine tools for specific tasks.
- A9316.4. Apply quality control and alignment techniques to achieve high-precision outputs.
- A9316.5. Analyze and verify the surface finish of a component using instruments like a surface roughness tester, and relate the results to the machining process used.

Course Syllabus

Unit-I:

Theory of Metal Cutting: Basic definitions: cutting speed, feed and depth of cut, orthogonal and oblique cutting, classification of cutting tools, Geometry of Single Point Cutting tool, chip formation and Types of chips. Merchant's circle diagram, forces acting on a single point cutting tool in turning, stress, strain and work done in cutting process. Problems related to cutting speed, feed and depth of cut.

Unit-II:

Machine Tools: Principle of lathe, types of lathe, different operations on lathe machine, Capstan and Turret lathe, Single spindle and multi-spindle automatic lathes, Shaping, Slotting and Planing Machines-principle of working, Different operations on Shaping and Planing machines. Milling Machines-Types of milling machines, different operations on milling machine.

Unit-III:

Drilling and Boring Machines: Principle of working, Types of Drilling and Boring machines, Different Operations performed using Drilling machines. Grinding Machines, selection of a grinding wheel, Types of Grinding machines, Operations on Grinding machines, Tool and Cutter Grinding machine.

Unit-IV:

Limits, fits and tolerances: Types of Fits - Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly, Design of go and No go gauges. Screw Thread Measurement, Errors in Screw threads, measurement of effective diameter, angle of thread and pitch.

Unit-V:

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Machine Tool Alignment Tests on Lathe, Milling, and Drilling Machines. Coordinate Measuring Machines- Types of CMM and Applications of CMM.

Books and Materials

Text Books:

1. Bewoor, Anand K. and Kulkarni, Vinay A. *Metrology and Measurement*, 1st edition, Tata McGraw Hill Education, 2009.
2. Rao, P. N. *Manufacturing Technology: Volume II - Metal Cutting and Machine Tools*, 4th edition, McGraw Hill Education, 2018.

Reference Books:

1. Jain, R. K. *Production Technology*, 17th edition, Khanna Publishers, 2019.
2. Jain, R. K. *Engineering Metrology*, 21th edition, Khanna Publishers, 2019.
3. Boothroyd, Geoffrey, et al. *Fundamentals of Metal Machining and Machine Tools*, 3rd edition, CRC Press, 2022.

A9317 - Fluid Mechanics and Hydraulic Machines Laboratory

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

Course Description

Course Overview

This course mainly deals with the behaviour of fluids and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

Course Pre/Co-requisites

A9303 - Engineering Mechanics

Relevant Sustainable Development Goals (SDG(s))

SDG 6: Clean Water and Sanitation

SDG 9: Industry, Innovation, and Infrastructure

SDG 13: Climate Action

Course Outcomes

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

- A9317.1. Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
- A9317.2. Correlate various flow measuring devices such as Venturimeter and orifice meter.
- A9317.3. Discuss the performance characteristics of turbines and pumps.
- A9317.4. Estimate energy losses and boundary layer parameters for laminar and turbulent flows.
- A9317.5. Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.

Course Syllabus

List of Experiments:

1. Calibration of Venturi meter.
2. Calibration of Orifice meter.
3. Determination of friction factor in a given pipe line.
4. Determination of loss co-efficient due to sudden contraction.
5. Verification of Bernoulli's theorem.
6. Determination of the nature of flow through a pipe (Reynold's experiment).
7. Determination of the efficiency of vane using Impact of jet on Vane Setup.
8. Determination of the operating characteristics of Pelton wheel turbine.
9. Determination of the operating characteristics of Francis Turbine.
10. Determination of the operating characteristics of Kaplan Turbine.
11. Determination of the efficiency of Single Stage Centrifugal Pump.
12. Determination of the efficiency of Multi Stage Centrifugal Pump.
13. Determination of the efficiency of Reciprocating Pump.

Laboratory Equipment/Software/Tools Required:

1. Venturimeter and Orifice meter setup
2. Major and Minor Losses in pipes setup
3. Bernoulli's theorem verification setup
4. Reynolds Apparatus
5. Impact of jet on vane setup
6. Pelton turbine test rig
7. Francis turbine test rig
8. Kaplan Turbine test rig
9. Single Stage Centrifugal Pump test rig
10. Multi Stage Centrifugal Pump test rig
11. Reciprocating Pump test rig

A9318 - Thermal Engineering 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 testing and analyzing various internal combustion engines and compressors. Students will conduct performance, motoring, heat balance, and Morse tests on single and multi-cylinder petrol and diesel engines. The course includes practical evaluation of engine timing through valve and port timing diagrams. It also covers disassembly/assembly of engines and viscosity measurement using a viscometer. Emphasis is placed on understanding engine performance, efficiency, and mechanical behavior through laboratory experimentation.

Course Pre/Co-requisites

A9309 - Thermodynamics

Relevant Sustainable Development Goals (SDG(s))

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:

- A9318.1. Analyze the performance characteristics of a diesel engine through load, motoring, and heat balance tests.
- A9318.2. Evaluate the efficiency of various petrol engines including two-stroke, four-stroke, and VCR engines.
- A9318.3. Interpret power measurement results from Morse and Compressor tests to determine output and efficiency.
- A9318.4. Draw and examine valve and port timing diagrams to understand engine operation and phase relationships.
- A9318.5. Perform mechanical diagnostics including engine dismantling and viscosity testing using standard instruments.

Course Syllabus

List of Experiments:

1. To conduct the Performance Test on Single Cylinder 4 Stroke Diesel Engine.
2. To conduct the Motoring Test on Single Cylinder 4-Stroke Diesel Engine.
3. To conduct the Heat Balance test on Single Cylinder 4-Stroke Diesel Engine.
4. To conduct the Performance Test on Single Cylinder 2-stroke Petrol Engine.
5. To conduct the Performance Test on Single Cylinder 4-stroke Petrol Engine.
6. To conduct the Performance Test on Single Cylinder 4-stroke Variable Compression Ratio (VCR) Petrol Engine.
7. To conduct the Morse Test on Multi Cylinder 4-stroke Petrol Engine.

8. To conduct the Performance Test on twin Cylinder Reciprocating Air Compressor.
9. To draw Valve Timing Diagram for Single Cylinder 4-stroke diesel engine.
10. To draw Port Timing diagram for Single Cylinder 2-stroke petrol engine.
11. Disassembly/assembly of Single Cylinder 4-stroke diesel engine.
12. To calculate viscosity of given oil using Redwood viscometer.

Laboratory Equipment/Software/Tools Required:

1. Single Cylinder 4-stroke Diesel Engine test rig
2. Single Cylinder 2-stroke Petrol Engine test rig
3. Single Cylinder 4-stroke Petrol Engine test rig
4. Single Cylinder 4-stroke VCR Petrol Engine test rig
5. Multi Cylinder 4-stroke Petrol Engine test rig
6. Single Cylinder 4-Stroke VCR Petrol Engine test rig
7. Twin Cylinder Reciprocating Air Compressor test rig
8. Single cylinder 4-stroke diesel engine cut model
9. Single cylinder 2-stroke petrol engine cut model
10. Single Cylinder 4-stroke diesel engine (old) for assembly and disassembly
11. Redwood Viscometer

A9319 - Metrology and Machine Tools 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

Metrology and Machine Tools Laboratory is a hands-on course designed to equip students with foundational skills in precision measurement and machining operations. The course focuses on the use of mechanical measuring instruments like vernier calipers, micrometers, bore gauges, and surface roughness testers to ensure dimensional accuracy and quality control. Students will gain practical experience in performing alignment tests on machine tools such as lathes and milling machines, and execute operations including turning, threading, drilling, grinding, and gear profiling. The curriculum bridges theoretical concepts from Production Technology with real-world applications, emphasizing safety, precision, and efficiency in machining processes. By the end of the course, students will be proficient in using metrology tools, maintaining machine tools, and producing components with high dimensional and surface finish standards.

Course Pre/Co-requisites

A9307 - Production Technology

Relevant Sustainable Development Goals (SDG(s))

SDG 8: Decent Work and Economic Growth

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:

- A9319.1. Develop proficiency in precision measurement techniques and dimensional inspection.
- A9319.2. Apply alignment testing and surface quality to maintain and improve machine tool performance.
- A9319.3. Develop hands-on skills in performing various turning, tapering, threading, and knurling operations on a lathe machine.
- A9319.4. Practical exposure on flat surface machining, drilling and grinding operations.
- A9319.5. Understand different machining techniques to produce Gear Profiles, key ways with desired shapes.

Course Syllabus

List of Experiments:

1. Applications of vernier calipers, micrometer, Bore gauge and height gauge.
2. Machine tool alignment test on the lathe and milling machine.
3. Tool maker's microscope and its application.
4. Measurement of effective diameter of screw thread by using two wire and three wire method.
5. Surface roughness measurement by using Taly Surf surface roughness tester.
6. Determine the angle of work piece by using Sine Bar.
7. To perform step turning, taper turning, Thread cutting and knurling operations using lathe machine.
8. To perform drilling and tapping operations using drilling machine.

9. To perform different types of milling operations using milling machine.
10. To perform grinding operations using cylindrical and surface grinding machines.
11. To perform planing operation using planing machine.
12. To perform shaping and key way machining by using Shaper and slotting machine.

Laboratory Equipment/Software/Tools Required:

1. Vernier calipers, micrometer, Bore gauge and height gauge
2. Dial indicator, mandrel, spirit level, straight edge
3. Tool makers Microscope
4. Micrometer with two wire and three wire setup
5. Taly Surf surface roughness tester
6. Sine bar, slip gauges and dial indicator
7. Lathe machine
8. Drilling machine
9. Milling machine
10. Cylindrical grinding machine and surface grinding machine
11. Planing machine
12. Shaping machine

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.

A9320 - Rapid Prototyping

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-oriented course offers a comprehensive introduction to Rapid Prototyping (RP) with a strong emphasis on Additive Manufacturing (AM) techniques using polymer and ceramic 3D printers. Students will gain hands-on experience in the end-to-end workflow of 3D printing—from CAD modelling and slicing, through printing and post-processing, to dimensional and mechanical evaluation of printed parts. The course covers FDM/FFF processes for both polymers and ceramics, providing foundational knowledge of AM technologies, materials, hardware setup, and troubleshooting. Through structured lab sessions and a mini project, learners will develop practical skills in design validation, functional part fabrication, and material-specific post-processing methods including sintering of ceramics. This course is designed to build rapid prototyping competencies for applications in product development, biomedical design, tooling, and research environments.

Course Pre/Co-requisites

A9301 - Engineering Drawing

A9305 - Computer Aided Machine Drawing

Relevant Sustainable Development Goals (SDG(s))

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:

- A9320.1. Understand the principles and workflow of rapid prototyping technologies.
- A9320.2. Operate polymer and ceramic 3D printers for part fabrication.
- A9320.3. Prepare 3D CAD models and slice them for printing.
- A9320.4. Post process printed parts (for both polymer and ceramics).
- A9320.5. Evaluate dimensional accuracy and mechanical performance of printed parts.

Course Syllabus

Unit-I:

Introduction to Rapid Prototyping and Overview of RP types: History and evolution of rapid prototyping, Introduction to Rapid Prototyping, Subtractive manufacturing, Comparison of subtractive vs additive manufacturing, Generalized AM process chain, Applications in product development, manufacturing, and research, Fused Deposition Modelling (FDM) – principles & workflow, materials, process benefits and drawbacks, Fused Filament Fabrication (FFF) for polymers and ceramics, Other common processes (VAT Photo polymerization, Laser Powder Bed Fusion, Directed Energy Deposition, Binder Jetting, material jetting, sheet lamination – brief overview), Advantages, limitations, and selection criteria.

Unit-II:

CAD Modelling & Slicing for 3D Printing, FDM Hands on: Basics of 3D CAD modelling (Solid-Works/Fusion 360/AutoCAD), File formats (.STL, .OBJ, .3MF) and repair tools, Slicing software (Ultimaker Cura, Flash Forge Flash Print, Prusa Slicers, Setting printing parameters: layer height, infill, temperature, speed for polymer printers, Printer hardware setup and calibration, Loading filament and setting material parameters, Printing a simple prototype part, Troubleshooting common printing issues (warping, stringing, under extrusion).

Unit-III:

Ceramic 3D Printing: FFF Workflow: Ceramic filament types & material preparation, principles and working mechanism for ceramic printing, extruder, green part, Sonication process for ceramic slurry/filament homogenization, Printing ceramics using FFF process, Handling green bodies (pre sintered ceramic parts), Sintering furnace, sintering properties.

Unit-IV:

Post Processing for Ceramic & Polymer Prints, Testing and Applications: Polymer post processing: sanding, chemical smoothing, painting, Ceramic post processing: drying, debinding, and sintering furnace operation, Safety measures in handling ceramics and high temperature equipment, Dimensional accuracy measurement (vernier calliper, micrometre, 3D scanner – if available), Mechanical property evaluation (basic strength tests), Case studies: biomedical implants, tooling, functional parts, Rapid prototyping for design validation.

Unit-V:

Mini Project & Assessment: Design → Print → Post process → Evaluate a functional part (polymer or ceramic), Presentation & viva on process workflow and challenges faced.

Books and Materials

Text Books:

1. Gibson, Ian, et al. *Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*, 2nd edition, Springer, 2015.
2. Chua, Chee Kai, and Kah Fai Leong. *3D Printing and Additive Manufacturing: Principles and Applications*, 5th edition, World Scientific Publishing, 2017.

Reference Books:

1. Chua, C.K., Leong, K.F., and Lim, C.S. *Rapid Prototyping: Principles and Applications*, 3rd edition, World Scientific Publishing, 2010.
2. Gebhardt, Andreas. *Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing*, 2nd edition, Hanser Publishers, 2019.
3. Liou, Frank W., and Liou, Liwei W. *Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development*, 2nd edition, CRC Press, 2019.
4. Noorani, Rafiq. *Rapid Prototyping: Principles and Applications*, 1st edition, John Wiley & Sons, 2006.

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.