Four-Year Undergraduate Programme

Bachelor of Technology in Automobile Engineering

Faculty of Engineering & Technology

Parul University Vadodara, Gujarat, India

Faculty of Engineering & Technology

Bachelor of Technology in Automobile Engineering

1. **Vision of the Department**
   To contribute for building the next generation technical excellence in the field of Automobile Engineering to serve the society globally by taking care of nature.

2. **Mission of the Department**

- **M1-** To offer the culture of application based lifelong learning amongst faculty, staff and students for better solutions of materials, designs, operations, services, manufacturing and managerial issues.
- **M2-** To be interactive with industries to work upon live projects in the mutual benefit of industry and academia.
- **M3-** To produce ethically strong and morally elevated human resource to serve mankind.
- **M4-** To provide environment for multidimensional development through curricular, co-curricular and extracurricular activities**.**

3. **Program Educational Objectives**

The statements below indicate the career and professional achievements that the B.Tech. Automobile Engineering curriculum enables graduates to attain.

PEO 1	Pursue successful career in engineering involving professional knowledge and skills for analysis, design and solution of real time engineering problems.
PEO 2	Excel in professional career with sound fundamental knowledge and pursue life-longlearning including higher education and research.
PEO 3	Demonstrate interpersonal skills, leadership ability and team building to achieveorganization goals and serve society with professional ethics and integrity.

4. **Program Learning Outcomes**

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	**Engineering knowledge:**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solutionof complex engineering problems.
PLO 2	**Problem analysis:**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated

		Conclusions using the first principles of mathematics, naturalsciences, and engineering sciences.
PLO 3	**Design/development of solutions:**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PLO 4	**Conduct investigations of complex problems:**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PLO 5	**Modern tool usage:**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	**The engineer and society:**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	**Environment and sustainability:**	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	**Ethics:**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	**Individual and team work:**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	**Communication:**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	**Project management and finance:**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work,

		as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	**Life-long learning:**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	**Social and Environmental Consciousness, Ethical Responsibility, and Entrepreneurial Excellence**	Graduates will be able to understand the social-awareness and environmental wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an entrepreneur.
PSO 2	**Cultivation of Professional Passion**	Graduates have nurtured their hobbies which are useful in their specific chosen career.

6. Credit Framework

Semester wise Credit distribution of the Programme	
Semester-1	22
Semester-2	20
Semester-3	23
Semester-4	19
Semester-5	24
Semester-6	22
Semester-7	22
Semester-8	15
Total Credits:	**167**

Category wise Credit distribution of the Programme	
Category	**Credit**
Major Core	98
Minor Stream	12
Multidisciplinary	24
Ability Enhancement Course	8
Skill Enhancement Courses	5
Value added Courses	2
Summer Internship	4
Research Project/Dissertation	14
Total Credits:	**167**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
1	303104101	Elements of Civil Engineering	4	3	0	2
2	303104155	Mechanics of Solids	4	3	0	2
3	303106101	Basic Electrical Engineering	4	3	0	2
4	303109101	Engineering Graphics	4	2	0	4
5	303191101	Mathematics-I	4	4	0	0
6	303193103	Communication Skills	2	0	2	0
Total			**22**	**15**	**2**	**10**
Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
7	303100101	Workshop	2	0	2	0
8	303104105	Environmental Science (Audit Course)	0	1	2	0
9	303105102	Programming for Problem Solving	4	3	2	0
10	303109102	Elements of Mechanical Engineering	4	3	2	0
11	303191151	Mathematics-II	4	4	0	0
12	303192101	Engineering Physics-I	4	3	0	0
13	303193152	Advanced Communication & TechnicalWriting	2	0	0	2
Total			**19**	**13**	**20**	**14**
Semester 3						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
14	303102202	Product Realization	1	0	0	2
15	303109201	Thermodynamics	4	3	1	0

16	303109203	Material Engineering	3	3	0	0
17	303109204	Material Engineering Lab	1	0	0	2
18	303109205	Manufacturing Processes	3	3	0	0
19	303109206	Manufacturing Processes Lab	1	0	0	2
20	303109207	Kinematics and Theory of Machines	3	3	0	0
21	303109208	Kinematics and Theory of Machines Lab	1	0	0	2
22	303191204	PDE, Probability and Statistics	4	4	0	0
23	303193203	Professional Communication Skills	2	0	2	0
Total			**22**	**15**	**23**	**16**
Semester 4						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
24	303102251	Vehicle Structural Engineering	2	2	0	0
25	303109251	Metrology and Instrumentation	3	3	0	0
26	303109252	Metrology and Instrumentation	1	0	0	2
27	303109253	Fluid Mechanics and Machines	3	3	0	0
28	303109254	Fluid Mechanics and Machines Lab	1	0	0	2
29	303109255	Manufacturing Technology	3	3	0	0
30	303109256	Manufacturing Technology Lab	1	0	0	2
31	303109257	Strength of Materials	4	3	1	0
Total			**20**	**15**	**1**	**0**
Semester 5						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
32	303102301	Automobile Engines	3	3	0	0
33	303102302	Automobile Engines Lab	1	0	2	0
34	303102303	Automobile Powertrains and Systems	3	3	0	0
35	303102304	Automobile Powertrains and Systems Lab	1	0	2	0
36	303102305	Electric and Hybrid Vehicles	3	3	0	0

37	303102306	Electric and Hybrid Vehicles Lab	1	0	2	0
38	303102307	Fundamentals of Heat Transfer	3	3	0	0
39	303102308	Fundamentals of Heat Transfer Lab	1	0	2	0
40	303102310	Summer Internship - I	2	0	0	1
41	303193304	Professionalism & Corporate Ethics	1	0	0	0
42		Open Elective 01	2	2	0	0
43		Open Elective 01	2	2	2	0
44		PEC 01	3	3	0	0
Total			**25**	**17**	**26**	**19**

Open Elective 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Tut	Lab
1	303101331	Basic Aircraft Science	2	2	0	0
2	303104311	Disaster Preparedness and Planning	2	2	0	0
3	303105304	Cyber Security	2	2	0	0
4	303105305	Internet of Things	2	2	0	0
5	303107346	Fundamentals of CommunicationEngineering	2	2	0	0
6	303109346	Renewable Energy Sources	2	2	0	0

PEC 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Tut	Lab
1	303102331	Optimization Techniques	3	3	0	0
2	303102333	Design of Experiments	3	3	0	0
3	303102335	Computational Methods	3	3	0	0

Semester 6

Sr. No.	Subject Code	Subject Name	Credit	Lect	Tut	Lab

45	303102351	Vehicle Operation Management	3	3	0	0
46	303102352	Vehicle Operation Management Lab	1	0	0	2
47	303102353	Automobile Components Design	4	3	1	0
48	303102355	Automotive HVAC	3	3	0	0
49	303102356	Automotive HVAC Lab	1	0	0	2
50	303102357	Dynamics of Automotive Systems	3	3	0	0
51	303102358	Dynamics of Automotive Systems Lab	1	0	0	2
52	303102360	Project - I	1	0	0	2
53	303193353	Employability Skills	1	0	1	0
54		PEC 02	2	2	0	0
55		Open Elective 02	2	2	0	0
Total			22	16	2	8

PEC 02

Sr. No.	Subject Code	Subject Name	Credit	Lect	Tut	Lab
1	303102381	Combustion and Emission Technology	2	2	0	0
2	303102383	Technomanagerial Practices and Mobility Engineering	2	2	0	0
3	303102385	Vibration and Noise Management	2	2	0	0
4	303102387	Automotive Certification and Homologation	2	2	0	0

Open Elective 02

Sr. No.	Subject Code	Subject Name	Credit	Lect	Tut	Lab
1	303100351	Programme Management and Entrepreneurship	2	2	0	0
2	303100352	Life Sciences	2	2	0	0
3	303100353	Fundamentals of Management	2	2	0	0
4	303100354	Constitution of India	2	2	0	0
5	303100355	Engineering Economics	2	2	0	0

6	303105392	Cyber Law and Ethics	2	2	0	0
Semester 7						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
56	303102401	Vehicle Dynamics	3	3	0	0
57	303102402	Vehicle Dynamics Lab	1	0	0	2
58	303102403	Computer Aided Design and Manufacturing	3	3	0	0
59	303102404	Computer Aided Design and Manufacturing Lab	1	0	0	2
60	303102406	Summer Internship - II	2	0	0	0
61	303102408	Project - II	6	0	0	12
62		PEC 03	2	2	0	0
63		PEC 03-LAB	1	0	0	2
64		PEC 04	3	3	0	0
Total			22	11	0	18
PEC 03						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
1	303102432	Alternative Fuel and Power System Lab	1	0	0	2
2	303102434	Special Purpose Vehicles Lab	1	0	0	2
3	303102436	Modern Automotive Control System Lab	1	0	0	2
4	303102438	Manufacturing Processes for Automotive Components Lab	1	0	0	2
PEC 03-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
1	303102432	Alternative Fuel and Power System Lab	1	0	0	2
2	303102434	Special Purpose Vehicles Lab	1	0	0	2

3	303102436	Modern Automotive Control System Lab	1	0	0	2
4	303102438	Manufacturing Processes for Automotive Components Lab	1	0	0	2
PEC 04						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
1	303102439	Vehicle Surveying and Loss Assessment	3	3	0	0
2	303102441	Nanostructures and Nanomaterials	3	3	0	0
3	303102443	Waste and Energy Management	3	3	0	0
4	303102445	Tribology in Vehicle Design	3	3	0	0
5	303102447	Industry 4.0 Technologies for Automobile	3	3	0	0
Semester 8						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
65	303102452	Project - III	6	0	0	12
66	303102453	Automobile System Design	4	3	1	0
67	303102455	Transport Management and Laws	2	2	0	0
68		PEC 05	3	3	0	0
		Total	15	8	1	12
PEC 05						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Tut**	**Lab**
1	303102481	Operations Research in Automotive Industries	3	3	0	0
3	303102485	Automotive Product Design and Manufacturing	3	3	0	0
4	303102487	Industrial Engineering, Safety and Quality Management	3	3	0	0
		Total	**167**			

Semester 1

a. **Course Name:** Elements of Civil Engineering
b. **Course Code:** 303104101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Basic Civil Engineering knowledge is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Define and recall the branches of civil engineering, the scope of the field, and the societal role of civil engineers.
CLOBJ 2	Explain the primary divisions of surveying, articulate fundamental surveying principles, and differentiate between types of graphical scales.
CLOBJ 3	Apply methods of linear measurements, use chaining instruments, and demonstrate proficiency in chain surveying.
CLOBJ 4	Analyse errors in chaining, correct tape measurements, and assess obstacles in the chaining process.
CLOBJ 5	Synthesize levelling principles, apply methods of levelling, and compute reduced levels using both HI and rise & fall methods.
CLOBJ 6	Evaluate foundation types based on different soil conditions and make decisions on suitable foundations for various scenarios.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate a comprehensive understanding of the branches of civil engineering, its scope, and the role of civil engineers in society.
CLO 2	Explain the primary divisions in surveying, fundamental principles, and the classification of surveying methods.
CLO 3	Apply various methods of linear measurements and use appropriate instruments in chaining and chain surveying.
CLO 4	Analyze the different types of compasses, compute angles, and correct bearings for local attraction in compass traversing.
CLO 5	Synthesize knowledge of levelling principles and instruments, record observations, and compute reduced levels using different methods.
CLO 6	Evaluate the importance of foundations, analyze different types of foundations, and make informed decisions based on site requirements.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage	Teaching hours
1	**INTRODUCTION:** Branches of Civil Engineering, Scope of CivilEngineering, Role of Civil Engineering Society, Impact of infrastructural development on economy of the country.	5%	2
2	**SURVEYING:** Object and Uses of Surveying, Primary Divisions in Surveying, Fundamental Principles of Surveying, Classification of Surveying, Plans and Maps, Scales, Types of Graphical Scales, Units of Measurements.	5%	2
3	**LINEARMEASUREMENTS:** Methods of Linear Measurements, Instruments used in Chaining, Chain Surveying, Ranging, Obstacles in Chaining, Errors in Chaining & Corrections, TapeCorrections, Conventional Symbols.	10%	4
4	**ANGULARMEASUREMENTS:** Types of Compass, Method of Using aCompass, Bearing & It's Measurements, Whole Circle Bearing and Reduced Bearing, Computation of Angles, Types of meridians and bearings, Declination and DIP, Compass traversing and correction of bearings for Local Attraction, Chain and Compass Surveying Field Work	12%	5
5	**LEVELING:** Aim sand applications, Definition of various terms, Instruments for levelling, Methods of levelling, Recording observations in level-book, Computing reduced levels by HI and rise & fall method.	12%	6
6	**MAPPING AND CONTOURING:** Mapping, Contours, Characteristics of contours of different terrains and application of contour maps, Methods of Contouring	6%	2

7	**MINOREQUIPMENTSANDMODERNTOOLSOFSURVEYING:** Introduction to Theodolite, Electromagnetic Distance MeasuringInstruments, Total Station, Global Positioning System, Remote sensing, Geographical Information System (GIS).	5%	2

8	**BUILDINGPLANNING:** Elements of a Building, Basic Requirements of a Building Planning, Planning Suitable Orientation, Planning for Energy Efficiency, Planning for Suitable Utility, Planning for Meeting Other Requirements	5%	2
9	**FOUNDATIONS:** Importance and necessity of Foundation, Conventional Spread Footings, R.C.C. Footings, Grillage Footing, Arch Foundation, Pile Foundations, Foundations in Black Cotton Soil	8%	4
10	**SUPERSTRUCTURES:** Types of Structures Based on the Method of Load Transfer, Building components and their functions and nominal dimensions.	7%	3
11	**DAMPNESSANDITSPREVENTION:** Causes of Dampness, Ill effects of Dampness, Requirements of an Ideal Material for Damp Proofing, Materials for Damp Proofing, Methods of Damp Proofing.	5%	2
12	**TRADITIONAL BUILDING MATERIALS:** Introduction, Types and Properties of Stones, Bricks, Lime, Cement, Timber.	5%	3
13	**MORTARS:** Introduction, Properties of Cement Mortar, Lime Mortar, Mud Mortar, Special Mortar, Tests on Mortar.	5%	2
14	**CONCRETE:** Introduction, Types and Properties of Plain Concrete, Reinforced Cement Concrete (R.C.C.), Reinforced Brick Concrete (RBC), Prestressed Concrete (PSC), Pre-cast concrete.	5%	3
15	**MISCELLANEOUS BUILDING MATERIALS:** Introduction, Types and Properties of Glass, Plastics, Bitumen, Asbestos, Paints, Distempers, Varnishes, Solid and Hollow Concrete Blocks, Roofing and Flooring Tiles	5%	3
	Total	100%	45

i. Text Book and Reference Book:

1. Surveying Vol. I By Dr. B. C. Punmia, Ashokkumar Jain, Arunkumar Jain | Laxmi Publication | 16th Edition.
2. Surveying and Leveling By R. Subramanian | Oxford University.
3. Elements of Civil Engineering By Dr. R.K. Jain and Dr. P.P. Lodha | McGraw Hill Education India Pvt. Ltd.
4. Building Construction and Construction Material By G.S.Birdie and T.D. Ahuja | Dhanpat Rai Publishing.
5. Basics of Civil Engineering (Textbook) By S S Bhavikatti | New Age International Publishers.

j. List of Experiments:

Exp. No.	Name of the Experiment
1	Introduction to Surveying instruments
2	Chaining and offset taking with the help of Chain and Tape
3	Compass Surveying
4	Simple Levelling with the help of Dumpy Level and Staff
5	Differential Levelling with the help of Dumpy level and Staff
6	Study of Theodolite
7	Study of Theodolite
8	Conventional Signs & Symbols in sketch Book
9	Plan, Elevation and section of simple Residential Building
10	Construction Site Visit
11	Different Types of Sketches of Substructure and superstructure in Sketch-Book

a. **Course Name:** Mechanics of Solids
b. **Course Code:** 303104155
c. **Prerequisite:** System of units, Laws of motion, Basic idea of force, Concept of centroid Fundamentals of stress, strain and their relationships
d. **Rationale:** Mechanics of Solids is conceptual applications of principles of mechanics in Engineering.

e. **Course Learning Objective:**

CLOBJ 1	Comprehend the concepts of stress, strain, and deformation in solid materials under various loading conditions, and apply this understanding to analyse structural behaviour.
CLOBJ 2	Gain insight into the mechanical properties of materials such as elasticity, plasticity, and failure mechanisms, and their implications in designing resilient and safe structures.
CLOBJ 3	Analyse structural components, including beams, columns, and trusses, under different loading scenarios using principles of mechanics of solids, determining stresses, and deformations.
CLOBJ 4	Develop proficiency in constructing shear force and bending moment diagrams to understand internal forces and moments in structural elements, crucial for design and analysis.
CLOBJ 5	Calculate deflections and assess stability criteria for structural elements, recognizing critical conditions that impact structural integrity and safety.
CLOBJ 6	Apply principles of mechanics of solids to design structural elements, ensuring they meet safety standards, considering factors such as material selection, loading conditions, and design codes.

f. **Course Learning Outcomes:**

CLO 1	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of Engineering.
CLO 2	Determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.
CLO 3	Apply principles of statics to determine reactions & internal forces in statically determinate beams.
CLO 4	Know basics of friction and its importance through simple applications.
CLO 5	Understand behaviour & properties of engineering materials.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION:** Forces/Equilibrium of Rigid body, Scalar and vectors, system of forces,resultant force, Statics of particles. Free-body diagrams. Equilibrium ofparticle in two dimensions, Resultants of three or more concurrent forces, Resolution of a force into components. Rectangular components of a force. Resultants by rectangular components, Concurrent force system in space: Resolution of a force into rectangular components in space, Coplanar Non-Concurrent Force Systems, Moments about Points and Axes, Equilibrium, Non-coplanar Non-concurrent Forces.	15%	6
2	**CENTROID MOMENT OF INERTIA:** Distributed forces: Centroid and centre of gravity. Determination of centroid of lines and areas using integral technique, Determination of centroid of composite wires and areas, Centroid of volumes. Theorems of Pappus-Guldinus and its applications, Second moment of areas, Definition of moment of inertia. Determination of moment of areas by integration, Parallel axis theorem for Moment of Inertia. MI of composite areas, Concept of Mass moment of inertia of bodies.	15%	10
3	**BEAMS:** Definitions, types of beams, types of loading, types of supports. Determination of reactions for simply, Supported and overhanging beams. Relation between distributed load, Shear force and BendingMoment, Shear force and Bending moment in beams with diagrams	20%	10
4	**FRICTION:** The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Analysis of systems involving dry frictions such as ladders spheres etc.,Belt Friction, Analysis of flat and v-belt.	25%	10

5	**SIMPLE STRESSES & STRAINS:** Basics of stress and strain: 3-D state of stress (Concept only), Normal/axial stresses: Tensile & compressive Stresses: Shear andcomplementary shear Strains, Linear, shear, lateral, thermal and volumetric. Hooke's law,Elastic Constants: Modulus of elasticity, Poisson's ratio.	25%	9
	Total	100%	45

i. Text Book and Reference Book:

1. "Statics and Dynamics" Beer, F.P. and Johnston, E.R. Vector mechanics for engineers; Tata McGraw-Hill
2. "Engineering Mechanics: Statics and Dynamics" J.A Desai and B.B Mistry; Popular Prakashan
3. "Engineering Mechanics: Statics and Dynamics", R.C Hibbeler; Prentice Hall of India
4. "Engineering Mechanics: Statics and Dynamics "S Rajsekaran; Vikas Publication
5. "Engineering Mechanics" S.S. Bhavikatti and K. G. Rajashekarappa; Wiley 'Eastern Ltd
6. "Engineering Mechanics", J.L. Meriam, and L.G.Kraige; John Wiley and sons, New York Signals and Systems" by Simon Haykin and Barry Van Veen.

j. List of Experiments:

Exp. No.	Name of the Experiment
1	Equilibrium of Coplanar-Concurrent force system (Law of Parallelogram of forces) by analytical method
2	Equilibrium of Coplanar-Concurrent force system (Law of Parallelogram of forces) by graphical method
3	Equilibrium of Coplanar-Concurrent force system (Law of Polygon of forces) by analytical method
4	Equilibrium of Coplanar-Concurrent force system (Law of Polygon of forces) by graphical method
5	Equilibrium of Coplanar non-concurrent forces (theory)
6	Equilibrium of Coplanar non-concurrent forces (performance)
7	Theorem Equilibrium of parallel force system - Simply Supported Beam
8	Verification of principle of the moment: Bell crank lever
9	Determination Coefficient of static friction (theory)

Exp. No.	Name of the Experiment
10	Determination Coefficient of static friction (performance)
11	Brinell Hardness test
12	Izod impact test
13	Compression test on timber
14	Transverse test on Timber
15	Tensile test on mild steel

a. **Course Name:** Basic Electrical Engineering
b. **Course Code:** 303106101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12^{th} science level
d. **Rationale:** Basic Electrical Engineering knowledge is fundamental as it provides a strong foundation for various engineering disciplines, promotes problem-solving skills, supports innovation, and opens doors to diverse career opportunities.
e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with electrical current, potential difference, power and energy,sources of electrical energy and elements of electrical circuit.
CLOBJ 2	Solve problems related to Alternating current, alternating voltage, etc, Demonstrate a clear understanding of Pure R, L C circuit and combination of RLC, Series and Parallel combination of R, L and C, etc
CLOBJ 3	Acquire knowledge of the resistor, capacitor, and inductor and their performance characteristics for series and parallel connections.
CLOBJ 4	Understand different single phase and three phase circuits.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principlesand applications of transformer, DC machines and AC machines.
CLOBJ 6	Study the use of LT Switch Gear, Fuse, MCB, ELCB etc

f. **Course Learning Outcomes:**

CLO 1	Understand electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.
CLO 2	Solve basic electrical circuit problems using various laws and theorems
CLO 3	Understand the role of resistor, capacitor and inductor and their performance characteristics for series and parallel connections.
CLO 4	Discuss three phase-balanced circuits.
CLO 5	Understanding the basic concepts and working principles of transformers, DC machines and AC machines.
CLO 6	Acquire knowledge about electrical installations

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

1. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**DC Circuits** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Mesh and Node analysis, Simplifications of networks using series and parallel combinations and star-delta conversions. Superposition, Thevenin and Norton Theorems.	22%	10
2	**AC Circuits** Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors, examples based on theory. Study of A.C. circuits consisting of pure resistance, pure inductance, pure capacitance and corresponding voltage-current phasor diagrams and waveforms. Development of the concept of reactance, the study of series R-L, R-C, R-L-C circuit and resonance, study of parallel R-L, R-C and R-L-C circuit, concept of impedance, admittance, conductance and susceptance in case of above combinations and relevant voltage-current phasor diagrams, the concept of active, reactive and apparent power and power factor, examples based on theory. Concept of three-phase supply and phase sequence. Voltages, currents and power relations three-phase have balanced star-connected loads and delta-connected loads along with phasor diagrams, Power and power factor measurement in balanced three-phase circuits (one, two and three wattmeter methods), examples based on theory.	33%	15

3	**Transformers** Magnetic effect of an electric current, right-hand thumb rule, Concept of m.m.f., flux, flux density, reluctance, permeability and field strength, their units and relationships, comparison between electrical and magnetic parameters. Fleming's left-hand rule. self and mutual inductance, Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.	20%	9
4	**Electrical Machines** Construction, working and application of DC Motor and Generator. Generation of 3 phase rotating magnetic fields, Construction and working of a three-phase and Single-phase induction motor and its types. Construction and working of Synchronous generator.	15%	7
5	**Electrical Installations** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	10%	4
	Total	100%	45

2. Text Book and Reference Book:

I. Electrical Engineering Fundamentals, By V. D. Toro, Prentice Hall India, Pub. Year 1989
II. Basic Electrical Engineering, By D. C. Kulshreshtha, McGraw Hill
III. Fundamentals of Electrical Engineering, By Leonard S. Bobrow, Oxford University Press, Pub. Year 1996
IV. Electrical and Electronics Technology, By E. Hughes Pearson, Pub. Year 2010
V. Basic Electrical Engineering, By D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, Pub. Year, 2010
VI. A textbook of Electrical Technology Volume 1&2, By B. L. Theraja, S. ChandPublication

3. List of Experiments:

Sr. No.	Experiment List
1	To Study about Various Electrical andElectronics Symbols and demonstrate various measuring instruments used inBasic electrical Engineering laboratory.
2	To Perform and Solve Electrical Networks with Series and Parallel Combinations of Resistors UsingKirchhoff ’s Laws.
3	To Obtain Capacitance, Power and Power Factor of the Series RL Circuit with AC Supply Using Phasor Diagram.
4	To Obtain Capacitance, Power and Power Factor of the Series RC Circuit with AC Supply Using Phasor Diagram.
5	To Obtain Capacitance, Power and Power Factor of the Series RLC Circuitwith AC Supply Using Phasor Diagram.
6	Verification of superposition theoremwith dc source
7	Verification of Thevenin's theorem with dc source
8	Verification of Norton's theorems in dccircuits
9	Verification of Current and VoltageRelations in Three Phase Balanced Star and Delta Connected Loads.
10	Find out the Efficiency and VoltageRegulation of Single Phase Transformer by Direct Load Test.

a. **Course Name:** Engineering Graphics
b. **Course Code:** 303109101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12^{th} science level
d. **Rationale:** "Engineering Graphics" course Provide students with a comprehensive foundation in the fundamental principles and concepts that form the backbone of mechanical engineering for various Engineering disciplines.
e. **Course Learning Objective:**

CLOBJ 1	Identify and name common drafting tools and their uses.
CLOBJ 2	Interpret engineering drawings and symbols.
CLOBJ 3	Demonstrate the ability to create accurate engineering drawings using industry-standard software.
CLOBJ 4	Solve engineering design problems by applying geometric and spatial concepts.
CLOBJ 5	Generate accurate and professional engineering drawings independently.
CLOBJ 6	Design and create 3D models of engineering components using computer-aided design (CAD) tools.

f. **Course Learning Outcomes:**

CLO 1	Identify and recall common drafting tools and their uses.
CLO 2	Interpret and explain engineering drawings and symbols.
CLO 3	Demonstrate the application of industry-standard software to create accurate engineering drawings.
CLO 4	Solve engineering design problems by applying geometric and spatial concepts.
CLO 5	Generate accurate and professional engineering drawings independently.
CLO 6	Design and create 3D models of engineering components using computer-aided design (CAD) tools.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
2	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION TO ENGINEERING GRAPHICS** Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Introduction to Drawing Standards BIS-SP-46, Representative Fraction, Types of Scales (Plain and Diagonal Scale), Dimensioning Terms and Notations,Types of Arrowheads, Lines, Lettering, Numbering and Dimensioning	5%	2
2	**ENGINEERING CURVES:** Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves - Conics, Spirals, Involutes and Cycloids with Tangents and Normal	10%	5
3	**PRINCIPLES OF PROJECTIONS:** Types of Projections - Oblique, Perspective, Orthographic and Isometric Projections; Introduction to Principal Planes of Projections, Projections of Points located in all four Quadrants; Projections of lines inclined to one of the Reference Plane and inclined to two Reference Planes.	10%	4
4	**PROJECTIONS OF PLANES:** Projections of various planes – Polygonal, Circular and Elliptical shape inclined to one of the Reference Plane and inclined to two Reference Planes; Concept of Auxiliary Plane of Projections.	10%	4
5	**PROJECTIONS OF SOLIDS AND SECTIONS OF SOLIDS:** Classifications of basic Solids, Projections of Solids - Right Regular Prism, Pyramid, Cone, Cylinder, Tetrahedron and Cube inclined to one of the Reference Plane and inclined to two Reference Planes; Frustum of Prism, Pyramid and Cone inclined to one of the Reference Plane; Types of Cutting Planes - Auxiliary Inclined Plane, Auxiliary Vertical Plane, Horizontal Cutting Plane, Profile Cutting Plane; Sections of Solids resting on H.P/V.P and Inclined to only one of the Reference Planes; Sectional Views, True Shape of the Sections	20%	10
6	**DEVELOPMENT OF SURFACES:** Methods of Development of Lateral Surfaces of Right Regular Solids, Parallel Line Development and Radial Line Development, Applications of Development of Surfaces.	10%	5

7	**ORTHOGRAPHIC PROJECTIONS:** Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection method; Full Sectional Orthographic Views – Side and Front, Offset Cutting views	15%	0
8	**ISOMETRIC VIEW/DRAWING AND ISOMETRIC PROJECTIONS:** Conversion of Orthographic Views into Isometric Projection, View or Drawing; Isometric Scale.	15%	0
9	**OVERVIEW OF COMPUTER AIDED DRAFTING TOOL:** Introduction to Computer Aided Drafting Software; Preparation of Orthographic Projections and Isometric Views Using Drafting Software	5%	0
	Total	100%	30

i. Text Book and Reference Book:

1. Engineering Drawing N.D. Bhatt & V.M. Panchal; Charotar Publishing House
2. ENGINEERING GRAPHICS P. J. Shah; S. Chand & Co., New Delhi Publications.
3. Graphic Science and Design French, T.E. Vierck, C.J & Foster; Tata McGraw HillPublications.
4. Fundamentals of Engineering Drawing Luzadder; W. J & Duff Prentice Hall Publications.
5. Engineering Drawing and Graphics Venugopal k; New Age International PrivateLimited Publishers.

a. **Course Name:** Mathematics-I
b. **Course Code:** 303191101
c. **Prerequisite:** Knowledge of Mathematics up to 12^{th} science level
d. **Rationale:** The Mathematics I syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and matrix algebra, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Develop a deep understanding of first-order linear and nonlinear PDEs,including the application of Charpit's Method. Proficiently solve second and higher-order linear PDEs using complementary function and particular integral methods. Apply separation of variables method to solve problems in Cartesian coordinates.
CLOBJ 2	Apply PDEs to model and analyse physical phenomena such as heat conduction, wave propagation, and electrostatics. Gain proficiency in formulating initial and boundary conditions and solve problems related to the Heat, Wave, and Laplace equations. Utilize visualization tools to interpret and communicate results.
CLOBJ 3	Comprehend and apply fundamental probability concepts, including probability spaces, conditional probability, and independence. Analyse and solve problems involving discrete random variables, the multinomial distribution, Poisson approximation, and infinite sequences of Bernoulli trials. Explore the properties of continuous random variables, distribution functions, and densities, with a focus on normal, exponential, and gamma distributions.
CLOBJ 4	Develop statistical analysis skills covering basic statistics, measures of central tendency, and probability distributions (Binomial, Poisson, and Normal). Evaluate statistical parameters for these distributions. Perform correlation and regression analyses, including rank correlation. Apply the method of least squares for curve fitting, specifically for straight lines, second-degree parabolas, and more general curves.
CLOBJ 5	Apply probability and statistics concepts to real-world scenarios. Analyse and interpret statistical data to draw meaningful conclusions. Use probability theory to make informed predictions and decisions in various fields.
CLOBJ 6	Enhance problem-solving and critical thinking skills through the application of mathematical and statistical methods. Demonstrate the ability to approach complex problems systematically, analyse them, and arrive at logical solutions.

f. **Course Learning Outcomes:**

CLO 1	Develop understanding of fundamental mathematical concepts
CLO 2	Formulate and solve mathematical models for real-world engineering problems,
CLO 3	Integrate knowledge from different mathematical topics to analyse and solve complex engineering problems
CLO 4	Critically analyse mathematical results, interpret their engineering significance, and make informed decisions based on mathematical outcomes, fostering a deeper understanding of the subject.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Improper Integral & Application of Definite Integral:** Evaluation of definite and improper integrals, Beta and Gamma functions and their properties Area bounded by curves in Cartesian and Polar form, Area of a region bounded by function, Area of a region bounded by curves in Parametric form, Volume by slicing, Volume of solid by revolution.	8%	5
2	**First order Ordinary Differential equation:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, Applications	15%	9
3	**Matrices:** Matrices & Determinants with Properties, Linear Independence, Rank of Matrix, System of Linear Equations, Consistency of System, Solution of system of Linear Equations by Gauss Jordan and Gauss-Elimination Method, Eigen values, Eigenvectors, Symmetric, Skew-symmetric, and orthogonal Matrices, Eigen bases, Diagonalization, Cayley Hamilton Theorem and its Applications, Diagonalization, Orthogonal Transformation, Quadratic form.	25%	15
4	**Sequences and Series:** Basic of Sequences, Bounded and Monotonic Sequences, Series, Convergence of sequence and series, Geometric series, P- series, Cauchy's Integral Test, Comparison Test, Alternating Series, Absolute and Conditional convergence, Ratio test, Cauchy's Root Test, Power series, Taylor's and Maclaurin's series.	17%	10
5	**Fourier Series:** Fourier Series of 2 periodic functions, Dirichlet's conditions for representation by a Fourier series, Fourier Series of a function of period 2, Fourier Series of even and odd functions, Half range series.	10%	6
6	**Multivariable Calculus (Differentiation):** Functions of Several Variables, Limit, Continuity, Partial Derivatives, Homogeneous function, Euler's Theorem for homogeneous function, Modified Euler's Theorem, Chain Rule, Implicit function, Jacobian, Tangent plane and Normal line, Maximum and Minimum Values, Lagrange's Multiplier, Taylor's and Maclaurin's Series for functions of two variables.	25%	15

Total	100%	60

i. Text Book and Reference Book:

1. "Calculus and Analytic Geometry", (Textbook), By G.B. Thomas and R.L. Finney, Addison Wesley
2. "Calculus with early transcendental functions", By James Stewart, Cengage Learning
3. "Higher Engineering Mathematics" By B. S. Grewal, Khanna Publication.

a. **Course Name:** Communication Skill
b. **Course Code:** 303193103
c. **Prerequisite:** Knowledge of English Language studied till 12th standard
d. **Rationale:** Basic Communication Skills are essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will demonstrate the ability to communicate ideas clearly and effectively
CLOBJ 2	Students will develop strategies for building positive interpersonal relationships, fostering effective collaboration and teamwork.
CLOBJ 3	Students will develop active listening skills, including the ability to comprehend, interpret, and respond appropriately to spoken messages.
CLOBJ 4	Students will exhibit proficiency in written communication, crafting clear, concise, and well-organized messages across various formats (emails, reports, memos, etc.).
CLOBJ 5	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content, and confident delivery.
CLOBJ 6	Students will understand and utilize various digital communication tools and platforms, demonstrating proficiency in virtual communication.

f. **Course Learning Outcomes:**

CLO 1	Understand the importance of creative and critical thinking.
CLO 2	Expand vocabulary with proper pronunciation.
CLO 3	Comprehend the basics of English grammar.
CLO 4	Read & write effectively for a variety of contexts.
CLO 5	Develop confidence in speaking skills.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	-	-	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Crazy Scientist**: • The students will be taught the importance of invention and innovation using some examples that changed the world theway it worked.	5%	2
2	**Phonetics**: • IPA Introduction (listening tracks) • Phonic Sounds • Pronunciation Practice including transcription	10%	4
3	**Vocabulary Building & Word Formation Process**: • Compounding, clipping, blending, derivation, creative respelling, coining and borrowing • Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided)	10%	2
4	**Speaking Activity: Role plays on Critical Thinking (Life boat)** • This activity topic gears towards making students do role play based on various scenarios. • It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it. • It aims to improve students' convincing skills.	10%	4
5	**Picture Description & Picture Connector** • Enable students to use vocabulary and useful expression to describe the picture. • In this class the students will be trained to form logical connections between a set of pictures which will be shared with them. • This geared towards building creativity and presentation skills.	15%	2
6	**Mine Activity: Usage of Preposition**: • Students will learn to use proper propositions by active participation in the activity.	8%	2
7	**Worksheets on Identifying Common Errors in Writing:** • Sentence structure • Punctuations • Subject-Verb Agreement • Noun-Pronoun Agreement	12%	2
8	**Reading Skills**: • The art of effective reading and its various strategies to be taught to the learners and practice exercises be given on reading comprehension.	10%	2

9	**Speech and spoken Exchanges; Extempore**: • Students will learn the correct usage of spoken language as different from the written form. It will help the students in extempore speech. • This will be done by making the students give variety of impromptu speeches in front of the class: 1 minute talk on simple topics. • To change the average speakers in the class to some of the best Orator.	10%	4
10	**Book Review**: • The learners will identify the central idea of the book, author's style and approach towards the book. • This will enable the learners to express their point of view and hone their creativity and writing skills.	10%	4
11	**Activity Session** • This will enhance the creative thinking among students. • To develop their interpersonal communication skills.	0%	2
	Total	100%	30

i. Text Book and Reference Book:

1. "Understanding and Using English Grammar", Betty Azar & Stacy Hagen; Pearson Education
2. "Business Correspondence and Report Writing ", SHARMA, R. AND MOHAN, K.
3. "Communication Skills", Kumar S and Lata P; New Delhi Oxford University Press
4. "Technical Communication: Principles and Practice" Sangeetha Sharma, Meenakshi Raman; Oxford University Press
5. "Practical English Usage MICHAEL SWAN
6. "A Remedial English Grammar for Foreign Student", F.T. WOOD
7. "On Writing Well", William Zinsser; Harper Paperbacks,2006; 30th anniversary edition

"Oxford Practice Grammar", John Eastwood; Oxford University Press

Semester 2

a. **Course Name:** Environmental Science (Audit Course)
b. **Course Code:** 303104105
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and Biology up to 10th science level
d. **Rationale:** Basic knowledge of the environment is essential for all human beings for a good life and sustainable existence
e. **Course Learning Objective:**

CLOBJ 1	Apply systems thinking to analyse the city as a system, demonstrating application
CLOBJ 2	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 3	Identify sources and stressors of water resources, demonstrating understanding
CLOBJ 4	Analyse the causes, effects, and control measures of population explosion

f. **Course Learning Outcomes:**

CLO 1	Understand the interrelation and interdependency of organisms and their interactions with the environment
CLO 2	Identify eco-friendly measures in engineering projects
CLO 3	Understand preventive steps for environmental protection.
CLO 4	Act as a responsible individual who is aware of efficient usage of resources and securing sustainable development

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**0**	**0**	**0**	**-**	**50**	**-**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**ENVIRONMENTAL HEALTH, ECOLOGY AND QUALITY OF LIFE** Environmental education: Objective and scope, Impact of technology on the environment, Environmental disasters: Case studies, Global environmental awareness to mitigate stress on the environment, Structure and function of an ecosystem, Ecological pyramids, Pyramid of number, Pyramid of energy and pyramid of biomass.	25%	7
2	**POLLUTION PREVENTION** Air & Noise pollution - Sources & their Effects, Case studies of Major Catastrophes, Structure and composition of the atmosphere, Water, Soil, Marine, Thermal & Marine Pollution: The story of fluoride contamination, Eutrophication of lakes, control measures, Measuring water quality: Water quality index, Waste water treatment (general) primary, secondary and tertiary stages, Municipal Solid waste management: Sources and effects of municipal waste, Biomedical waste, Hazardous waste	20%	6
3	**POPULATION GROWTH, GLOBAL ENVIRONMENTAL CHALLENGES & LATEST DEVELOPMENTS** Population Explosion - Causes, Effects and Control, an International initiative in population-related issues, Urbanization, Growth of the world's large cities, Water resources: Sources of water, Stress on water resources, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Variation in concentrations of GHG gases in ambient air during last millennium, Role of Environmental Information System (ENVIS) in India and similar programs run by EPA(USA), Role of soft tools like Quantum GIS, Autodesk Building Information Modelling (BIM) and City Finance Approach to Climate-Stabilizing Targets (C- FACT), Life Cycle Assessment, Bioinformatics and Optimization tools for sustainable development.	25%	7
4	**SMART CITIES** **Introduction to smart cities -** about smart cities, what is a smart city, world urbanization, case studies of Songdo, Rio De Janeiro, what makes cities smart.	30%	10

	City as a system of systems – Introduction, systems thinking, Milton Keynes Future Challenges, Rich picture as city challenges, Wicked problems, Development of **smart city approach –** core elements, open data, sustainability, privacy and ethics, development processes. **Smart Citizens –** their role, engaging citizens, IES Cities, Energy systems, Approaches for Citizen Engagement, co-creating smart cities, cities unlocked, living labs, city problems, crowdsourcing ideas, redesigning cities for citizens, all age-friendly cities, mobility on demand, motion maps. **Infrastructure, Technology and Data –** urban infrastructure and its technology, future of lighting, IoT, connected objects, sensing the city, NOx eating paints and air quality sensors, safest, smart citizen kit, sensing your city, Sensored City, Cyber security for data power, open, shared and closed data, satellite data, open data revolution, Smart City Project Data **Innovation –** smart innovations, smart city ecosystem, data-driven innovations for smart cities **Standards and Capacity Building –** the role of Standard, BSI smart city Standards, HyperCat, ITU Smart Sustainable cities, Smart City Readiness, Lessons Learnt from Amsterdam **Smart Measurements -** metrics and indicators, city indicators, WCCD data portal, value proposition, integrated reporting, smart city learning and education, urban data school.		
	Total	100%	30

i. Text Book and Reference Book:

1. "Environmental Studies For Undergraduate Courses",(TextBook),By Dr Erach Bharucha | Orient BlackSwan | Second Edition, Pub. Year 2013.
2. "Basics of Environmental Studies", By U K Khare, Tata McGraw Hill
3. "Environmental Studies" By Anindita Basak, Drling Kindersley (India)Pvt. Ltd Pearson
4. "Environmental Sciences", By Daniel B Botkin & Edward A Keller, John Wiley & Sons
5. "Air Pollution", By M N Rao, H. V N Rao, McGraw Hill Publishing Company Limited, New Delhi
6. "Environmental Engineering" By Howard S. Peavy, Donald R. Rowe, George Tchobanoglous | McGraw-Hill

a. **Course Name:** Programming for Problem Solving
b. **Course Code:** 303105102
c. **Prerequisite:** Requires Basic Knowledge of Computer
d. Rationale: This course is design to provide basic ideas of computer programming. This course also makes help to understand programming language. It will help to develop their logical abilities.
e. **Course Learning Objective:**

CLOBJ 1	Recognize and recall fundamental principles and organizations of computers, demonstrating a foundational understanding of computer architecture and design.
CLOBJ 2	Comprehend the concepts of computer programming languages, illustrating a grasp of syntax, semantics, and the essential components of programming languages.
CLOBJ 3	Develop algorithms for solving basic engineering problems, demonstrating the ability to apply theoretical knowledge to practical problem-solving scenarios.
CLOBJ 4	Demonstrate proficiency in the practical application of C programming by writing, compiling, and debugging programs, showcasing the ability to implement and troubleshoot code effectively.
CLOBJ 5	Evaluate and analyse complex computational programs written in C, demonstrating the capacity to assess and understand intricate solutions to computational challenges.
CLOBJ 6	Develop simple projects using the C programming language, showcasing creativity and application of learned principles to produce functional and practical software solutions.

f. **Course Learning Outcomes:**

CLO 1	Recognize the computer's basic principles and organizations.
CLO 2	Understand Concepts of Computer Programming Language.
CLO 3	Develop the algorithm for solving basic Engineering Problems.
CLO 4	Write, Compile and debug program with C Programming.
CLO 5	Analyse the Solved, Complex Computational Program written in C.
CLO 6	Develop simple projects using C Language.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Topics	Weightage	Teaching Hours
1	**Number System:** Introduction and type of Number system, Conversion between number system, Arithmetic operations on number system, Signed and unsigned number system Software, Computer Languages and Computer Program	2%	3
2	**Introduction to 'C' Programming:** Features of C language, structure of C Program, Flow Charts and Algorithms Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory.	3%	3
3	**Constants, Variables and data Types:** Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, assigning values to variables, typedef, and defining symbolic constants.	5%	2
4	**Operators and Expression:** Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively.	10%	3
5	**Management Input and Output Operators:** Introduction, reading a character, writing a character, formatted input, formatted output.	5%	2
6	**Control structure in C:** Decision Making & branching: Decision making with If &I .. Else statements, If.. Else statements (Nested .... Ladder), The Switch & goto statements, The turnery (?:) Operator Looping: The while statement, The break statement & The Do.. While loop, The FOR loop, Jump within loops – Programs	15%	4
7	**Array:** Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.	10%	4
8	**String:** string, string storage, Built-in-string functions	10%	4
9	**User-Defined Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing.	10%	5

10	**Structure and Unions:** Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions	10%	5
11	**Pointers:** Basics of pointers, pointer to pointer, pointer and array, Pointer to array, array of pointers, functions returning a pointer	10%	5
12	**Dynamic memory allocation:** Introduction to Dynamic memory allocation, malloc (), calloc (), free (), realloc ()	5%	3
13	**File Management in C:** Introduction to file management and its functions	5%	2
	Total	100%	45

i. Text Book and Reference Book:

1. "Programming in ANSI C", (Textbook), By E. Balaguruswamy, Tata McGraw-Hill
2. "C Programming: Test Your Skills", By Ashok Kamthane
3. "Computer Fundamentals", By P.K. Sinha and Priti Sinha, BPB Publications, 4th Edition
4. "Star C Programming", STAR Certification, C Certification Exam
5. "Programming with C", By Byron Gottfried, Tata McGraw Hill Education.
6. "C The Complete Reference", By Herbert Schildt
7. "Let Us C", By Yeshavant Kanetkar | BPB Publications

j. List of Experiments:

Sr. NO.	Experiment List
1	Write a program to print HELLO FRIENDS!
2	Write a program that reads two nos. from key board and gives their addition, subtraction, multiplication, division and modulo.
3	Write a program to calculate area of circle, use Ω as symbolic constants.
4	Write a program to convert days into months and days.
5	Write a program which calculates the summation of three digits from the given 3-digit number.
6	Write a program to demonstrate enumerates data type.
7	Write a program to compute Fahrenheit from centigrade.
8	Write a program to calculate simple interest. Read the price of item in decimal form e.g. 12.50 and separate Rs and Paise from the given value e.g. 12 rupees and 50 paise.
9	Write a program to find the largest of the three nos. using Nested-If-Else statement.
10	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
11	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
12	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.

13	Write a program to read marks from keyboard and your program should display equivalent grade according to following table. Marks Grade 100-80 Dist 60-79 First Class 35-59 Second Class
14	Write a program to read marks of a student from keyboard whether the student id pass (if).
15	Write a program to find the sum of first N odd numbers.
16	Write a program using while loop construct which finds the factorial of a given integer number.
17	Write a C program using do«while and for loop constructs to reverse the digits of the number.
18	Write a program to demonstrate use of Switch- Break Statement.
19	Write a program to find out all the numbers divisible by 5 and 7 between 1 to 100.
20	Check for Armstrong number. A number is Armstrong if sum of cube of every digit is same as the original number. E.g. 153=13+53+33=153
21	Write a program to print the output of bellow series. 1!+2!+3!+4!+ .....n!
22	Write a program to print the following outputs using for Loop. 1 * 12 ** 123 ***
23	Write a program to print the following outputs using for Loop. (a) 1 (b) 321 21 21 321 1
24	Write a program which sorts 10 numbers into ascending order.
25	Write a program to find maximum element from 1-D array.
26	Write a program to find number of odd and even elements from the 1-D array.
27	Write a program add two 2x2 matrices.
28	Write a program to count number of positive, negative and zero elements from 3x3 matrix.
29	Write a function for the following operations on string: Copy one string to another Comparing two strings Adding a string to the end of another.
30	Write a program to count vowels from a entered String.
31	Write a program which finds whether a string is a palindrome or not.
32	Write a program to find factorial of a number using recursion.
33	Write a program that used user defined function Swap ( ) and interchange the value of two variable.
34	Write a function to return 1 if the number is prime otherwise return 0.
35	Define a structure type, personal that would contain person name, date of joining and salary.
36	Define a structure called cricket that will describe the following information: Player name Team name Batting average
37	Write a program to add two numbers using pointers.
38	Write a program to swap two numbers using pointer
39	Write a program to illustrate reading files contents.
40	Write a program to illustrate the use of fgets( )

a. **Course Name:** Elements of Mechanical Engineering
b. **Course Code:** 303109102
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Elements of Mechanical Engineering Course Provide students with a comprehensive foundation in the fundamental principles and concepts that form the backbone of mechanical engineering for various Engineering disciplines.
e. **Course Learning Objective:**

CLOBJ 1	Identify and basic mechanical components such as gears, bearings, Pumps, Compressor, boiler, I.C Engines.
CLOBJ 2	Understand various laws and behaviour of fluid at different conditions.
CLOBJ 3	Illustrate the operational mechanisms through diagrams, models, or practical demonstrations.
CLOBJ 4	Demonstrate construction and working principles of diverse mechanical devices, such as engines, pumps, and compressors.
CLOBJ 5	Evaluate basic problems related to I.C engine, pumps, compressors and fluids.
CLOBJ 6	Analyse and discuss the interactions and relationships between various mechanical elements within a system

f. **Course Learning Outcomes:**

CLO 1	Identify basic mechanical components and their functions.
CLO 2	Understand basic Properties and behaviour of various fluids.
CLO 3	Understand Construction and working of various mechanical devices
CLO 4	Apply fundamental principles to solve basic mechanical engineering problems

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Basics of Thermodynamics** Prime Movers - Meaning and Classification; Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Internal Energy, Enthalpy, Specific Volume; Thermodynamics – Definition: Change of State, Path, Process, Cycle, Thermodynamic systems, Statement of Zeroth Law, First Law and Second Law of Thermodynamics and its Applications.	10%	5
2	**Properties of Gases** Gas Laws, Boyle's law, Charles law, Combined gas law; Gas Constant, Relation between Cp and Cv Constant Volume Process; Constant Pressure Process; Isothermal Process; Adiabatic Process; Poly-tropic Process. Examples based on above topics.	15%	6
3	**Properties of Steam** Types of Steam and Steam formation; Specific Enthalpy; Specific Volume; Dryness Fraction of Steam; Measurement of Dryness Fraction; Steam Table. Examples based on above topics.	15%	6
4	**Heat Engines** Definition of Heat Engine; Classification of Heat Engine; Carnot Cycle, Rankine Cycle, Otto Cycle and Diesel Cycle. **Internal Combustion Engines:** Two Stroke Petrol and Diesel Engine; Four Stroke Petrol and Diesel Engine; Measurement of Indicated Power and Brake Power: Numerical on calculation of Mechanical, Thermal and Volumetric Efficiency. Examples based on above topics.	20%	10
5	**Energy Conversion Devices** **Steam Generators:** Definition and Classification; Cochran, Lancashire, Locomotive, Babcock and Wilcox Boiler: Construction and Working; Boiler Mounting and Accessories. **Refrigeration and Air Conditioning:** Meaning of Refrigeration; Vapor Compression Refrigeration Cycle; Vapor Absorption Refrigeration Cycle; Air conditioning; Window Air Conditioning and Split Air Conditioning.	20%	5
6	**Pumps And Air Compressors** **Pumps** Definition, Classification and Application of Pumps; Types and Operation of Rotary pump, Reciprocating Pump, Centrifugal Pump. **Air Compressors** Definition, Classification and Application of Compressors;	10%	5

	Types and Operation of Rotary and Reciprocating Air Compressor.		
7	**Motion And Power Transmission Devices** Shaft and Axle; Belt Drive; Chain Drive; Friction Drive; Gear Drive; Clutch, Coupling and Brake.	5%	4
8	**Conventional And Non-Conventional Energy Sources** Introduction and Classification of Energy Sources; Conventional Energy Sources E.g. Solid, Liquid, Gaseous and Nuclear fuels; Calorific Value of Fuels; Non-Conventional Energy Sources E.g. Solar Energy, Wind Energy, Hydro Power, Biomass and Biomass Energy; Comparison of Conventional & Non-Conventional Energy Sources.	5%	4
	Total	100%	45

i. Text Book and Reference Book:

1. "Elements of Mechanical Engineering", By S.B. Mathur, S. Domkundwar, Dhanpat Rai & Sons Publications.
2. "Thermal Engineering, By R.K Rajput", Laxmi Publications.
3. "Thermal Science and Engineering", By Dr. D. S. Kumar, S. K. Kataria and sons Publishers.
4. "Basic Mechanical Engineering", By T. S. Rajan, Wiley Eastern Ltd
5. "Fundamental of Mechanical Engineering", By G. S. Sawhney, PHI Publication New Delhi.

j. List of Experiments:

Sr. NO.	Experiment List
1	Demonstration and study of construction and working of Petrol Engine Model.
2	Demonstration and study of construction and working of Diesel Engine Model.
3	Determination of brake thermal efficiency of an I. C. Engine.
4	Demonstration and study of construction and working of various types of boiler Models.
5	Study of construction and working of different boiler mountings and accessories.
6	Demonstration on construction and working of different types of pumps.
7	Demonstration on construction and working of different types of air compressors.
8	Demonstration on vapour compression refrigeration cycle and vapour absorption refrigeration cycle.
9	Demonstration on construction, working and applications of different types of coupling, clutch and brake.
10	Demonstration on construction, working and applications of motion and power transmission devices.

a. **Course Name:** Mathematics-II
b. **Course Code:** 303191151
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12^{th} science level
d. **Rationale:** The mathematics II syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Define and identify ordinary differential equations of higher order. Classify ODEs based on homogeneity and linearity. Solve homogeneous linear ODEs of higher order with constant coefficients, and variable coefficients.
CLOBJ 2	Solve homogeneous linear ODEs of higher order with constant coefficients, variable coefficients
CLOBJ 3	Apply the Method of Undetermined Coefficients to solve nonhomogeneous ODEs. Utilize the Solution by Variation of Parameters for solving nonhomogeneous ODEs. Explore applications of ODEs in real-world scenarios.
CLOBJ 4	Understand power series solutions for ordinary points and regular singular points. Explore properties and applications of Legendre polynomials and Bessel functions.
CLOBJ 5	Define Laplace transform and its inverse. Understand the linearity property of Laplace transforms. Solve ordinary differential equations using Laplace transforms.
CLOBJ 6	Define Fourier Integral and its applications. Explore Fourier Cosine and Sine Integrals.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate the ability to translate physical or engineering problems into mathematical equations and solve them.
CLO 2	Develop analytical and critical thinking skills through the process of solving complex mathematical problems.
CLO 3	Understand and interpret mathematical solutions in the context of the given problems.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms.
CLO 5	Present mathematical arguments and solutions in a logical and organized manner.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Higher order ordinary differential equations:** Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEs with Constant Coefficients, Euler–Cauchy equations,Nonhomogeneous ODEs, Method of Undetermined Coefficients, Solution by Variation of Parameters, Applications	8%	5
2	**Power Series:** Power series solutions at ordinary point and regular singular point; Legendre polynomials, Bessel functions of the first kind and their property	15%	9
3	**Laplace Transform:** Laplace Transform and inverse Laplace transform, Linearity, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals, ODEs, UNIT Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Laplace transform of periodic functions, Short Impulses, Dirac's Delta Function, Convolution, Integral Equations, Differentiation and Integration of Transforms, Solution of ordinary differential equation by Laplace transform	25%	15
4	**Fourier Integral:** Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral	17%	10
5	**Vector Calculus:** Gradient of scalar field, Directional Derivative, Divergence and curl of Vector field, Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	10%	6
6	**Multivariable Calculus (Integration):** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals (Cartesian)	25%	15

Total	100%	60

i. Text Book and Reference Book:

1. "Calculus and Analytic Geometry (Textbook)", By G.B. Thomas and R.L. Finney, Addison Wesley
2. "Calculus with early transcendental functions", By James Stewart, Cengage Learning
3. "Higher Engineering Mathematics", By B. S. Grewal | Khanna Publications
4. "Elementary Linear Algebra (Textbook)", By Howard Anton, Chris Rorres | Willy India Edition | 9th Edition
5. "Advanced Engineering Mathematics (Textbook)", By Erwin Kreyszig | Willey India Education

a. **Course Name:** Engineering Physics-I
b. **Course Code:** 303192101
c. **Prerequisite:** Knowledge of Physics and some basic concepts in Mathematics like differentiation, integration, limit, differential equation, vector calculus up to 12^{th} science level.
d. **Rationale:** Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.
e. **Course Learning Objective:**

CLOBJ 1	Understand and explain the elastic properties of materials. Analyse the tensile stress-strain curve and its implications for material behaviour. Evaluate shear strength in both perfect and real crystals.
CLOBJ 2	Investigate thermo-electric effects and their applications. Examine the Wiedemann-Franz law and its significance. Explore phonons and their role in heat transfer. Analyse different modes of heat transfer and specific heat of solids. Compare and contrast the Einstein and Debye models for solids.
CLOBJ 3	Gain a qualitative understanding of statistical mechanics. Differentiate between Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics.
CLOBJ 4	Analyse transverse waves on a string and harmonic waves. Investigate reflection, transmission, standing waves, and eigenfrequencies.
CLOBJ 5	Explore Einstein's theory of matter-radiation interaction. Understand absorption, spontaneous, and stimulated emission of radiation. Identify characteristics and components of lasers.
CLOBJ 6	Examine applications of lasers in various fields.

f. **Course Learning Outcomes:**

CLO 1	Acquire a deep understanding of fundamental principles and concepts in classical mechanics, electromagnetism, thermodynamics, and modern physics.
CLO 2	Develop proficiency in applying mathematical techniques to solve physics problems
CLO 3	Gain familiarity with experimental methods, laboratory equipment, and techniques for conducting physics experiments.
CLO 4	Apply theoretical knowledge to solve a variety of physics problems
CLO 5	Integrate knowledge from different branches of physics to understand interdisciplinary phenomena and real-world applications.
CLO 6	Evaluate the appropriateness of theoretical models in explaining physical phenomena and predict outcomes.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	30	60	20	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Properties of Material Mechanical Properties**: Elastic properties, Model of elastic behaviour, tensile stress strain curve, shear strength of perfect and real crystals. **Thermal Properties:** Thermo-electric effects, Wiedemann-Franz law, Phonons, Modes of heat transfer, Specific heat of solids, Einstein and Debye Model, Qualitative idea about Maxwell-Boltzmann, Bose Einstein, Fermi-Dirac statistics	20%	9
2	**Motion in a Plane**: Transformation of coordinates, Newtons laws and its completeness in describing particle motion, Problems including constraints and friction, Motion of a rigid body in the plane; Rotation in the plane; Angular momentum about a point of a rigid body in planar motion	20%	9
3	**Classical Mechanics:** Degrees of freedom, Constraints and constraint forces, Lagrange's equations of motion, Conservation law, Euler's laws of motion, non-inertial frames of reference; Centripetal and Coriolisaccelerations; **Fluid Mechanics: -** Flow of fluids, Viscosity, Continuity equation, Euler and Bernoulli's equations	20%	9
4	**Waves &Vibration:** Transverse wave on a string, Wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, Standing waves and their Eigen frequencies, longitudinal waves and the wave equation, Acoustics waves and speed of sound, Phase velocity and group velocity	20%	9
5	**Lasers:** Einstein's theory of matter-radiation interaction, Absorption, Spontaneous and Stimulated Emission of Radiation, Characteristics of Laser, Components of Laser, Types of Laser: Nd:YAG Laser, CO2 Laser, Semiconductor, Diode Laser, Applications of Lasers.	20%	9
	Total	100%	45

i. Text Book and Reference Book:

1. "Engineering Mechanics", by MK Harbola
2. "Engineering Mechanics – Dynamics", by JL Meriam
3. "Mechanical Vibrations" by JP Den Hartog
4. "University Physics", by Sears and Zemansky, Pearson

j. List of Experiments:

Sr. NO.	Experiment List
1	Determination of Velocity of ultrasonic waves in water.
2	Determination of Dielectric constants of Dielectric samples.
3	Measurement of Band gap of semiconductor material.
4	Measurement of Planck's constant using LED.
5	Measurement of wavelength of laser light using diffraction grating.
6	Measurement of Numerical aperture of an optical Fiber.
7	Determine Moment of Inertia of a flywheel.
8	Measurement of power loss in an optical fibre.
9	Measurement of a size of a Lycopodium powder.

a. **Course Name:** Advanced Communication & Technical Writing
b. **Course Code:** 303193152
c. **Prerequisite:** Knowledge of English Language studied till 12th standard
d. **Rationale:** Communication confidence laced with knowledge of English grammar is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to adapt writing style to different audiences and purposes.
CLOBJ 2	Create comprehensive technical documents such as reports, manuals, and proposals.
CLOBJ 3	Refine editing and proofreading skills for complex technical documents.
CLOBJ 4	Explore and apply technical communication through various mediums (video, web content, multimedia)
CLOBJ 5	Incorporate advanced document design principles for clarity and readability.

f. **Course Learning Outcomes:**

CLO 1	Develop four basic skills
CLO 2	Construct grammatically correct sentences.
CLO 3	Develop and deliver professional presentation skills
CLO 4	Develop the skills of critical thinking.
CLO 5	Compare different types of written communication.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	-	-	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Developing Effective Listening Skills**: • To help students understand the meaning and importance of good listening skills, learning the traits of being a good listener through activity and listening audio tracks.	10%	2
2	**Error analysis**: • To provide insights into the complicated processes of language development as well as a systematic way for identifying, describing and explaining errors. (Tenses, Voices, Reported speech)	10%	4
3	**Delivering different types of speeches:** Students will understand and use the different patterns for structuring speeches: Welcome / Introductory speech, Vote of Thanks speeches, Farwell speeches	10%	2
4	**Professional** Presentations: Students will learn Combating stage fright, preparing power point presentation, Delivering PPT	10%	4
5	**Essay writing**: Students will overcome the common pitfalls in the task of essay writing by understanding • Basics of Paragraph development and paragraph jumble • Types of essays • Characteristic features of essays • Guiding Principles	10%	2
6	**Reading Comprehension**: • Employing Different Reading Skills • Activity • Practice	10%	2
7	**Project Proposal**: • To equip students with the various elements required to prepare a winning proposal.	5%	2
8	**Misplaced Modifiers**: • Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	5%	2
9	**Movie Review**: • A movie show followed by writing a review. • To provide an exposure to students how to express their opinions about some film or documentary with unbiased and objective	10%	4

	approach.		
10	**Narrative Writing**: • Narrative writing helps them explore different characters and settings. • To help students clarify their thinking, and teach them to express that in writing in an organized way.	5%	4
11	**Writing Reports**: • Process of writing • Order of writing • Final draft & checklist for reports • Sample reports: • Memorandum • Letter report	10%	2
12	**Critical Thinking**: • Need, relevance and Significance of Critical Thinking • Logic in problem solving and decision making(activities) Moral Reasoning (Case Studies)	5%	1
13	**Activity Session (Presentation)** An activity where the scene of a press conference is created in the class. Students are encouraged to ask sharp questions and in turn are invited to assume roles of famous personalities, thus answering the questions posed.	0%	1
	Total	100%	30

i. Text Book and Reference Book:

1. "Understanding and Using English Grammar", Betty Azar & Stacy Hagen; Pearson Education
2. "Business Correspondence and Report Writing ", SHARMA, R. AND MOHAN, K.
3. "Communication Skills", Kumar S and Lata P; New Delhi Oxford University Press
4. "Technical Communication: Principles and Practice" Sangeetha Sharma, Meenakshi Raman; Oxford University Press
5. "Practical English Usage MICHAEL SWAN
6. "A Remedial English Grammar for Foreign Student", F.T. WOOD
7. "On Writing Well", William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
8. "Oxford Practice Grammar", John Eastwood; Oxford University Press

Semester 3

a. **Course Name:** Thermodynamics
b. **Course Code:** 303109201
c. **Prerequisite:** Basic knowledge of Mechanical workshop
d. **Rationale:** To impart basic knowledge to enable the student to assimilate the concurrent manufacturing operations and process in the discipline of metal casting and machining.
e. **Course Learning Objective:**

CLOBJ 1	Grasp the distinctions between work and heat interactions, comprehending their roles in the transfer of energy between a system and its surroundings.
CLOBJ 2	Utilize the first law of thermodynamics to analyse energy conservation in diverse devices, elucidating the balance of energy between a system and its surroundings.
CLOBJ 3	Apply the second law of thermodynamics, considering entropy and enthalpy, to assess and compute system performance, emphasizing energy transformation efficiency.
CLOBJ 4	Assess changes in substance properties during processes like compression and heating, gaining insights into the principles governing energy transfer and transformation.
CLOBJ 5	Distinguish between high- and low-grade energies, recognizing their utility and efficiency, and understand their impact on the performance of energy conversion systems.
CLOBJ 5	Apply the first law to analyse energy conversion devices such as engines and turbines, elucidating the transformation of energy forms and their implications on system behaviour.

f. **Course Learning Outcomes:**

CLO 1	Explain about work and heat interactions and balance of energy between system and its surroundings.
CLO 2	Apply the first law of thermodynamics to various energy conversion devices.
CLO 3	Apply the second law of thermodynamics and concepts of entropy, enthalpy in analysing and computing the performance of system.
CLO 4	Evaluate the changes in properties of substances in various processes.
CLO 5	Differentiate high grade and low-grade energies.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	0	4	20	20	50	60	-	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**BASICS OF THERMODYNAMICS** (a) Introduction to Engineering Thermodynamics - Macroscopic vs microscopic view point,Thermodynamic systems, properties, process, cycle, thermodynamic equilibrium, Reversible, Irreversible & Quasistatic Process, Zeroth Law of thermodynamics, concept of continuum. Exact & Inexact differentials. Work-electrical, magnetic, gravitational, spring and shaft work, Displacement work (P-dv), flow work,stirring work, free expansion, Equation of state of a gas, properties of Ideal gas, specific heat, work done in various quasi-static processes, work as a path function. Heat transfer-sensible heat, latent heat, heat as a path function. (b) First Law of thermodynamics - Joules experiment, internal energy as property of system, first law applied to various quasi static processes, PMMI, Limitations of the First Law, control volume, Steady flow energy equation, Applications of SFEE.	25%	12
2	**SECOND LAW OF THERMODYNAMICS AND ENTROPY** (a) Second law of thermodynamics: Thermal Reservoir, Heat Engine, cyclic Heat engine, Kelvin-Planck statement and Clausius Statements and their Equivalence, Refrigerator and Heat pump, COP, PMM II, reversibility and irreversibility, causes of irreversibility, Carnot cycle, reversed heat engine, Carnot theorem, corollaries of Carnot theorem, Absolute thermodynamic temperature scale. (b) Entropy: Clausius theorem, the property of entropy, the inequality of Clausius, Entropy principle and its applications, Entropy change during different thermodynamic processes, entropy generation in closed systems and open systems.	25%	12

3	**EXERGY** Available energy, availability and availability function of a closed system, availability and availability function of an open system, dead state, Helmholtz function, Gibbs functions, Irreversibility and Gouy-Stodola Theorem, Second law efficiency.	15%	7
4	**PROPERTIES OF PURE SUBSTANCE** Thermodynamic properties of pure substances in solid, liquid and vapour phases, Phase Transformations, dryness fraction, Gibbs phase rule, Triple point, critical state, p-v, p-T, T-s, h-s,p-h diagrams, Properties and processes in ideal vapour, use of steam tables and Molliers diagram in determination of steam properties, energy interaction and entropy calculations for various thermodynamic processes.	20%	8
5	**Thermodynamic Cycles & Relations** (a) Thermodynamic cycles - Basic Rankine cycle, Basic Brayton cycle, Basic vapor compression cycle and comparison with Carnot cycle. (b) Thermodynamic relation- Maxwell relation, first and second law combined (T-ds relation). Joule-Kelvin effect (real gas), basics of Fuel cell.	15%	6
	Total	100%	45

i. Text Book and Reference Book:

1. "Thermodynamics-An Engineering Approach" By Cengel, Y.A & Boles, M.A., TMH, 2011
2. "Engineering Thermodynamics", By P K Nag | Tata McGraw-Hill
3. "Fundamental of Engineering Thermodynamics" By R. Yadav, CPH Publications
4. "Thermodynamics", By C.P. Arora | Tata McGraw Hill

a. **Course Name:** Materials Engineering
b. **Course Code:** 303109203
c. **Prerequisite:** Knowledge of Engineering Physics and Engineering Chemistry
d. **Rationale:** Basic principles of science are used to study the structure-properties relationship of various materials for their proper applications in this subject. Especially study of different types of ferrous and non-ferrous metals and alloys, in terms of their composition, structure, properties and applications; non- destructive testing are included in this course to understand the basic concept of selection and processing of metals and materials for their applications.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the fundamental properties of engineering materials, including mechanical, thermal, and electrical characteristics.
CLOBJ 2	Apply principles of materials science to design and optimize materials for specific engineering applications.
CLOBJ 3	Understand the influence of processing parameters on the microstructure and mechanical properties of materials, and apply this knowledge to optimize manufacturing processes.
CLOBJ 4	Investigate the role of material defects, fatigue, corrosion, and other factors in determining the life expectancy and reliability of engineering components.
CLOBJ 5	Investigate the impact of nanotechnology on materials engineering, including the development of new materials and innovative manufacturing techniques.
CLOBJ 6	Understand the concept of chemical analysis for materials and explore innovative technologies for material synthesis.

f. **Course Learning Outcomes:**

CLO 1	Define the relationship between material structure and properties, enabling the prediction and explanation of material behaviour under diverse conditions.
CLO 2	Apply principles of materials science to proficiently design and optimize materials for specific engineering applications, emphasizing aspects such as strength, durability, and sustainability.
CLO 3	Evaluate and identify key processing parameters in manufacturing, and their influence on material microstructure and mechanical properties.
CLO 4	Examine the impact of material defects, fatigue, corrosion, and various factors on the life expectancy enabling them to contribute to the enhancement of component durability and performance.
CLO5	Investigate the transformative impact of nanotechnology on materials engineering, including advancements in material development and innovative manufacturing techniques.
CLO6	Develop the ability to understand various techniques for materials synthesis facilitating their ability to contribute to advancements in material

	science and engineering.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Engineering Materials and Crystal Structures** Classification of Engineering Materials, Engineering requirements of materials, Criterion for selection of materials for engineering applications through, Structure-Properties Performance correlation ship. Unit Cell, Crystal structure, Bravais lattice, atomic packing factor, coordination number, crystaldirections and planes, Miller indices, Imperfections in crystals and their effect on properties, Strain hardening, Recovery, Recrystallization and Grain Growth.	15%	7
2	**Phase Diagrams and Theory of Alloys** Unary and Binary equilibrium phase diagrams, Lever rule, Gibb's phase rule, solid solutions and compounds, Solid Solution Strengthening Mechanisms, Hume-Rothery rules; cooling curves, Different reactions like eutectic, eutectoid etc. Allotropy of Iron, Iron-Iron-Carbide equilibrium diagram. Plain carbon steels, its classification and properties, Alloy Steel, its classification and properties, Stainless steel, Tool Steel, designation of Steels, Effect of alloying elements like Cr, Mo, Ni, W, V, Nb, B, Al, etc on the Properties of Steel,Cast Iron, its classification and properties, White Cast iron, Grey Cast iron, Nodular Cast iron, Malleable Cast iron, Chilled Cast Iron etc.	25%	13
3	**Heat Treatment of Steels and Alloys** Heat Treatment Cycle, Time-Temperature Transformation (TTT) Diagram, CCR, Different types of heat Treatments like Annealing, Normalizing, Hardening, Tempering, Austempering, Martempering, Ausforming, Surface hardening and Case hardening treatments, Jominy Hardenability Test.	15%	9

4	**Non-Ferrous Alloys, Non-Metallic Materials and Nanomaterials** Copper alloys, Aluminium alloys: Classification, Composition, Properties and applications. Plastics, Composites, Ceramics: Classification, Composition, Properties and applications. Introduction to Nanomaterials and its applications	20%	12
5	**Powder Metallurgy** Production of Powder, blending, Compacting, Sintering; Application, advantages and limitations.	10%	4
6	**Non-Destructive Testing** Principle, Advantages, limitations and Applications of Dye Penetration Testing, Magnetic Particle Testing, Eddy current testing Radiography Testing, UT.	10%	2
7	**Metallography** Structure of Metals, Macro-examination: Macro-etching; Microscopic examinations: Specimen Preparation, etching, grain size measurement; Concept of chemical analysis of steel and Iron for Carbon, Sulphur & Phosphorous.	5%	2
	Total	100%	45

i. Text Book and Reference Book:

1. Introduction to Physical Metallurgy by Sydney H. Avner | Tata McGraw-Hill
2. Callister's Material Science and Engineering, 2 By R. Balasubramaniam | Wiley India.
3. Practical Non-Destructive Testing, By Baldev Raj, T. Jayakumar and M. Thavasimuthu | Narosa Pub. House
4. Mechanical Metallurgy by George E. Dieter | McGraw-Hill book company
5. Materials Science and Engineering: By V. Raghavan | A First Course, 5th Edition Prentice Hall India, 2004.

a. **Course Name:** Material Engineering Lab
b. **Course Code:** 303109204
c. **Prerequisite:** Knowledge of Engineering Physics and Engineering Chemistry
d. **Rationale:** Basic principles of science are used to study the structure-properties relationship of various materials for their proper applications in this subject. Especially study of different types of ferrous and non-ferrous metals and alloys, in terms of their composition, structure, properties and applications; non- destructive testing are included in this course to understand the basic concept of selection and processing of metals and materials for their applications.
e. **Course Learning Objective:**

CLOBJ 1	Enable a comprehensive understanding of their inherent properties and diverse applications of materials in various fields.
CLOBJ 2	Proficiently prepare specimens for microstructure examination and skilfully observe the microstructures of standard specimens.
CLOBJ 3	Proficiently demonstrate the heat treatment of steel and perform the Jominy end quenching test.
CLOBJ 4	Explore and investigate the principles and applications of powder metallurgy for material synthesis.
CLOBJ 5	Demonstrate the ability to perform various non-destructive tests for effective evaluation of material integrity and flaw detection.

f. **Course Learning Outcomes:**

CLO 1	Classify and analyse engineering materials to comprehend their properties and applications.
CLO 2	Prepare the specimen for microstructure examination and evaluate micro structure of standard specimen
CLO 3	Demonstrate heat treatment of steel and perform Jominy end quenching test.
CLO 4	Define powder metallurgy and investigate its principles and applications for material synthesis.
CLO5	Conduct non-destructive tests, to report material integrity and detect flaws effectively.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	2	1	0	0	20	0	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. Introduction to Physical Metallurgy by Sydney H. Avner, Tata McGraw-Hill
2. Callister's Material Science and Engineering, 2 By R. Balasubramaniam, Wiley India.
3. Practical Non-Destructive Testing, By Baldev Raj, T. Jayakumar and M. Thavasimuthu, Narosa Pub. House
4. ASM Handbook Vol. 9: Metallography and Microstructure by Ed. George F. Vander Voort, ASM International
5. Mechanical Metallurgy by George E. Dieter, McGraw Hill
6. Materials Science and Engineering: By V. Raghavan, A First Course, 5th Edition Prentice Hall India, 2004

i. List of Experiments:

Exp. No.	Name of the Experiment
1	Study of Engineering Materials and its Classification.
2	Demonstration of Metallurgical Micro Scope.
3	Specimen Preparation for Micro Structural Examination
4	Observation of Micro Structure for Standard Samples.
5	Demonstration on Heat Treatment of Steels.
6	Study of Powder Metallurgy
7	Demonstration of Liquid Penetrant Test/Dye Penetrant Test.
8	Demonstration of Magnetic Particle Test.
9	Flaw Detection through Ultrasonic Testing
10	Demonstration of Jominy Hardenability Test.

a. **Course Name:** Manufacturing Process
b. **Course Code:** 303109205
c. **Prerequisite:** Basic knowledge of Mechanical workshop
d. **Rationale:** To impart basic knowledge to enable the student to assimilate the concurrent manufacturing operations and process in the discipline of metal casting and machining.
e. **Course Learning Objective:**

CLOBJ 1	Identify and differentiate various machine tools utilized in manufacturing processes. Demonstrate an understanding of the applications and limitations of different machine tools in diverse industrial contexts. Apply knowledge of machine tools to make informed decisions regarding tool selection for specific machining operations.
CLOBJ 2	Organize and sequence machining operations systematically to achieve the desired end product. Demonstrate the ability to create a step-by-step plan for machining processes, considering efficiency and precision.
CLOBJ 3	Define the concept of patterns and their role in shaping materials for manufacturing. Describe the purpose and function of gating systems in the casting process. Demonstrate the ability to articulate the importance of patterns, moulding processes, and gating systems in the broader context of manufacturing.
CLOBJ 4	Demonstrate practical knowledge by executing casting processes in controlled environments. Apply theoretical knowledge to real-world scenarios, ensuring proficiency in the implementation of casting processes.
CLOBJ 5	Demonstrate practical knowledge by setting up and operating unconventional machining equipment. Apply critical thinking to assess the suitability of unconventional machining processes for different manufacturing challenges.

f. **Course Learning Outcomes:**

CLO 1	Understand various machine tools and related operations.
CLO 2	Generate the sequence of machining operation to produce the end product.
CLO 3	Describe the concept of pattern, moulding process and gating systems.
CLO 4	Demonstrate the understanding casting processes.
CLO 5	Understand working principle and machine setup of unconventional machining processes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	-	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**Lathe Machines Tool:** Introduction to lathe machine and its classification, Construction, Setting and Operations of lathe machines, construction and principal units of engine lathes, Operations carried on engine lathe, plain turning lathes, facing lathes, multiple tool lathes, special purpose lathes, Capstan and turret lathes, shift invariance, causality, stability, reliability.	13%	6
2	**Conventional Machining Processes:** Introduction to Turning, shaping, planning, milling, drilling, broaching processes; types of machines and operations; different mechanisms on the machine; tool and work holding devices; special attachments; machining time calculations.	36%	16
3	**Finishing Processes:** Introduction to grinding, types of machines and operations, dressing and trueing, glazing, designating system, selection of grinding wheel, lapping, honing, etc	11%	5
4	**Moulding and Casting processes:** Patterns, Requirements of a good pattern, pattern materials, types of patterns, pattern allowances - Mould making, types of moulds, moulding processes, types of sand moulding - Core making, types of cores, core prints, core box - Moulding Sand, Properties of moulding sand, types of moulding sand, Gating system and its design, Introduction to casting, Different types of Casting processes, Casting Defects, Cleaning and Inspection of casting.	27%	12
5	**Non-Conventional Machining Processes:** Introduction and Classification and applications of non-Conventional machining processes. EDM, EBM, PAM, IBM, ECM, ECG, CM, AJM, WJM, AWJM, wire cut EDM, USM, LBM process principles, and their applications	13%	6
	Total	100%	45

i. Text Book and Reference Book:

1. "Manufacturing Technology (Textbook)" by By P.N. Rao, Tata McGraw Hill publication.
2. "Manufacturing Science" By A Ghosh and A K Mallik, Wiley Eastern, 1986.
3. "A Course in Workshop Technology" By Raghuwamsi B S, Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi. Pub. Year 1982.
4. "Elements of Workshop Technology (Vol I & Vol II)" By Hajra Choudhary, Media Promoters and Publishers Pvt ltd.
5. "Introduction To Machining Science", By G K LAL, New Age International Pvt Ltd., 2007
6. "P C Sharma, "A Textbook of Production Engineering". S. Chand publishers.
7. "Metal Cutting Principles", By M C Shaw, MIT Press, 2004.

a. **Course Name:** Manufacturing Processes Lab
b. **Course Code:** 303109206
c. **Prerequisite:** Basic knowledge of Mechanical workshop.
d. **Rationale:** To impart basic knowledge to enable the student to assimilate the concurrent manufacturing operations and process in the discipline of metal casting and machining.
e. **Course Learning Objective:**

CLOBJ 1	Identify and differentiate various machine tools utilized in manufacturing processes. Demonstrate an understanding of the applications and limitations of different machine tools in diverse industrial contexts. Apply knowledge of machine tools to make informed decisions regarding tool selection for specific machining operations.
CLOBJ 2	Organize and sequence machining operations systematically to achieve the desired end product. Demonstrate the ability to create a step-by-step plan for machining processes, considering efficiency and precision.
CLOBJ 3	Define the concept of patterns and their role in shaping materials for manufacturing. Describe the purpose and function of gating systems in the casting process. Demonstrate the ability to articulate the importance of patterns, moulding processes, and gating systems in the broader context of manufacturing.
CLOBJ 4	Demonstrate practical knowledge by executing casting processes in controlled environments. Apply theoretical knowledge to real-worldscenarios, ensuring proficiency in the implementation of casting processes.
CLOBJ 5	Demonstrate practical knowledge by setting up and operating unconventional machining equipment. Apply critical thinking to assess the suitability of unconventional machining processes for different manufacturing challenges.

f. **Course Learning Outcomes:**

CLO 1	Understand various machine tools and related operations.
CLO 2	Generate the sequence of machining operation to produce the end product.
CLO 3	Describe the concept of pattern, moulding process and gating systems.
CLO 4	Demonstrate the understanding casting processes.
CLO 5	Understand working principle and machine setup of unconventional machining processes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. “Manufacturing Technology (Textbook)" By P.N. Rao, Tata McGraw Hill publication.
2. “A Course in Workshop Technology" By Raghuwamsi B S, Dhanpat Rai and Sons, 1682 Nai Darak, New Delhi. Pub. Year 1982.
3. “P C Sharma, “A Textbook of Production Engineering”. S. Chand publishers.
4. “Manufacturing Science" By A Ghosh and A K Mallik, Wiley Eastern, 1986.
5. “Introduction To Machining Science”, By G K LAL, New Age International Pvt Ltd., 2007
6. “Metal Cutting Principles”, By M C Shaw, MIT Press, 2004.

i. List of Experiments:

Exp. No.	Name of the Experiment
1	To perform various lathe operation on a given work-piece.
2	Machining practices on drilling machine.
3	Machining practices on milling machine to cut spur gear.
4	Machining practices on shaping machine
5	Machining practice on grinding machine.
6	Demonstration of Capstan lathe.
7	Demonstration of EDM.
8	The understand the basic concept of pattern and its allowances and making of pattern.
9	To demonstrate the procedure of moulding.
10	To demonstrate the procedure of casting**.**

a. **Course Name:** Kinematics and Theory of Machines
b. **Course Code:** 303109207
c. **Prerequisite:** Basic knowledge of physics, mechanics and mathematics.
d. **Rationale:** It is important for mechanical engineers to understand about relative motions amongst various elements of mechanisms of machines responsible to perform the targeted task. This course is essential to provide fundamental study about establishment of relative motions for designing various mechanisms to build various machines.

e. **Course Learning Objective:**

CLOBJ 1	Classify different links and joints, understand the motion of mechanisms and determine degrees of freedom, study the concept of inversions
CLOBJ 2	Understand velocity and acceleration vectors, draw velocity diagrams using Relative velocity method and instantaneous centers, understand radial, transverse and Corioli's components of acceleration, draw acceleration vector diagrams to analyse the motion of the links in the mechanisms
CLOBJ 3	Understand cams and followers, its terminology and classification, analyse output follower motion, create displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions.
CLOBJ 4	Classification of gears and gear trains, understand gear terminology, gearteeth profiles, concept of contact ratio, interference and undercutting, evaluate minimum number of teeth on pinion to avoid interference, classify gear train: simple, compound, reverted and epicyclic.
CLOBJ 5	Understand working principle and application of governors, classify governors, understand gyroscopic effect and gyroscope in various applications.
CLOBJ 6	Study the concept of friction and apply it to various friction devices like clutches, bearings, brakes and power transmission elements, understand the working principles of various friction devices and its classification.

f. **Course Learning Outcomes:**

CLO 1	Understand and analyse the kinematics and dynamics of kinematically driven rigid-body machine components.
CLO 2	Analyse the motion of mechanisms in terms of displacement, velocity and acceleration at any point in a rigid link.
CLO 3	Understand and analyse cam-follower systems that generate specified output motion.
CLO 4	Explain kinematics of gear and gear trains.
CLO 5	Understand the applications of governors, gyroscope, clutches, bearings, brakes and various power transmission elements.
CLO 6	Understand the role of friction in various friction devices like clutch, bearing, brakes and various.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Mechanisms And Machines:** Basic kinematic concepts, definition and classification of link, kinematic pair, joint, kinematic chain, mechanism and machine, types of constraint motion, Degrees of freedom (mobility) - Kutzbach and Grubler's criterion for degrees of freedom, Grashof's law, Kinematic inversions of four bar chain, single slider crank chain and double slider- crank chain, Mechanical advantage, Transmission angle, Introduction of exact and approximate straight-line mechanisms.	16%	7
2	**Velocity and Acceleration Analysis:** Velocity Analysis: Vectors, Displacement of a rigid body, Definition of velocity, angular velocity, Relative velocity method for four bar mechanism and slider-crank mechanism, Kennedy's theorem. Graphical velocity analysis using instantaneous centers. Acceleration Analysis: Definition of acceleration, Angular acceleration, Radial and transverse components of acceleration, Corioli's component of acceleration, Difference of synthesis and analysis.	22%	10
3	**Cam And Followers:** Classification of cams and followers, Terminology and definitions, Description of follower movement, Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions, specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile.	18%	8
4	**Gears & Gear Trains**: Classification of gears, Gear terminology, Involute and cycloidal gear profiles, Law of gearing, spur gear contact ratio and interference and Undercutting of	16%	7

	Involute teeth. Minimum number of teeth on pinion to avoid interference. Gear Train: Simple, compound, reverted and epicyclic gear train.		
5	**Governors & Gyroscope:** Types of governors, Working principle and application of governors, characteristics of governor. Gyroscope.	6%	3
6	**Friction Devices:** Clutch: Surface contacts - sliding and rolling friction, Function and classification of clutches, Torque transmission capacity using uniform wear and uniform pressure theory applicable to various clutches. Bearings: Friction and classification of bearings, Working principle and Applications, Lubrications. Brakes: Function and classification of brakes, Braking effect, case studies of applications. Power Transmission Elements: Classification of belt and rope drives, Working principle, construction of rope drives, case studies of application.	22%	10
	Total	100%	45

i. Text Book and Reference Book:

1. "Theory of Machine" by R. S. Khurmi and J. K. Gupta.
2. "Theory of Machine" by S S Ratan.
3. "Theory of Machine" by P.L. Ballaney.
4. "Theory of Machine" by V P Singh.
5. “Theory of Machines”, by Dr. Sadhu Singh

a. **Course Name:** Kinematics and Theory of Machines Lab
b. **Course Code:** 303109208
c. **Prerequisite:** Basic knowledge of physics, mechanics and mathematics.
d. **Rationale:** It is important for mechanical engineers to understand about relative motions amongst various elements of mechanisms of machines responsible to perform the targeted task. This course is essential to provide fundamental study about establishment of relative motions for designing various mechanisms to build various machines.
e. **Course Learning Objective:**

CLOBJ 1	Define and classify mechanical links and joints, apply Kutzbach and Gruebler's criteria to determine the degrees of freedom, comprehend Grashof's law, study inversions and mechanical advantage.
CLOBJ 2	Understand the concept of velocity and acceleration vectors, apply graphical methods to do velocity and acceleration analysis, Understand the Coriolis component of acceleration.
CLOBJ 3	Demonstrate a comprehensive understanding of centrifugal governor principles, including assembly, adjustment, and graphical representation of governing characteristics.
CLOBJ 4	Understanding angular momentum, precession, and be able to analyse and communicate the observed gyroscopic behaviours and effects.
CLOBJ 5	Classification of cams and followers, analyse displacement diagrams, and apply graphical and analytical methods to synthesize disc cam profiles.
CLOBJ 6	Demonstrate a comprehensive understanding of gear classification, profile analysis, and gear train kinematics, as well as the function, classification, and application of frictional devices.

f. **Course Learning Outcomes:**

CLO 1	Analyse various mechanisms, determine its degrees of freedom and design new mechanisms.
CLO 2	Draw velocity and acceleration vector diagrams to determine velocity and acceleration at any point of linkages for given case studies of mechanisms.
CLO 3	Perform experiments on Porter governor.
CLO 4	Perform experiment on gyroscope set-up.
CLO 5	Design cam-follower mechanisms for various applications.
CLO 6	Analysis for studying kinematics of various gear trains, frictional elements and devices.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. "Theory of Machine" by R. S. Khurmi and J. K. Gupta.
2. "Theory of Machine" by S S Ratan.
3. "Theory of Machine" by P.L. Ballaney.
4. "Theory of Machine" by V P Singh.
5. “Theory of Machines”, by Dr. Sadhu Singh

i. List of Experiments:

Exp. No.	Name of the Experiment
1	Exercise based on basic concepts of kinematics.
2	Performance to determine the gyroscopic effect.
3	Study of working principle and construction of the different types of the centrifugal governor.
4	Performance to determine operating characteristics of Porter governor.
5	Exercise on velocity analysis of four-bar and slider crank mechanisms by ICR method.
6	Exercise on velocity and acceleration analysis of four bar and slider-crank mechanisms by relative velocity and relative acceleration method.
7	Study of synthesis of cam and follower mechanism.
8	Exercise on the kinematics of gear and gear train.
9	Exercise to learn about friction devices.
10	Exercise using Mech Analyzer software.

a. **Course Name:** PDE, Probability, and Statistics
b. **Course Code:** 303191204
c. **Prerequisite:** Basic knowledge of physics, mechanics and mathematics.
d. **Rationale:** The course provides solution techniques of Partial Differential Equations, Probability Methods and Statistical Methods for Mechanical and Automobile Engineering.

e. **Course Learning Objective:**

CLOBJ 1	Solve first-order linear and nonlinear PDEs, use Charpit's Method, and apply methods for second and higher-order linear equations. Model and solve problems related to Heat, Wave, and Laplace equations.
CLOBJ 2	Understand probability spaces, conditional probability, and independence. Analyse discrete and continuous random variables, distributions (including normal and exponential), and properties of random sequences.
CLOBJ 3	Develop skills in basic statistics, measures of central tendency, probability distributions, correlation, regression, and curve fitting using the method of least squares.
CLOBJ 4	Apply probability and statistics to real-world scenarios. Use mathematicaland statistical tools to make informed predictions and decisions in practical situations.
CLOBJ 5	Enhance problem-solving and critical thinking skills through the application of mathematical and statistical methods. Approach complex problems systematically and arrive at logical solutions.
CLOBJ 6	Communicate mathematical and statistical results effectively in written and oral forms. Present solutions, interpretations, and implications to technical and non-technical audiences.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate the ability to translate physical or engineering problems into mathematical equations and solve them.
CLO 2	Develop analytical and critical thinking skills through the process of solving complex mathematical problems.
CLO 3	Understand and interpret mathematical solutions in the context of the given problems.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms.
CLO 5	Present mathematical arguments and solutions in a logical and organized manner.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Partial Differential Equations:** First-order partial differential equations, solutions of first-order linear and nonlinear PDEs, Charpit's Method, The solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	40%	24
2	**Probability:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	33%	20
3	**Statistics:** Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis – Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank	27%	16

	correlation. Curve fitting by the method of least squares- fitting of straight lines, second-degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes.		
	Total	100%	60

i. Text Book and Reference Book:

1. "Advanced Engineering Mathematics", E. Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. "Applied Statistics and Probability for Engineers", D. C. Montgomery and G. C. Runger, Wiley
3. "Introduction to Probability Theory", Universal Book Stall P. G. Hoel, S. C. Port and C. J. Stone, 2003 (Reprint).
4. "A First Course in Probability", S. Ross, 6th Ed., Pearson Education India, 2002.
5. "A text book of Engineering Mathematics", N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.
6. "Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem", R. Haberman, 4th Ed., Prentice Hall, 1998

a. **Course Name:** Professional Communication Skills
b. **Course Code:** 303193203
c. **Prerequisite:** Knowledge of English language in practical life
d. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism.

e. **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to communicate clearly and persuasively in oral presentations.
CLOBJ 2	Practice active listening techniques to enhance understanding in professional interactions.
CLOBJ 3	Write professional emails, memos, and reports with clarity and conciseness.
CLOBJ 4	Understand and practice professional etiquette in various business settings.
CLOBJ 5	Demonstrate skills in resolving conflicts and negotiating effectively.
CLOBJ 6	Use digital communication tools and platforms effectively.

f. **Course Learning Outcomes:**

CLO 1	Develop four basic skills
CLO 2	Construct grammatically correct sentences.
CLO 3	Develop and deliver professional presentation skills
CLO 4	Develop the skills of critical thinking.
CLO 5	Compare different types of written communication.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	-	-	-	-	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Technical Writing: Email etiquette & Email writing Letter Writing (Types of Letters & Layouts)**: • Trains students on detailed email and letter writingetiquette. • Students will be able to write formal letters following certain stipulated formats. • They will learn different types of letters for different official purposes.	10%	4
2	**Interpersonal Communication at Workplace: Dynamics of communication**: • To develop the confidence to handle a wide range of demanding situation more effectively at the workplace • To enable the students to analyze their own interpersonal communication style.	10%	2
3	**Debate: The three-minute debate planner**: • To enable the students to generate effectivecritical thinking into primary issues in the given topic. • Students will be able to resolve controversies and recognize strengths and weaknesses of arguments.	10%	4
4	**Goal setting & Tracking**: To enable the students to define strategies or implementation steps to attain the identified goals and make progress every day.	10%	2
5	**Time Management & Task Planning (Case –study)**: • To enable the students to identify their own time wasters and adopt strategies to reduce them. • To enable students to clarify and priorities their objective and goals by creating more planning time	15%	2
6	**Reading Comprehension: Intermediate level**: • To enable the students, develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	10 %	2
7	**Information design and writing for print and online media: Blog Writing**: • To enable students to design information that is targeted to specific audiences in specific situation to meet defined objectives. • To create blogs and share their own knowledge and experience to the world.	5%	2

8	**Advanced vocabulary Building:** • The students will expand their vocabulary so as to enhance their proficiency in reading and listening to academic texts, writing, and speaking. • The students will attain vocabulary to comprehend academic and social reading and listening texts. • The students will develop adequate speakingskills to communicate effectively.	10%	4
9	**Picture Perception**: • To prepare the students for a test for basic intelligence and IQ, generally done on the first day of SSB (Sashastra Seema Bal is one of India's Central Armed Police Forces)	5%	2
10	**Appreciation, Apology and Acknowledgement letters**: • To enable the students to maintain productive business relationship through different types of letters. • To enable the students to express their feelings without speaking out loud.	10%	3
11	**The Art of Negotiation**: • To enable the students to reach an agreement for mutual benefits through negotiation. • To enable the students to learn a process by which compromise or agreement is reached while avoiding argument and dispute.	5%	3
	Total	100 %	30

i. Text Book and Reference Book:

1. "Understanding and Using English Grammar", Betty Azar & Stacy Hagen; Pearson Education
2. "Business Correspondence and Report Writing ", SHARMA, R. AND MOHAN, K.
3. "Communication Skills", Kumar S and Lata P; New Delhi Oxford University Press
4. "Technical Communication: Principles and Practice" Sangeetha Sharma, Meenakshi Raman; Oxford University Press
5. "On Writing Well", William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. "Oxford Practice Grammar", John Eastwood; Oxford University Press

"Quantitative Aptitude for Competitive Examinations ", Dr. R.S. Aggarwal

Semester IV

a. **Course Name:** Metrology and Instrumentation
b. **Course Code:** 303109251
c. **Prerequisite:** Basic knowledge of Elements of Mechanical Engineering
d. **Rationale:** Metrology and Instrumentation are critical disciplines that underpin precision and quality in various industries. Mastery of these subjects ensures the accurate measurement of parameters, compliance with standards, and the development and maintenance of advanced instruments. As technology advances, the knowledge of metrology and instrumentation becomes increasingly indispensable for innovation, efficiency, and safety across diverse fields.

e. **Course Learning Objective:**

CLOBJ 1	Explain the fundamental principles and purpose of metrology in measurement science and precision engineering.
CLOBJ 2	Apply knowledge to select appropriate linear measuring instruments for accurate measurements of diverse component dimensions.
CLOBJ 3	Demonstrate the ability to choose suitable instruments for measuring angular and taper features in a variety of components.
CLOBJ 4	Develop the skill to differentiate between various screws based on precise measurements of their dimensional characteristics.
CLOBJ 5	Apply measurement techniques to distinguish between different gears by assessing various dimensions critical to their function.
CLOBJ 6	Assess machining process effectiveness by quantifying and analysing the surface finish of produced components for improved quality control and performance optimization.

f. **Course Learning Outcomes:**

CLO 1	Describe basic concepts of Metrology.
CLO 2	Select linear measuring instrument for measurement of various components.
CLO 3	Select angular and taper measurement devices for measurement of various components.
CLO 4	Discriminate between various screws by measuring their dimensions.
CLO5	Separate different gears through measurement of various dimensions of gears.
CLO 6	Distinguish capabilities of machining process by measuring surface finish of the component produced.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Fundamental of Measurement System** Principal, Metrology and its types, Methods of Measurement, Measurement Terminology, Measurement Standards, Uncertainty in Measurement, Characteristics of an Instruments, Classification of an Instruments, Calibration Process, Need of Inspection and Quality Control, Quality attributes.	12%	5
2	**Linear and Angular Measurement** Line standards, end standards, sources of error in measurement. Various Linear measuring instruments like Callipers, surface plates, vernier height gauge, vernier depth gauges, micrometres, slip gauges. Comparators: classification and Characteristics of comparators, uses, working principal, advantages and disadvantages of various types of comparators. Angular measurements: Bevel protector, sine principle and sine bars, angle gauges, clinometers, optical instrument for angle measurements.	20%	8
3	**Limits, fits and gauges** Tolerances, limits, fits and allowances, basis of system (Shaft and Hole), types of fits and their interpretation, types of gauges and gauge design.	8%	4
4	**Measurement of Surface Finish, Screw Threads & Gears Measurement of Surface Finish:** Meaning of surface texture & surface roughness, terminology as per Indian standards, methods of measuring surface finish, surface roughness measurement techniques. Measurement of screw threads and gears: Metrology of screw thread: screw thread terminology, errors in threads, measurements of various elements of thread. Gear measurement: Sources of error in manufacturing gears, gear tooth terminologies, rolling tests, measurements of various gear elements.	10%	6

5	**Measurements of Force, Torque, and Pressure** **Measurement of Force:** platform balance, load cell, proving ring; **Measurement of Torque:** dynamometer; Pressure Measurement Scales, Method of Pressure Measurement, Ring Balance, Inverted Bell Manometer, Dead-weight Pressure Gauge, Measurement of Vacuum, High Pressure Measurement.	15%	7
6	**Measurements of Strain, Speed, and Temperature** Techniques of Measurement of Strain, Strain Gauge Material, Backing or Carrier Materials, Adhesives, Protective Coatings, Bonding of Gauges. Different techniques of Measurement of speed such as tachometer, Speedometers and Stroboscope, Different techniques of temperature measurement: Thermistor, Thermocouples, Thermometer.	15%	7
7	**Transducers, Sensors and Miscellaneous Instrumentation.** Transducers-concept, classifications, measurable physical quantities Electrical transducers-types, working principles and applications, types of transducers, Sensors-classification and applications, proximity sensor, piezo electric sensor, RTD Sensor, LVDT. Coordinate measuring machines, Precision Instruments based on Laser, Automated Inspection, Machine Vision, Data Acquisition System, Data Analysis Tools, Interfacing, Digital and Analog Converter, Microcontrollers, VFD.	20%	8
	Total	100%	45

i. Text Book and Reference Book:

1. A textbook of metrology, By M. Mahajan
2. Engineering Metrology, By G. Thomas and G. Butter | Worth PUB
3. Engineering Metrology and Measurement, By N V Raghavendra and Krishnamurthy | Oxford University Press
4. Metrology and Measurement, By Anand Bewoor & Vinay Kulkarni | McGraw-Hill

a. **Course Name:** Metrology and Instrumentation Lab
b. **Course Code:** 203109262
c. **Prerequisite:** Basic knowledge of Elements of Mechanical Engineering
d. **Rationale:** The "Metrology and Instrumentation Lab" provides students with practical exposure to precision measurement techniques and advanced instruments, bridging the gap between theoretical knowledge and real-world applications. This experiential learning environment is essential for cultivating hands-on skills, ensuring that students are well-prepared to meet the demands of industries that rely on accurate measurements and instrumentation expertise.

e. **Course Learning Objective:**

CLOBJ 1	Explain the fundamental principles and purpose of metrology in measurement science and precision engineering.
CLOBJ 2	Apply knowledge to select appropriate linear measuring instruments for accurate measurements of diverse component dimensions.
CLOBJ 3	Demonstrate the ability to choose suitable instruments for measuring angular and taper features in a variety of components.
CLOBJ 4	Develop the skill to differentiate between various screws based on precise measurements of their dimensional characteristics.
CLOBJ 5	Apply measurement techniques to distinguish between different gears by assessing various dimensions critical to their function.
CLOBJ 6	Assess machining process effectiveness by quantifying and analysing the surface finish of produced components for improved quality control and performance optimization.

f. **Course Learning Outcomes:**

CLO 1	Describe basic concepts of Metrology.
CLO 2	Select linear measuring instrument for measurement of various components.
CLO 3	Select angular and taper measurement devices for measurement of various components.
CLO 4	Discriminate between various screws by measuring their dimensions.
CLO5	Separate different gears through measurement of various dimensions of gears.
CLO 6	Distinguish capabilities of machining process by measuring surface finish of the component produced.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	2	1	0	0	20	0	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Exp. No.	Name of the Experiment
1	Basic understanding of measurements and metrology: concepts, application, advantage and future aspects.
3	Angular measurement
4	Temperature measurement
5	Speed measurement
6	Surface roughness measurement
7	Thread parameter measurement
8	Gear tooth measurement
9	Calibration of Pressure Gauge and Micrometre
10	Study of Stress, strain and force measurements
11	Demonstration of Profile Projector

a. **Course Name:** Fluid Mechanics and Machines
b. **Course Code:** 303109253
c. **Prerequisite:** Basic knowledge of Elements of Mechanical Engineering
d. **Rationale:** The subject builds the ability of the student to analyse Fluid Properties and its flow parameters by applying different theories and principles of Fluid Mechanics and Fluid Machines.

e. **Course Learning Objective:**

CLOBJ 1	Develop a thorough grasp of the fundamental principles, properties, and their applications in diverse engineering scenarios.
CLOBJ 2	Apply acquired knowledge to solve problems and address challenges in fluid mechanics and hydraulics within engineering contexts.
CLOBJ 3	Assess, identify, and utilize key performance parameters crucial in evaluating fluid systems and apply various measuring techniques to quantify and assess the performance of fluid systems.
CLOBJ 4	Understand & analyse the static and dynamic behaviour of fluids using foundational principles.
CLOBJ 5	Apply mathematical models to investigate fluid behaviour, solving engineering problems related to fluid mechanics, and evaluating the performance of hydraulic devices.

f. **Course Learning Outcomes:**

CLO 1	Develop a comprehensive understanding of fluid mechanics and hydraulics.
CLO 2	Apply the encompassing fundamental principles, properties, and applications in various engineering contexts
CLO 3	Evaluate and identify key Performance parameter and measuring techniques
CLO 4	Analyse statics and dynamics of fluids using principles
CLO5	Investigate fluid behaviour, apply mathematical models to solve problems, and evaluate the performance of hydraulic devices.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	0	0	3	20	20	0	60	0	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Fluid Properties and Fluid Statics** Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Pascal's law, hydrostatic law, pressure measurements through Piezometer and U-Tube manometer.	10%	6
2	**Fluid Dynamics (Inviscid flow)** Control volume- application of continuity equation and momentum equation, Incompressible flow, Euler's equation, Bernoulli's equation and its application. Flow measurements using Venturimeter, Orifice meter and Pitot tube.	15%	8
3	**Fluid Dynamics (Viscous flow)** Flow of viscous fluids in a circular pipe, shear stress and pressure gradient relationship, Velocity distribution, Major and Minor energy losses in pipes, Darcy-Weisbach equation, Moody's diagram, pipes in series and parallel connection.	15%	7
4	**Dimensional Analysis** Dimensional homogeneity, Rayleigh's method, Buckingham-pi theorem, Dimensionless Numbers, Geometrical, Kinematics and Dynamic Similarity.	10%	3
5	**Impact of Jet** Impact of jet on fixed and moving flat and curved plates.	10%	4
6	**Turbo machinery Hydropower Plant** Introduction and essential components. Impulse Turbine: Classification of a turbine, Impulse turbine, Pelton wheel, Construction working, work done, Head & efficiencies and design aspects. Reaction Turbine. Radial flow reaction turbine, Francis turbine: construction & working, work done, efficiency and design aspect, Propeller and Kaplan turbine, Draft tube, Specific speed, Unit quantities, Cavitation, Degree of reaction, Performance Characteristics, Governing of turbines.	20%	9
7	**Pumps & Hydraulic Devices** Classification of Pumps, Construction and working of Centrifugal Pump and Reciprocating Pump, work done, Heads, Efficiencies, Characteristic curves, Net positive suction head, minimum starting speed of the pump, Cavitation phenomena. Hydraulic press, Hydraulic accumulator, Hydraulic lift, Hydraulic ram, Hydraulic coupling, Hydraulic intensifier.	20%	8

Total	100%	45

i. Text Book and Reference Book:

1. Fluid Mechanics & Hydraulics Dr. R. K. Bansal; Laxmi Publications
2. Fluid Mechanics By Yunus A. Cengel, John M. Cimbala | Tata McGraw Hill.
3. Introduction to Fluid Mechanics and Fluid Machines By S. K. Som and G. Biswas | Tata McGraw Hill.
4. Fluid Mechanics and Fluid Power Engineering D.S. Kumar; S.K. Kataria & Sons
5. Engineering Fluid Mechanics By K.L. Kumar | Eurasia Publication House

a. **Course Name:** Fluid Mechanics and Machines Lab
b. **Course Code:** 303109254
c. **Prerequisite:** Knowledge of Engineering Physics and Engineering Chemistry
d. **Rationale:** The subject builds the ability of the student to analyse Fluid Properties and its flow parameters by applying different theories and principles of Fluid Mechanics and Fluid Machines.
e. **Course Learning Objective:**

CLOBJ 1	Illustrate how variations in fluid properties influence overall system behaviour and performance.
CLOBJ 2	Analyse how design, operational variables, and fluid properties affect device efficiency and functionality.
CLOBJ 3	Apply experimental findings to evaluate the practical performance of hydraulic systems in real-world scenarios.
CLOBJ 4	Analyse and quantify the efficiencies, coefficients, and forces exerted by fluid flows on different structures and components.
CLOBJ 5	Evaluate the performance characteristics of hydraulic devices such as pumps, turbines, orifices, and other components.

f. **Course Learning Outcomes:**

CLO 1	Apply acquired knowledge to understand and interpret the behaviour of fluids in various flow conditions and geometries.
CLO 2	Analyse efficiencies, coefficients, and forces exerted by fluid flows on various structures.
CLO 3	Apply experimental data to assess the efficiency, power output, and performance parameters of diverse hydraulic systems and components.
CLO 4	Evaluate the performance characteristics of hydraulic devices.
CLO 5	Demonstrate the fluid behaviour and Its property analysis.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	2	1	0	0	20	0	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. Fluid Mechanics & Hydraulics Dr.R. K. Bansal; Laxmi Publications
2. Fluid Mechanics, By Yunus A. Cengel, John M. Cimbala | Tata McGraw Hill.
3. Introduction to Fluid Mechanics and Fluid Machines, By S. K. Som and G. Biswas | Tata McGraw Hill.
4. Fluid Mechanics and Fluid Power Engineering D.S. Kumar; S.K. Kataria & Sons
5. Engineering Fluid Mechanics, By K.L. Kumar | Eurasia Publication House

i. List of Experiments:

Exp. No.	Name of the Experiment
1	To validate Bernoulli's theorem as applied to the flow of water in a tapering circular duct.
2	To determine coefficient of discharge for venturimeter.
3	To study laminar and turbulent flow and its visualization on Reynolds apparatus.
4	To calibrate the given rectangular, triangular and trapezoidal notches.
5	To determine hydraulic coefficients of an orifice.
6	To determine the impact forces of a jet of water on the flat and hemispherical vane.
7	To determine the output power and overall efficiency of a centrifugal pump.
8	To determine the specific speed and efficiency of a Pelton wheel turbine.
9	To determine the specific speed and efficiency of a Francis turbine.
10	To study about wind tunnel experiment.

a. **Course Name:** Manufacturing Technology
b. **Course Code:** 303109255
c. **Prerequisite:** Knowledge of Manufacturing Processes
d. **Rationale:** Manufacturing technology focuses on manufacturing process of conventional and non-conventional methods, gear manufacturing process and techniques used for holding and fixing of work piece during manufacturing process.This subject is helpful for getting basic knowledge of metal cutting, force analysis, tool wear, welding, jig and fixture.
e. **Course Learning Objective:**

CLOBJ 1	Demonstrate a comprehensive understanding of fundamental metal machining processes. Interpret tool signature parameters.
CLOBJ 2	Explain the forces involved in metal cutting, significance of Merchant circle diagrams.
CLOBJ 3	Apply knowledge of metal cutting forces to optimize cutting parameters and understand the economic implications of machining processes
CLOBJ 4	Evaluate the applications and advantages of different metal forming methods
CLOBJ 5	Analyse and select the most appropriate welding process based on material compatibility, joint configuration, and application requirements.
CLOBJ 6	Demonstrate the ability to design jigs and fixtures for manufacturing processes, considering accuracy and repeatability.

f. **Course Learning Outcomes:**

CLO 1	Understand the concepts of Metal Cutting, Tool Geometry and its impact on machining.
CLO 2	Analyse the forces acting on Tool and workpiece, draw the force analysis diagram using merchant circle.
CLO 3	Apply the Knowledge to select the right welding process to specific application.
CLO 4	Compare various types forming methods and its applications.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	-	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**Mechanics of Metal Cutting** Introduction to basic elements of machining. Classification of cutting tools, tool geometry and nomenclature, selection of tool materials, characteristics of cutting tool materials. Tool life, factors affecting tool life. Mechanics of chip formation, types of chips and conditions conducive for the formation of Built-up edge, chip breakers. Orthogonal v/s Oblique cutting- Merchant circle diagram. Force and velocity relationship, shear plane angle. Energy consideration in Machining, Earnst-Merchant theory. Economics of metal machining.	20%	9
2	**Gear and Threads Manufacturing** Different types of threads, manufacturing methods, and tools involved. Different types of gears, it's forming and generating methods with their special features. Gears finishing processes. Gear manufacturing machines.	10%	4
3	**Presses and Press** Work Classification of presses and Press operations. Classification of dies, cutting actions in dies, clearance, cutting forces, centre of pressure.	10%	4
4	**Introduction and mechanism of metal forming processes** Plastic deformation and yield criteria, Material behaviour in metal forming processes, Role of temperature in forming processes, Classification of metal forming processes. Hot and Cold Working, Rolling, Extrusion, Wire and Tube Drawing, Cold working processes: Shearing, Drawing Squeezing, Blanking, Piercing, Deep Drawing, Bending, Coining and embossing, Metal working defects. Mechanism of bulk deformation processes (rolling, forging, wire drawing, and extrusion) and sheet metal forming processes, Applications of metal forming processes.	25%	12
5	**Metal Joining Processes** Importance, classification, advantages andlimitations in general, comparison between fusion & non-fusion welding processes. Principle of operation, characteristics and applications of: Diffusion welding (arc welding, resistance welding, oxy-fuel welding), ultrasonic welding, friction welding, electron beam, laser beam, plasma arc welding, explosive welding, soldering, brazing and adhesive bonding. Spot, Projection and Seam welding process. Welding defects and its remedies. Welding joints andpositions. Overview of underwater welding.	25%	12
6	**Jigs & Fixtures**		

	Difference between jigs& fixtures. Design principles, Types of jigs & fixtures, design of jigs and fixtures for various machining operations.	10%	4
	Total	100%	45

i. Text Book and Reference Book:

1. "Metal Cutting Principles", by Trent McGraw Hill Publication.
2. "Tool Design, by Donaldo", Tata McGraw Hill Publication.
3. "Fundamentals of Machining and Machine Tools", by Boothroyd CRC Publications.
4. "Production Technology", by HMT-Tata Mc Graw Hill Publication.

a. **Course Name:** Manufacturing Technology Lab
b. **Course Code:** 303109256
c. **Prerequisite:** Knowledge of Manufacturing Processes
d. **Rationale:** Manufacturing technology focuses on manufacturing process of conventional and non-conventional methods, gear manufacturing process and techniques used for holding and fixing of work piece during manufacturing process. This subject is helpful for getting basic knowledge of metal cutting, force analysis, tool wear, welding, jig and fixture.
e. **Course Learning Objective:**

CLOBJ 1	Demonstrate a comprehensive understanding of fundamental metal machining processes. Interpret tool signature parameters.
CLOBJ 2	Apply the theoretical Knowledge of forces calculation in Machining and compare practical.
CLOBJ 3	Illustrate the Gear and Thread Manufacturing types with advantages and limitations.
CLOBJ 4	Apply the Welding concepts to see the coalescing of materials, flames and the characteristics.
CLOBJ 5	Demonstrate the Arc Welding types, its parameter impact on the weld structurers.

f. **Course Learning Outcomes:**

CLO 1	Understand the concepts of Metal Cutting, Tool Geometry and its impact on machining.
CLO 2	Develop the methods to measure the forces acting on the Tool and work piece.
CLO 3	Design and analyze Gear, Thread manufacturing with optimization of process parameters.
CLO 4	Examine the physical and mechanical behaviour of metals with variation in properties and structure.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. "Metal Cutting Principles", by Trent McGraw Hill Publication.
2. "Tool Design, by Donaldo", Tata McGraw Hill Publication.
3. "Fundamentals of Machining and Machine Tools", by Boothroyd CRC Publications.
4. "Production Technology", by HMT-Tata Mc Graw Hill Publication.

i. List of Experiments:

Exp. No.	Name of the Experiment
1	To understand the Effect of chosen parameters on the type of chip produced
2	Determination of chip-thickness ratio during Machining.
3	Determination of shear plane angle during machining
4	Measurement of cutting forces in turning using Lathe Tool Dynamometer and preparation of Merchant's circle
5	To study and practice of thread manufacturing.
6	Design a Jig and Fixture for given component
7	To study different types of press tool dies and exercise on strip layout and centre of pressure.
8	To measure the force required in extrusion.
9	To understand the principle and performance of gas welding and gas cutting Process
10	To understand and practice of arc welding process: TIG, MIG, SMAW

a. **Course Name:** Strength of Materials
b. **Course Code:** 303109257
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Basic Electrical Engineering knowledge is fundamental as it provides a strong foundation for various engineering disciplines, promotes problem-solving skills, supports innovation, and opens doors to diverse career opportunities.
e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of all stresses and strains and principal stress in 2D state of stress.
CLOBJ 2	Solve problems of strain energy in different loading conditions
CLOBJ 3	Solve 2-dimension state of stress and apply theories of failures to find safety of an object.
CLOBJ 4	Understand the torsion of shaft and design the shaft in standard loading conditions
CLOBJ 5	Derive the flexure and shear stress equation and apply the same on beams.
CLOBJ 6	Derive the equations for long and short columns and apply the same to decide the safety of columns and beams deflections

f. **Course Learning Outcomes:**

CLO 1	Understand the principal stresses.
CLO 2	Apply the concept of strain energy to different structures and components.
CLO 3	Apply different theories of failures for designing structure or a real-life machine component made of ductile and brittle materials.
CLO 4	Understand the behaviour of shafts under the action of torque and twisting moment.
CLO 5	Understanding beam bending and draw the stress distribution.
CLO 6	Analyze columns and determine the critical buckling loads and analyze the deflection of simply supported and cantilever beam

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	1		4	20	20	50	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Principal Stresses** Normal stress and strain, shear stress and strain, stresses on inclined sections, stress transformation, state of plane Stress, principal stress, maximum principal shear stress, Mohr strain.	18%	08
2	**Strain Energy** Strain energy, strain energy stored in a body when load is applied gradually, suddenly and with impact, strainenergy stored in a bar due to shear stress.	09%	04
3	**Theories of Failure** Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory, graphical representation and derivation of equation for each and their application to problems relating to two- dimensional stress systems only.	18%	08
4	**Torsion** Derivation of equation of torsion, assumptions, Applications of torsion equation to solid & hollow circular shaft, torsional rigidity, power transmitted by a shaft.	7%	03
5	**Stresses in Beams** Flexural Stresses, Theory of simple bending, assumptions, derivation of equation of bending, neutral axis determination, section modulus, bending stresses in symmetrical and unsymmetrical sections, composite beams (flitched beams). Shear Stresses and derivation of formula, shear stress distribution across various beam sections.	20%	09
6	**Columns** Eulers Column theory with assumptions, crippling load of a column subjected to different boundary conditions (both ends hinged, both ends fixed, one end fixed with other end free, one end fixed with other end hinged), Effective length of a column.	13%	06
7	**Deflection of Beams** Equation of elastic curve, double integration method, Macaulay's method, Slope and deflection for standard loading cases (simply supported beam carrying central point load, eccentric point load, uniformly distributed load; cantilever subjected to point load at free end, uniformly distributed load).	15%	07
	Total	100%	45

i. Text Book and Reference Book:

1. Mechanics of Materials by R. C. Hibbeler | Pearson Education | 9th, Pub. Year 2018
2. Mechanics of Solids by B.C. Punamia | Laxmi publications Private limited.
3. Strength of Materials by By S. Ramamrutham | Dhanpat Rai Publishing Company (P) Limited.
4. Mechanics of Materials by Timoshenko and Gere | Van Nostrand Reinhold Co.
5. Engineering Solid Mechanics by By L.S Srinath | Tata McGraw Hill

j. List of Experiments:

Sr. NO.	Experiment List
1	Fundaments of SF, BM, CG and M.o.I
2	Problems on principal stress and principal strain using analytical and graphical method (Mohr's circle).
3	Problems on torsion of shaft.
4	Problems on stresses in beams and distribution diagrams.
5	Problems on strain energy and impact load.
6	Problems on deflection of beam.
7	Problems on theories of failure and their applications.
8	Exercise on columns subjected to different boundary conditions
9	Study of Universal Testing Machine
10	Study of Torsion Testing Machine

a. **Course Name:** Vehicle Structure Engineering
b. **Course Code: 303102251**
c. **Prerequisite:** Basic knowledge about different types of vehicle chassis and body.
d. **Rationale:** The course is designed to impart knowledge in the construction of vehicle, aerodynamics, design, and construction of the external body of the vehicle.
e. **Course Learning Objective:**

CLOBJ 1	Understand the fundamental principles of structural design as they apply to vehicles.
CLOBJ 2	Learn about the selection of materials for vehicle structures, considering factors such as strength, weight, and durability.
CLOBJ 3	Explore principles of crashworthiness and safety in vehicle design.
CLOBJ 4	Understand the design considerations for vehicle chassis and frames.
CLOBJ 5	Demonstrate knowledge of painting techniques employed in vehicle body finishing.

f. **Course Learning Outcomes:**

CLO 1	Understand the concept of car body design, passenger safety, crumple zone and crash testing.
CLO 2	Explain the concepts of wind tunnel testing and vehicle body optimization techniques to reduce drag.
CLO 3	Explain the various types of the bus body construction, seating layout, regulations, and comfort.
CLO 4	Understand the various heavy vehicle bodies, Driver's visibility, and cabin design.
CLO 5	Explain the different types of materials and painting techniques for a vehicle body.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**Vehicle Chassis:** Introduction, Basic construction of chassis, Types of chassis layout with reference to power plant location and drive, Chassis frame components, Types of joints and sections used.	10%	03
2	**Car Body:** Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car − Driver seat design, Visibility regulations, driver's visibility, improvement in visibility and tests for visibility, Safety aspect of car body − Crumple Zone. Crash Test & Roll Over Test, Dash-Board, Heating & ventilation systems, Instrument panel & passenger compartment lighting.	17%	05
3	**Bus Body: Types of bus body:** Based on capacity, Distance travelled and based on construction. Layout for various types of Bus body − Mini Bus, Single & Double decker, Split Level & Articulated bus, Floor Height, Passenger Seating dimensions, Entrance & Exit Locations, Emergency door location. Double skin construction, Types of metal sections used, Bus body code regulations (ARAI), Constructional details: Conventional and integral. Luggage space location, seating layouts, passenger comfort.	20%	06
4	**Commercial Vehicle Body:** Types of commercial vehicle bodies − LCV, MCV, HCV. Construction details of − Flat platform body, Trailer, Tipper and Tanker body, Tractor Trailer − Dimensions of driver's seat in relation to controls − Driver's cabin design, Pay load and related regulations.	13%	04
5	**Vehicle Aerodynamics:** Vehicle Aerodynamic drag and its types, Types of force and moments and its effects on performance, various body optimization techniques for minimum drag, Wind tunnel testing of scale model.	10%	03
6	**Body loads:** Idealized structure, structural surface, shear panel method, symmetric and asymmetric vertical loads in a car, longitudinal load, different loading situations, chassis frame design, Construction of Doors, door apertures, windows. Spare wheel carrier construction and design for different types of vehicle and weight distribution criteria in	17%	05

	relation to Spare wheel location. Sources of body noises testing and methods of elimination. Water leakage test.		
7	**Body Materials, Trim & Mechanisms:** Metal sheets (Steel, Aluminum etc.), plastics, timber, GRP, FRP, Insulating materials, adhesives and sealants. Wind screen, Back light & window Glasses and regulations for glasses. Difference between toughened glass, sheet glass & laminated glass. Composite materials, properties of materials, corrosion, anti-corrosion methods, selection of paint and painting process, body trim items, body mechanisms.	13%	04
	Total	100%	30

i. Text Book and Reference Book:

1. Automotive Chassis & Body By P.L.Kohli | Papyrus Publishing House, New Delhi 2018
2. Automotive Chassis By Crouse W.H.& Anglin D.L. | McGraw-Hill Int. Book Co
3. Vehicle Body Engineering By J. Powloski | Business Books Ltd., London
4. Body Engineering By Sydney F. Page | Chapman & Hill Ltd., London
5. Automotive Chassis By P.M. Heldt | Chilton Co. NK
6. Vehicle Body Layout & Analysis By John Fenton | Hutchinson, London