Second Year Curriculum

Admission Year 2026-27

Bachelor of Technology
Automobile Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Semester 3

a. Course Name: Vehicle Kinematics and Machines
b. Course Code: 03010203PC01
c. Prerequisite: Engineering Mathematics, Engineering Mechanics, Basic Physics, Introduction to Automobile Engineering
d. Rationale: This course provides a strong foundation in machine kinematics and motion control devices, enabling students to analyze both conventional automotive mechanisms and modern vehicle systems including stability control and automation.
e. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**				
L	T	P	C	MSE	CE	P	Theory	Total
3	0	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
f. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction to Kinematics of Machines: Machine and mechanism concepts, Links, pairs, kinematic chains, Degree of freedom (Kutzbach criterion), Classification of mechanisms, Automobile examples	12%	6
2	Kinematic Analysis of Mechanisms: Four-bar and slider-crank mechanisms, Inversions and applications in IC engines, pumps, compressors, Steering mechanisms (Ackermann, Davis), Straight-line mechanisms	18%	8
3	Velocity and Acceleration Analysis: Relative velocity method, Instantaneous center method, Velocity and acceleration polygons, Application to engine, valve, and suspension mechanisms	20%	9
4	Cam and Gear Mechanisms: Cams and followers – types and applications, Displacement, velocity, acceleration diagrams, Motion programs (SHM, uniform velocity, uniform acceleration), Gears – law of gearing, spur, helical, bevel gears, Automotive gearbox and differential gearbox	20%	9
5	Governors and Friction Devices: Governors: purpose and classification, Centrifugal governors (Watt, Porter, Proell, Hartnell), Sensitiveness, stability, isochronism, Friction: laws of friction, Brakes (shoe, band, disc) and clutches (single & multi-plate), Automotive braking and clutch systems	18%	8
6	Gyroscope and Advanced Automotive Applications:	12%	5

	Gyroscopic motion and effects, Gyroscopic couple and reactions, Effect of gyroscope on vehicles, ships, and aircraft, Stability of two-wheelers and automobiles, Introduction to modern vehicle mechanisms (active suspension, steering assist), Case studies		
Total		100%	45

g. Text Book and Reference Book:

1. Theory of Machine (TextBook) – By R. S. Khurmi and J. K. Gupta | S. Chand
2. Design of Machinery – By Robert L. Nortan | Tata McGraw Hill Edition
3. Theory of Machines and Mechanisms – By J. Uicker, Gordon R Penstock & J.E. Shigley | Oxford
4. Mechanisms and Dynamics of Machinery – By Hamilton H. Mabie | John Wiley and Sons New York
5. Theory of Ground Vehicles – By J. Y. Wong | John Wiley and Sons Inc., New York | 2001
6. Fundamentals of Vehicle Dynamics – By Thomas D. Gillespie | SAE USA | 1992

h. Course Outcome:

After Learning the Course the students shall be able to:

1. Classify machines, mechanisms, and kinematic pairs used in vehicles.
2. Analyze motion and mobility of planar mechanisms.
3. Determine velocity and acceleration of automobile mechanisms.
4. Analyze cam, gear, and governor mechanisms used in engines and transmissions.
5. Evaluate frictional devices such as brakes and clutches.
6. Apply gyroscopic principles to vehicle stability, steering, and dynamic behavior.

a. Course Name: Vehicle Kinematics and Machines Lab

b. Course Code: 03010203PC02

c. Prerequisite: Engineering Mathematics, Engineering Mechanics, Basic Physics, Introduction to Automobile Engineering

d. Rationale: This course provides practical understanding of machine kinematics, mechanisms, gears, governors, brakes, clutches, and gyroscopic effects used in automobile engineering.

e. Teaching & Examination Scheme:

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

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

f. List of Practical:

1. Study and identification of kinematic pairs, chains, and mechanisms used in automobile systems.
2. Analysis of slider–crank mechanism: determination of displacement, velocity, and acceleration.
3. Determination of velocity and acceleration using instantaneous center method.
4. Cam and follower mechanism: plotting displacement, velocity, and acceleration diagrams.
5. Study and analysis of gear trains (simple, compound, and epicyclic) used in automotive transmissions.
6. Performance characteristics of centrifugal governor (Watt / Porter / Hartnell).
7. Study of friction in mechanical systems: block on ring or inclined plane experiment.
8. Performance evaluation of brakes (shoe / band / disc brake).
9. Performance evaluation of clutches (single-plate or multi-plate clutch).
10. Demonstration and analysis of gyroscopic effects using gyroscope apparatus.

g. Course Outcome:

1. Understand kinematic pairs, chains, and mechanisms used in automobile systems.
2. Analyze displacement, velocity, and acceleration in mechanisms.
3. Determine velocity and acceleration using instantaneous center method.
4. Evaluate gear trains, governors, brakes, and clutch systems.
5. Analyze gyroscopic effects in vehicle systems.

a. Course Name: Automotive Chassis & Components
b. Course Code: 03010203PC03
c. Prerequisite: Engineering Mechanics, Basic Automobile Engineering.
d. Rationale: This subject provides fundamental knowledge of automotive chassis systems and components essential for understanding vehicle structure, ride, handling, safety, and overall performance.
e. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory	Total
3	0	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

f. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Fundamentals of Automotive Chassis and Body:** Classification of Vehicles Based on Application and Design; Evolution and History of Automotive Body Engineering; Functional Requirements of Automotive Body Structures; Functions and Role of Vehicle Body in Safety and Performance; Classification and Description of Automotive Body Types; Chassis Frames: Functions and Structural Requirements; Types of Chassis Frames: Ladder, Cruciform, Twin Tube, Backbone, Monocoque, Space Frame, and Platform Structures; Location of Power Plant in Different Vehicle Layouts	17%	5
2	**Car Body Design, Structure, and Styling Engineering:** Classification of Car Body Coachwork and Body Styles; Monocoque (Integral) Body Construction: Features and Advantages; Description and Functions of Major Car Body Components; Sub-Frame and Under-Floor Structure of Car Body; Types of Frame Sections Used in Car Body Structures; Loads Acting on Car Body Structures; Concept and Importance of Body-in-White (BIW) Design; Design Features and Structural Requirements of Car Body; Static Loading Case Analysis of Car Body; Asymmetric Loading Case Analysis; Longitudinal Loads Acting on Car Body; Side Loads and Lateral Load Effects; Materials Used for Car Body Construction and Their Properties.	27%	8
3	**Design and Construction of Bus and Commercial Vehicle Bodies: Bus and Coach Body Design:** Classification of Bus Bodies Based on Application and Design; Coach and Bus Body Styles; Layout of Bus and	33%	10

	Coach Bodies; Floor Height Variations and Their Significance; Engine Location in Bus and Coach Designs; Seating Dimensions and Passenger Comfort Requirements. **Constructional Features and Regulations:** Frame Construction Methods for Bus Bodies; Double-Skin Construction and Its Advantages; Types of Metal Sections Used in Bus Body Construction; Bus Body Regulations and Standards; Conventional and Integral Type Bus Body Construction. **Commercial Vehicle Body Design:** Classification of Commercial Vehicle Bodies (Drop-side, Tanker, Tipper, Flat Platform, etc.); Driver Cabin Dimensions and Control Layout; Ergonomic Design Considerations for Driver Cabin. Materials Used for Bus and Commercial Vehicle Body Construction		
4	**Vehicle Aerodynamics and Safety Systems:** **Vehicle Aerodynamics:** Objectives and Importance of Vehicle Aerodynamics; Aerodynamic Drag and Its Types; Aerodynamic Forces and Moments Acting on Vehicles; Effects of Aerodynamic Forces and Moments on Vehicle Performance and Stability; Wind Tunnel Testing for Automotive Applications; Body Shape Optimization Techniques for Drag Reduction. **Vehicular Safety Systems:** Concept and Classification of Vehicular Safety; Seat Belt and Air-Bag Systems: Concept and Working; Occupant Protection and Passive Safety Features; Vehicle Crash Test: Body Alignment and Structural Safety Tests.	13%	4
5	**Ergonomic Design and Interior Layout of Vehicles:** Introduction to Automotive Ergonomics; Interior Ergonomics and Vehicle Control Layout; Concept of Driver Reference Points (H-Point, BOF, AHP, SRP); Driver–Seat–Control Relationship; Forward Vision Requirements and Visibility Analysis; Truck Cab Ergonomics and Cabin Layout Design; Design and Layout of Dashboard Instruments.	10%	3
Total		100%	30

g. Text Book and Reference Book:

1. Vehicle Body Engineering (TextBook) – By J. Powloski | Business Books Ltd., London
2. Automotive Chassis & Body (TextBook) – By P.L. Kohli | Papyrus Publishing House, New Delhi
3. Advanced Vehicle Technology – By Heinz Heisler | Butterworth Heinemann

4. Automotive Engineering: Powertrain, Chassis System & Vehicle Body – By David Crolla | Elsevier
5. Fundamentals of Automobile Body Structure Design – By Donald E. Malen | SAE International

h. Course Outcome:

1. Explain the classification, structure, and functional role of automotive chassis and body systems.
2. Describe car body design, Body-in-White structure, loading conditions, and material selection.
3. Explain the design, layout, construction, and regulations of bus and commercial vehicle bodies.
4. Analyze vehicle aerodynamic characteristics and safety systems for performance and occupant protection.
5. Explain ergonomic principles and interior layout design of vehicles for driver comfort and control.

a. Course Name: Automotive Chassis & Components Lab
b. Course Code: 03010203PC04
c. Prerequisite: Engineering Mechanics, Basic Automobile Engineering.
d. Rationale: This lab provides practical exposure to automotive chassis systems, body structures, ergonomics, safety systems, and aerodynamic characteristics.
e. Teaching & Examination Scheme:

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

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

f. List of Practical:

1. Demonstrate the vehicle types based on application, body style, and layout.
2. Study of chassis frames and vehicle body structures.
3. Demonstrate car body components, sub-frame, and under-floor structure.
4. Demonstrate the Body-in-White (BIW) structure and identification of major load paths.
5. Investigation of car body loading conditions.
6. Examination of bus and coach body layout.
7. Assessment of commercial vehicle body types and driver cabin ergonomics.
8. Evaluation of vehicle aerodynamic features and drag reduction techniques.
9. Investigation of vehicular safety systems.
10. Demonstrate vehicle interior ergonomics, driver reference points, and dashboard layout.

g. Course Outcome:

1. Understand various vehicle body structures and layouts.
2. Analyze BIW structure and load paths.
3. Examine commercial vehicle body and ergonomics.
4. Evaluate aerodynamic and safety systems.
5. Understand vehicle ergonomics and dashboard layout.

a. Course Name: Fundamentals of Thermodynamics
b. Course Code: 03010203PC05
c. Prerequisite: Engineering Physics and Elements of Mechanical Engineering.
d. Rationale: The course is designed to understand students the application of Dynamics of Machine in Automobile Engineering.
e. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory	Total
3	1	0	4	20	20	-	60	100

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

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Basic Concepts: Property, Equilibrium, Concept of Quasi Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, Heat and work transfer, First law of thermodynamics, steady flow process, limitations of first law of thermodynamics	20%	9
2	Second Law of Thermodynamics: Heat engine, heat reservoir, refrigerator, heat pump, COP, Carnot's theorem, Carnot cycle, entropy, T-S diagrams, availability concept, irreversibility, Gibbs and Helmholtz functions	28%	13
3	Properties of Steam: Pure substance, phase transformations, formation of steam, properties of steam, HS, TS, PV, PH, TV diagrams, dryness fraction, mollier chart	13%	6
4	Air Standard Cycles and Combustion: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle, efficiency, mean effective pressure, combustion equations, theoretical air and excess air	18%	8
5	Properties of Gas and Thermodynamic Relations: Ideal gas, real gas, Vander-wall's equation, compressibility factor, Maxwell relations, Joule-Kelvin effect	21%	9
Total		100%	45

g. Text Book and Reference Book:
1. Engineering Thermodynamics (TextBook) – By P. K. Nag
2. Basic and Applied Thermodynamics – By P. K. Nag | TMH | 2005
3. A Course in Thermodynamics and Heat Engines – By Kothandaraman C P, Khajuria P R and Arora S C

h. Course Outcome:
1. Understand fundamentals of thermal systems and their processes.
2. Apply the First Law of Thermodynamics to closed and open systems.
3. Apply the Second Law and entropy concepts.
4. Analyze thermodynamic cycles used in IC engines.
5. Calculate stoichiometric air-fuel ratios and combustion efficiency.

a. Course Name: Theory of Complex Variable, Partial Differential Equations
b. Course Code: 03019103BS03
c. Prerequisite: Geometry, Multivariable Calculus, Ordinary Differential Equations.
d. Rationale: - The course is designed to understand students the application of complex numbers and partial differential
e. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory	Total
3	0	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
f. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Analytic Functions and Complex Integration: Cauchy-Riemann equations, Harmonic functions, Contours and line integrals, Cauchy-Goursat theorem, Cauchy's integral formula	30%	14
2	Series Representation, Residue Theory and Conformal Mapping: Taylor Series, Laurent series, singularities, residues, residue theorem, Mobius transformations	30%	14
3	Partial Differential Equations: Solutions of first order linear and nonlinear PDEs, classifications of PDE, separation of variables method	40%	17
Total		100%	45

g. Text Book and Reference Book:

1. Complex Variables and Applications (TextBook) – By J. W. Brown and Ruel V. Churchill | McGraw-Hill
2. Advanced Engineering Mathematics (TextBook) – By Erwin Kreyszig | Willey India Edition
3. Elements of Partial Differential Equations (TextBook) – By I. Sneddon | McGraw Hill
4. Elementary Applied Partial Differential Equations with Fourier Series and Boundary Value Problem – By R. Haberman | Prentice Hall | 4th Edition
5. A First Course in Complex Analysis with Applications – By D. G. Zill and P. D. Shanahan | Jones and Bartlett Publishers
6. Introduction to Partial Differential Equations – By Rao K. S. | PHI Learning Pvt. Ltd.

h. Course Outcome:

1. Analyse properties of complex variable functions.
2. Understand singularities, residues and residue theorem.
3. Solve linear PDEs using separation of variables and transform methods.

a. Course Name: Basic Automotive Electronics
b. Course Code: 03010203ES01
c. Prerequisite: Basic knowledge of electronics components and sensors, knowledge of microprocessor/microcontroller, basic familiarity of automobile functions.
d. Rationale: Electronics system is integral part of Automobile. Embedded systems are used in automobiles for many operations like engine control, cruise control, transmission control, lighting, central locking system, battery management, fuel indication, ABS, parking assistance, on board diagnostics and alarms.
e. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory	Total
3	0	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
f. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit-1 Introduction to Automotive Electronics:**Introduction to modern automotive systems, Evolution of automotive electronics, Need for electronics in automobile, Introduction of electronics systems used in automobile at different places.	16%	7
2	**Unit 2: Basics of Electronic engine control:**Motivation for electronic engine control, Input to controller, output from controller, Definition of engine performance terms: Torque, Power, Fuel Consumption, Engine Overall Efficiency, Calibration, Engine Mapping, Effect of Air/Fuel Ratio on Performance, Effect of Spark Timing on Performance, Effect of Exhaust Gas Recirculation on Performance, Electronic Fuel Control Systems, Ideal speed control, Electronic ignition. Digital Engine control.	20%	10
3	**Unit 3: Sensors and Actuators: Sensors:**Airflow rate sensor, Pressure measurements, strain gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Hall effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP), Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Air Bag Sensors, Magnetic Reluctance position sensor, Exhaust gas oxygen sensor, knock sensor. Actuators: Automotive Ignition Control Actuators, Fuel Injector Actuator, Solenoids, Various types of piezoelectric force generators, Relays (Solid State relays and Electromechanical relays). Electro-Pneumatic: Pneumatic Motors, Electro Hydraulic Valves, Variable valve timings, Electric motor actuators: Brushless DC motor, Stepper motor, Ignition coil operations	28%	12
4	**Unit 4: Vehicle motion controls, diagnostic and protection systems:**Digital Cruise Control, Hardware Implementation Issues, Throttle Actuator, Cruise	20%	10

	control electronics, Antilock braking system, Electronics Suspension system, Electronic steering control, Four wheel steering, On board diagnosis, Automotive alarms, Lighting, Central locking and electric windows, Climatic Control, Driver information, Parking, occupant protection systems		
5	**Unit 5: Battery and electrical wiring:**Battery types and maintenance, Alternators in vehicles, Electrical circuits and wiring in vehicles, vehicle network and communication buses, Introduction to battery operated electric vehicles.	16%	6
Total		100%	45

g. Text Book and Reference Book:

1. Understanding Automotive Electronics – By Bechtold | SAE 1998
2. Automotive Electronics Handbook – By Ronald K. Jurgen | McGraw-Hill Inc. | 1999
3. Understanding Automotive Electronics – By William B. Ribbens | Butterworth Heinemann | 5th Edition

h. Course Outcome:

1. Understand the role of electronics in modern automobiles.
2. Explain electronic engine control systems.
3. Identify and analyze automotive sensors and actuators.
4. Apply automotive electronics concepts in system design.
5. Understand vehicle motion control, safety, and diagnostic systems.

a. Course Name: Design Thinking
b. Course Code: 03010203ES03
c. Prerequisite: Basic understanding of engineering problem-solving.
d. Rationale: Design Thinking provides a human-centered, structured approach to innovation, enabling students to tackle complex engineering and mobility challenges.
e. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory	Total
1	0	0	1	-	20	-	-	20

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

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit 1: Introduction to Design Thinking** Evolution of Design Thinking, Importance in engineering and innovation, Design Thinking vs traditional problem-solving, Automotive innovation examples	15%	2
2	**Unit 2: Empathy & Problem Identification:-** User-centered design, Stakeholder analysis, Observation and interviewing techniques, Identifying pain points in vehicle users, drivers, and society	20%	3
3	**Unit 3: Problem Definition & Ideation**Framing problem statements (How Might We?), Brainstorming techniques, SCAMPER, mind mapping, Ideation for automotive systems and mobility solutions	25%	4
4	**Unit 4: Prototyping & Testing:-**Rapid prototyping concepts, Low-fidelity prototypes (sketches, mock-ups), Feedback and iteration, Validation of design solutions	20%	3
5	**Unit 5: Design Thinking Applications in Automobile Engineering:**Case studies in vehicle design and mobility, Sustainable and user-friendly automotive solutions, Design Thinking for EVs, safety, ergonomics, and smart mobility	20%	3
Total		100%	15

g. Text Book and Reference Book:

1. Change by Design (TextBook) – By Tim Brown
2. Design Thinking: Understanding How Designers Think and Work – By Nigel Cross

h. Course Outcome:

1. Explain the principles and stages of Design Thinking.
2. Identify user needs and define problem statements effectively.
3. Generate innovative ideas using structured creativity tools.
4. Develop and evaluate low-fidelity prototypes.
5. Apply Design Thinking methodology to solve automobile-related challenges.

a. Course Name: Functional Communication Skills
b. Course Code: 03010003HM01
c. Prerequisite: Knowledge of Advanced Communication and Interpersonal Skills.
d. Rationale: This course develops workplace-oriented communication skills by bridging academic language competence with professional communication requirements.
e. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme				
L	T	P	C	MSE	CE	P	Theory	Total
1	0	2	2	-	-	60	30	150

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

f. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Sentence Correction** Error identification (grammar, usage, style) Common workplace errors Contextual grammar usage	10%	2
2	**Para Jumbles & Sentence Reordering** Logical sequencing Cohesion markers Theme identification	8%	1
3	**Statement and Assumptions** Fact vs assumption Logical reasoning basics Workplace problem scenarios	10%	1
4	**Reading Comprehension (Level of Difficulty - Advanced** Inferential questions Author's tone & intent Vocabulary in context	12%	2
5	**Resume and Cover Letter Writing** Resume formats Achievement-based bullet points Customizing cover letters	14%	2
6	**Building a Professional LinkedIn Profile** Professional headline Summary writing Digital networking ethics	8%	1
7	**Just a Minute (JAM)** Idea organization Fluency techniques Time management in speech	8%	1
8	**Telephone and Video Call Etiquette** Opening & closing calls Voice modulation Virtual meeting etiquette	8%	1
9	**Email Writing** Format Professional tone Subject lines Email etiquette	10%	2
10	**Report Writing Report Writing** Types of reports Structure & formatting	12%	2

	Use of visuals & data		
Total		100%	15

g. Text Book and Reference Book:

1. Business Communication Today – By Bovee, Courtland L., and John V. Thill | Pearson Education | 2019
2. Essentials of Business Communication – By Mary Ellen Guffey and Dana Loewy | Cengage Learning | 2018
3. Advanced Grammar in Use – By Martin Hewings | Cambridge University Press | 2013
4. English Vocabulary in Use: Advanced – By Michael McCarthy and Felicity O'Dell | Cambridge University Press | 2017
5. Personality Development and Soft Skills – By Barun K. Mitra | Oxford University Press | 2011
6. Technical Communication: Principles and Practice – By Meenakshi Raman and Sangeeta Sharma | Oxford University Press | 2018

h. Course Outcome:

1. Identify grammatical, usage, and style errors.
2. Understand grammatical rules and professional writing formats.
3. Apply principles of professional communication.
4. Analyse effective verbal, digital, and virtual communication skills.

Semester – 4

a. Course Name: Mechanics of Materials for Automobiles

b. Course Code: 03010204PC01

c. Prerequisite: Engineering Mathematics, Engineering Physics, Engineering Mechanics

d. Rationale: This course provides fundamental knowledge of stress, strain, bending, torsion, and deflection in engineering materials. It enables students to analyze and design safe and efficient structural and machine components used in mechanical and automotive engineering applications.

e. Course Learning Objective:

CLOBJ 1	Understand and analyze stress–strain behavior of materials under different loading conditions.
CLOBJ 2	Apply principles of elasticity to determine stresses and strains in simple and composite members.
CLOBJ 2	Analyze shear force and bending moment in beams subjected to various types of loading.
CLOBJ 4	Evaluate bending, shear, torsional stresses, and deflection of structural members.
CLOBJ 5	Apply theoretical concepts to real-life engineering design problems.

f. Course Learning Outcomes:

CLO 1	Calculate stresses and strains for uni-axial, bi-axial, and thermal loading conditions.
CLO 2	Determine principal stresses and strains using analytical methods.
CLO 3	Draw and analyze shear force and bending moment diagrams for different types of beams.
CLO 4	Compute bending and shear stresses in beams of various cross-sections.
CLO 5	Assess strain energy, impact loading effects, and buckling of columns and struts for safe design.

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.	Topics	Weightage	Teaching Hours
1	**Basic Concepts of Stress, Strain, and Elasticity** Concept of simple stresses and strains: Introduction, stress, strain, types of stresses, stress and strain diagram for brittle & ductile material, elastic limit, Hooks law, modulus of elasticity, modulus of rigidity, factor of safety, analysis of tapered rod, analysis of composite section, thermal stress and strain. Longitudinal Stress & Strain, Lateral Stress & Strain, Poisson's Ratio, Volumetric Stresses and Strain with uni-axial, bi-axial & tri-axial loading, bulk modulus, relation between Young's Modulus and Modulus of Rigidity Principal stresses and strains: - Definition of principal planes & principal stresses, analytical method of determining stresses on oblique section when member is subjected to direct stresses in one plane in mutually perpendicular two planes, when member is subjected to shear stress and direct stress in two mutually perpendicular planes, Mohr's Circle for representation of principal stresses.	20%	10
2	**Shear Force, Bending Moment, and Bending Stresses in Beams** Shear force and bending moment: - Types of beam (cantilever beam, simply supported beam, overhung beam etc.), Types of loads (Concentrated and UDL), shear force and bending moment diagrams for different types of beams subjected to different types of loads, sign conventions for bending moment and shear force, shear force and bending moment diagrams for beams subjected to couple, Relation between load, shear force and bending moment. Stresses in beams: - Pure bending, theory of simple bending with assumptions & expressions for bending stress, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections. Shear stresses in beams: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear Stress	25%	10
3	**Deflection of Beams, Strain Energy, and Impact Loading** Deflection of beams:- Deflection & slope of cantilever, simply supported, overhung beams subjected to concentrated load, UDL, Relation between slope, deflection & radius curvature Strain energy & impact loading: - Definition of strain energy stored in a body when it is subjected to gradually applied load, suddenly applied loads & impact loads. Strain energy stored in bending & torsion	25%	10
4	**Torsion of Circular Shafts and Combined Loading** Torsion of circular shafts: - Derivation of torsion equation with the assumptions made in it. Torsion shear stress induced in the shaft, when it is subjected to torque. Strength and rigidity criterion for design of shaft. Torque transmitted by solid & hollow circular shaft. Equivalent twisting and bending moment in shaft when it is subjected to bending moment, torque & axial load.	15%	8

5	**Columns and Struts: Buckling and Stability Analysis** Column & Struts: - Failure of long & short column, slenderness ratio, assumptions made in Euler's column theory, End Condition for Column, Expression for crippling load for various end conditions of column and derivation on column with both ends hinged. Effective length of column, limitation of Euler's formula, Rankine formula	15%	7

i. Text Book and Reference Book:

1. Strength of Materials by Bansal, R.K. , Laxmi Publications.
2. Mechanics of Materials by Beer, F.P., Johnston, E.R., DeWolf, J.T. McGraw-Hill
3. Engineering Mechanics of Solids by Popov, E.P., Pearson Education.
4. Strength of Materials by Ramamrutham by Dhanpant Rai & Sons

a. Course Name: Mechanics of Materials for Automobiles Lab

b. Course Code: 03010204PC02

c. Prerequisite: Engineering Mathematics, Engineering Physics, Engineering Mechanics

d. Rationale: This course provides fundamental knowledge of stress, strain, bending, torsion, and deflection in engineering materials. It enables students to analyze and design safe and efficient structural and machine components used in mechanical and automotive engineering applications.

e. Course Learning Objective:

CLOBJ 1	Understand and analyze **stress–strain behavior** of materials under different loading conditions.
CLOBJ 2	Apply principles of **elasticity** to determine stresses and strains in simple and composite members.
CLOBJ 2	Analyze **shear force and bending moment** in beams subjected to various types of loading.
CLOBJ 4	Evaluate **bending, shear, torsional stresses**, and **deflection** of structural members.
CLOBJ 5	Apply theoretical concepts to **real-life engineering design problems**.

f. Course Learning Outcomes:

CLO 1	Calculate stresses and strains for uni-axial, bi-axial, and thermal loading conditions.
CLO 2	Determine principal stresses and strains using analytical methods.
CLO 3	Draw and analyze shear force and bending moment diagrams for different types of beams.
CLO 4	Compute bending and shear stresses in beams of various cross-sections.
CLO 5	Assess strain energy, impact loading effects, and buckling of columns and struts for safe design.

g. Mapping of Experiment List with Course Learning Outcomes:

Sr. No.	Experiment List
1	Study of Simple Stresses and Strains
2	Study of determination of Principal Stresses and Principal Planes
3	Study of Thermal Stresses Analysis
4	Study of Shear Force and Bending Moment Diagrams
5	Study of Bending Stresses in Beams
6	Study of Shear Stress Distribution in Beams
7	Study of Deflection of Beams
8	Study of Torsion of Circular Shafts
9	Study of Columns and Struts
10	Strain Energy in Axially Loaded and Bending Members

a. **Course Name:** Automobile Engines
b. **Course Code:** 03010204PC03
c. **Prerequisite:** Basic Mechanical Engineering, Engineering Thermodynamics
d. **Rationale:** This course provides fundamental knowledge of internal combustion engines used in automobiles. It enables students to understand engine construction, working, performance and emission characteristics. The course also introduces modern engine technologies required for efficient, clean and high-performance vehicles.
e. **Course Learning Objective:**

CLOBJ 1	Describe the construction, working and classification of internal combustion engines.
CLOBJ 2	Understand the air–fuel preparation, ignition and combustion processes in spark ignition engines.
CLOBJ 3	Analyze fuel injection, combustion and knocking phenomena in compression ignition engines.
CLOBJ 4	Demonstrate the working of lubrication, cooling systems used in automobile engines.
CLOBJ 5	Understand Supercharger and Turbocharger used in Automobile Engines.

f. **Course Learning Outcomes:**

CLO 1	Describe the construction, working and classification of internal combustion engines.
CLO 2	Explain the air–fuel preparation, ignition and combustion processes in spark ignition engines.
CLO 3	Analyze fuel injection systems, combustion characteristics and knocking in compression ignition engines.
CLO 4	Demonstrate the operation of lubrication, cooling systems used in automobile engines.
CLO 5	Understand Supercharger and Turbocharger used in Automobile Engines.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				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.	Topics	Weightage	Teaching Hours
1	**Fundamentals of Internal Combustion Engines:** Concept, Definition, and Scope of Internal Combustion Engines; Classification and Applications of IC Engines; Engine Components: Construction, Materials, and Functional Roles; Working Principles of IC Engines; Operating Cycles of Four-Stroke and Two-Stroke Engines; Comparative Analysis of Four-Stroke and Two-Stroke Engines; Scavenging Process in Two-Stroke Engines and Its Types; Air-Standard Fuel–Air Cycles and Their Performance Analysis; Actual Engine Cycle and Deviations from Ideal Cycles; Valve Timing Events and Valve Timing Diagrams; Port Timing in Two-Stroke Engines and Port Timing Diagrams; Low Heat Rejection (LHR) Engines: Concept and Advantages.	16%	07
2	**Spark Ignition Engine: Systems and Operation:** **Spark Ignition (SI) Engine Fuel Systems:** Fundamentals and Principles of Carburetion; Functional Requirements of Automotive Carburetors; Carburetor Circuits: Starting, Idling, Acceleration, and Normal Running; Fuel Supply Systems: Mechanical and Electrical Fuel Pumps; Petrol Injection Systems: Overview and Classification; Multi-Point Fuel Injection (MPFI) System; Air–Fuel Ratio Requirements for SI Engines. **Ignition System:** Fundamentals and Purpose of Ignition Systems in SI Engines; Battery Ignition System: Construction and Working Principle; Magneto Ignition System: Construction and Working Principle; Ignition Coil: Function, Construction, and Operation; Spark Plug: Types, Working, and Performance Requirements; Contact Breaker Mechanism: Function and Operation; Ignition Advance Requirements in SI Engines; Ignition Advance Mechanism; Electronic Ignition Systems: Overview and Advantages; Capacitor Discharge Ignition (CDI) System. **Combustion Process and Characteristics in SI Engines:** Fundamentals of Combustion Phenomena in SI Engines; Ignition Delay in Spark Ignition Engines; Flame Propagation Process and Combustion Speed; Abnormal Combustion in SI Engines; Auto-Ignition Phenomenon in SI Engines; Detonation and Engine Knocking: Causes and Effects; Factors Influencing Combustion and Detonation; Types of Combustion Chambers for SI Engines; Stages of Combustion in SI Engines	31%	14
3	**Compression Ignition Engines: Systems and Operation:** **Compression Ignition (CI) Engine Fuel Systems:** Fundamentals of Fuel Injection in CI Engines; Common Rail Direct Injection (CRDI) System; Components and Functional Operation of CI Fuel Systems; Types of Fuel Injection Pump - Jerk Type Fuel Injection	22%	10

	Pump & Distributor Type Injection Pump; Fuel Injectors: Construction and Working; Types of Injector Nozzles and Spray Characteristics. **Combustion Process and Characteristics in Compression Ignition Engines:** Fundamentals of Combustion Phenomena in CI Engines; Stages of Combustion in Compression Ignition Engines; Ignition Delay Period in CI Engines; Diesel Knock: Causes, Effects, and Control; Factors Affecting Combustion and Knocking in CI Engines; Types of Combustion Chambers Used in CI Engines.		
4	**Engine Lubrication and Thermal Management Systems:** **Engine Lubrication:** Purpose and Functions of Engine Lubrication; Classification of Lubricants Used in IC Engines; Physical and Chemical Properties of Lubricants; SAE Viscosity Rating and Grading of Engine Oils; Types of Engine Lubrication Systems. **Thermal Management System:** Need and Importance of Engine Cooling; Effects and Disadvantages of Overcooling; Classification of Engine Cooling Systems; Air Cooling System: Construction and Working; Liquid Cooling System: Construction and Working.	18%	08
5	**Engine Supercharging and Turbocharging Systems:** Need, Objectives, and Significance of Forced Induction in IC Engines; Limitations of Naturally Aspirated Engines; Methods of Engine Supercharging and Turbocharging; Classification and Types of Superchargers; Classification and Types of Turbochargers.	13%	06

i. Text Book and Reference Book:

1. Internal Combustion Engines Fundamentals, John B. Heywood , Tata McGraw Hill
2. Internal Combustion Engine, M.L.Mathur and R.P.Sharma, Dhapant Rai Publications
3. Internal Combustion Engine, V Ganeshan, Tata McGraw Hill
4. Internal Combustion Engine, Domkundwar, Dhapant Rai Publications
5. Internal Combustion Engines, R.K.Rajput, Laxmi Publication,2016

a. **Course Name:** Automobile Engines Lab
b. **Course Code: 03010204PC04**
c. **Prerequisite:** Basic Mechanical Engineering, Engineering Thermodynamics
d. **Rationale:** This course provides fundamental knowledge of internal combustion engines used in automobiles. It enables students to understand engine construction, working, performance and emission characteristics. The course also introduces modern engine technologies required for efficient, clean and high-performance vehicles.
e. **Course Learning Objective:**

CLOBJ 1	Describe the construction, working and classification of internal combustion engines.
CLOBJ 2	Understand the air–fuel preparation, ignition and combustion processes in spark ignition engines.
CLOBJ 3	Analyze fuel injection, combustion and knocking phenomena in compression ignition engines.
CLOBJ 4	Demonstrate the working of lubrication, cooling systems used in automobile engines.
CLOBJ 5	Understand Supercharger and Turbocharger used in Automobile Engines.

f. **Course Learning Outcomes:**

CLO 1	Describe the construction, working and classification of internal combustion engines.
CLO 2	Explain the air–fuel preparation, ignition and combustion processes in spark ignition engines.
CLO 3	Analyze fuel injection systems, combustion characteristics and knocking in compression ignition engines.
CLO 4	Demonstrate the operation of lubrication, cooling systems used in automobile engines.
CLO 5	Understand Supercharger and Turbocharger used in Automobile Engines.

g. **Mapping of Experiment List with Course Learning Outcomes:**

Sr. NO.	**Experiment List**
1	Study and Identification of Major Components of an Internal Combustion Engine
2	Study of Valve and Port Timing Diagrams for I. C. Engine.
3	Demonstration of different types of Ignition, Cooling and Lubrication system.
4	Demonstration of Various Types of Carburetors.
5	Preparation and Analysis of Heat Balance Sheet for a Four-Stroke Diesel Engine
6	Performance Analysis on multi cylinder Diesel engine.
7	Preparation and Analysis of Heat Balance Sheet for a Four-Stroke Petrol Engine
8	Performance Analysis test on multi cylinder petrol engine

9	Determination of Indicated Power of an IC Engine Using Morse Test on a Petrol Engine Test Rig
10	Performance Evaluation of Computerized Exhaust Gas Analyzer.

a. Course Name: Fluid Mechanics

b. Course Code: 03010204PC05

c. Prerequisite: Basic understanding of Engineering Mathematics, Engineering Physics, and Applied Mechanics.

d. Rationale: The course is designed to provides the fundamental understanding of fluid flow, pressure, and energy transfer essential for the operation of automotive systems such as fuel injection, cooling, lubrication, and braking. It forms the foundation for analyzing and designing efficient and safe automobile components and systems.

e. Course Learning Objective:

CLOBJ 1	To understand and evaluate fluid properties, pressure variation, and hydrostatic forces using manometers and pressure measuring devices.
CLOBJ 2	To analyze fluid motion using kinematic principles, flow classification, and continuity equations for one- and two-dimensional flows.
CLOBJ 3	To apply momentum and energy principles to determine flow parameters and losses in pipe flow systems.
CLOBJ 4	To study boundary layer behavior, drag, and flow separation for predicting fluid flow over surfaces.
CLOBJ 5	To use dimensional analysis and similitude principles for modeling and analyzing fluid flow systems.

f. Course Learning Outcomes:

CLO 1	Apply fluid properties and hydrostatic principles to analyze pressure and force in static fluid systems.
CLO 2	Analyze fluid motion using kinematic relations, flow classification, and continuity equations.
CLO 2	Evaluate fluid flow using momentum, energy equations, and pipe flow loss relations.
CLO 4	Assess boundary layer development, drag, and flow separation over surfaces.
CLO 5	Use dimensional analysis and similitude to model and predict fluid flow behavior.

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.	Topics	Weightage	Teaching Hours
1	**Properties of Fluids & Hydrostatic Forces:** Density, specific weight, specific gravity, surface tension & capillarity, Newton's law of viscosity, incompressible & compressible fluid. Pressure at a point, Pascal's law, pressure variation with temperature and height, Center of pressure on vertical surfaces. Simple and differential manometers, inverted manometers, micro manometers, Pressure gauges.	**22%**	**10**
2	**Fluid Kinematics:** Stream line, path line, streak line, stream tube. Steady, unsteady, uniform, non-uniform, laminar, turbulent flows. One dimensional & two-dimensional approximation, 2-D flow in wind tunnel. Continuity equations for 1-D and 2-D flows (compressible and incompressible), Velocity potential function and stream function.	**18%**	**8**
3	**Fluid Dynamics & Flow Through Pipes:** Surface & body forces, momentum equation, Euler equation, Bernoulli's equation for flow along a stream line. Pressure, velocity and mass flow rate, viscosity, venturi meter and orifice meter. Darcy's Weisbach Equation, major and minor losses.	**22%**	**10**
4	**Boundary Layer Flows:** Introductory concepts of boundary layer, Prandtl's boundary layer hypothesis, Boundary layer growth along a flat plate. Boundary layer thickness (Displacement, Energy and Momentum), Von Karman's Momentum Integral Equation, Drag forces due to laminar and turbulent boundary layer on flat plate. Separation of boundary layer (Adverse pressure gradient and Sharp bending/turning of surface), Methods of preventing separation.	**20%**	**9**
5	**Dimensional and Model Analysis:** Dimensional homogeneity, Methods of Dimensional Analysis, Buckingham's π-theorem. Similitude: Types of similarities, Dimensionless numbers, Similarity laws.	**18%**	**8**

i. Text Book and Reference Book:

1. Fluid Mechanics and Hydraulic Machines By Raghuwanshi, N. | Laxmi Publications, New Delhi, Pub. Year: 2018
2. A Textbook of Fluid Mechanics and Hydraulic Machines By R. K. Rajput | S. Chand & Company, Pub. Year: 2017
3. Fluid Mechanics By R. K. Rajput | Laxmi Publications, Pub. Year: 2016
4. A Textbook of Fluid Mechanics and Hydraulic Machines By R. K. Bansal | Laxmi Publications, Pub. Year: 2019
5. Fluid Mechanics and Hydraulic Machines By R. S. Khurmi & J. K. Gupta | S. Chand &

Company, Pub. Year: 2018

6. Introduction to Fluid Mechanics By Robert W. Fox, Alan T. McDonald & Philip J. Pritchard | John Wiley & Sons, Pub. Year: 2016
7. Fluid Mechanics By Frank M. White | McGraw-Hill Education, Pub. Year: 2017
8. Fundamentals of Fluid Mechanics By Bruce R. Munson, Donald F. Young & Theodore H. Okiishi | Wiley, Pub. Year: 2014
9. Mechanics of Fluids By Irving H. Shames | McGraw-Hill, Pub. Year: 2015
10. Fluid Mechanics with Engineering Applications By Daugherty, Franzini & Finnemore | McGraw-Hill, Pub. Year: 2013

a. **Course Name:** Fluid Mechanics Lab
b. **Course Code:** 03010204PC06
c. **Prerequisite:** Basic knowledge of fluid properties, hydrostatics, and fundamental fluid flow concepts from Fluid Mechanics theory.
d. Rationale: This laboratory provides hands-on experience to validate fluid mechanics theory and develop practical skills in measuring and analyzing real fluid flow systems.
e. **Course Learning Objective:**

CLOBJ 1	To provide practical understanding of fluid flow through pipes, jets, and flow measuring devices.
CLOBJ 2	To verify fundamental fluid mechanics principles through laboratory experiments.
CLOBJ 2	To develop skills for measuring flow parameters such as velocity, discharge, and pressure.
CLOBJ 4	To study the performance of pumps, turbines, and flow meters.
CLOBJ 5	To enhance data analysis, observation, and technical report writing skills.

f. **Course Learning Outcomes:**

CLO 1	Conduct experiments related to pipe flow, jets, and turbomachinery.
CLO 2	Measure and calculate flow rate, head, velocity, and efficiency of fluid systems.
CLO 2	Analyze experimental data and compare it with theoretical predictions.
CLO 4	Plot and interpret performance and characteristic curves of pumps, turbines, and jets.
CLO 5	Prepare systematic laboratory reports and demonstrate practical problem-solving skills.

g. **Mapping of Experiment List with Course Learning Outcomes:**

Sr. NO.	**Experiment List**
1	To study velocity distribution and verify the characteristics of fully developed laminar and turbulent flow in pipes.
2	To determine the efficiency, power output, and characteristic curves of a Pelton wheel under different load conditions.
3	To verify Bernoulli's theorem by measuring pressure, velocity, and elevation heads in a flowing fluid.
4	To determine the velocity distribution and decay of velocity in a submerged jet.
5	To study jet velocity, flow rate, momentum, and impact force of free jets.
6	To determine the discharge coefficient of flow meters such as Venturimeter, Orifice meter, and Flow nozzle.
7	To evaluate head, efficiency, power, and discharge characteristics of a centrifugal pump.
8	To visualize streamline patterns, flow separation, and vortices using dye or

	smoke techniques.
9	To study pressure distribution, drag, and wake formation around a circular cylinder in a flowing fluid.
10	To study velocity profiles and entrance length in turbulent pipe flow.

a. **Course Name:** Sustainable Fuels for Conventional Engines
b. **Course Code:** 03010204PE01
c. **Prerequisite:** Basic knowledge of thermodynamics, internal combustion engines, conventional fuels, combustion principles, and engine emissions.
d. **Rationale**: The course bridges the gap between traditional engine technology and modern sustainability requirements, enabling learners to evaluate the feasibility and limitations of various sustainable fuel options.
e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of sustainability in the transportation sector and the role of alternative and renewable fuels in reducing environmental impact.
CLOBJ 2	Explain the classification, production methods, physicochemical properties, and energy potential of sustainable fuels such as biofuels, alcohol fuels, gaseous fuels, and synthetic fuels.
CLOBJ 2	Analyze the combustion characteristics and performance behavior of sustainable fuels when used in conventional spark ignition (SI) and compression ignition (CI) engines.
CLOBJ 4	Evaluate the effects of sustainable fuels on engine performance parameters, fuel economy, emissions, and durability in comparison with conventional fossil fuels.
CLOBJ 5	Assess fuel–engine compatibility issues, including material compatibility, storage, safety, and minor engine modifications required for sustainable fuel utilization.

f. **Course Objective Outcomes:**

CLO 1	Explain the concept of sustainability in energy systems and the need for alternative and sustainable fuels for conventional IC engines.
CLO 2	Classify various sustainable fuels such as biofuels, alcohol fuels, gaseous fuels, hydrogen, and synthetic fuels based on their properties, production methods, and applications.
CLO 2	Analyze the physicochemical and combustion characteristics of sustainable fuels and compare them with conventional fossil fuels.
CLO 4	Evaluate the performance, combustion, and emission characteristics of conventional engines operating on different sustainable fuels.
CLO 5	Assess environmental, economic, and regulatory impacts associated with the adoption of sustainable fuels in the transportation sector.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				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.	Topics	Weightage	Teaching Hours
1	**Introduction to Sustainable Fuels:** Energy scenario: global and Indian perspective, Environmental impact of fossil fuels, Definition and classification of sustainable fuels, Renewable vs non-renewable fuels, Role of sustainable fuels in reducing emissions and carbon footprint, Compatibility of sustainable fuels with conventional engines.	15%	4
2	**Fuel Properties and Engine Compatibility:** Physical properties of fuels: Density**,**Viscosity, Volatility**,** Flash point and fire point, Chemical properties: Molecular structure, Hydrogen-to-carbon ratio**,** Oxygen content, Heating value and calorific value**,** Octane number and knocking in SI engines**,** Cetane number and ignition delay in CI engines**,** Stoichiometric air–fuel ratio**,** Combustion characteristics of alternative fuels**,** Fuel spray, atomization, and evaporation**,** Material compatibility issues**,** Fuel storage, transportation, and safety considerations**,** Effects of fuel properties on: Power output**,** Brake thermal efficiency**,** Specific fuel consumption	25%	7
3	**Biofuels for Conventional Engines:** Bio-ethanol: production methods, properties, blending (E10, E20), performance and emissions, Performance analysis in SI engines, Emission characteristics: CO, HC, NOx, CO_2, Advantages and limitations Biodiesel: feed stocks, transesterification process, properties (B20, B100), Performance and emission characteristics in CI and SI engines**,** Advantages and limitations of biofuels**,** Case studies on biofuel implementation in India: Ethanol blending program in India, Biodiesel usage in transport and agriculture	20%	6
4	**Gaseous and Synthetic Fuels:** Compressed and Liquefied Gaseous Fuels: Compressed Natural Gas (CNG): Properties, Engine modifications, Performance and emissions, Liquefied Natural Gas (LNG): Storage and safety, Heavy-duty engine applications Hydrogen as a Fuel: properties, production methods: Steam methane reforming, Electrolysis, storage techniques, combustion in IC engines, Pre-ignition and backfire issue, Performance and emission characteristics	20%	7
5	**Emissions, Regulations, and Future Trends:** Formation of engine emissions: HC, NOx**,** Particulate Matter (PM), CO_2, Emission measurement techniques, Effect of sustainable fuels on exhaust emissions**,** After-treatment devices: Catalytic converters, Diesel particulate filters, Emission norms: Bharat Stage VI, Euro VI, Government policies and mandates: Ethanol blending targets**,** Biofuel policy of India, Economic and technical challenges, Future prospects of sustainable fuels, Role of sustainable fuels in net-zero emission targets**.**	20%	6

i. Text Book and Reference Book:

1. Heywood, J.B., *Internal Combustion Engine Fundamentals*, McGraw-Hill
2. Gupta, H.N., *Fundamentals of Internal Combustion Engines*, PHI
3. Agarwal, A.K., *Biofuels: Technology, Benefits and Challenges*, Springer
4. Pulkrabek, W.W., *Engineering Fundamentals of IC Engines*
5. Turns, S.R., *An Introduction to Combustion*

a. **Course Name:** Sustainable Fuels for Conventional Engines Lab
b. **Course Code:** 03010204PE02
c. **Prerequisite:** Basic knowledge of thermodynamics, internal combustion engines, conventional fuels, combustion principles, and engine emissions.
d. **Rationale**: The course bridges the gap between traditional engine technology and modern sustainability requirements, enabling learners to evaluate the feasibility and limitations of various sustainable fuel options.
e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of sustainability in the transportation sector and the role of alternative and renewable fuels in reducing environmental impact.
CLOBJ 2	Explain the classification, production methods, physicochemical properties, and energy potential of sustainable fuels such as biofuels, alcohol fuels, gaseous fuels, and synthetic fuels.
CLOBJ 2	Analyze the combustion characteristics and performance behavior of sustainable fuels when used in conventional spark ignition (SI) and compression ignition (CI) engines.
CLOBJ 4	Evaluate the effects of sustainable fuels on engine performance parameters, fuel economy, emissions, and durability in comparison with conventional fossil fuels.
CLOBJ 5	Assess fuel–engine compatibility issues, including material compatibility, storage, safety, and minor engine modifications required for sustainable fuel utilization.

f. **Course Learning Outcomes:**

CLO 1	Explain the concept of sustainability in energy systems and the need for alternative and sustainable fuels for conventional IC engines.
CLO 2	Classify various sustainable fuels such as biofuels, alcohol fuels, gaseous fuels, hydrogen, and synthetic fuels based on their properties, production methods, and applications.
CLO 2	Analyze the physicochemical and combustion characteristics of sustainable fuels and compare them with conventional fossil fuels.
CLO 4	Evaluate the performance, combustion, and emission characteristics of conventional engines operating on different sustainable fuels.
CLO 5	Assess environmental, economic, and regulatory impacts associated with the adoption of sustainable fuels in the transportation sector.

g. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Study of Conventional and Sustainable Fuels
2	To study Fuel Property Analysis and Standards
3	To study Production Methods of Biofuels
4	To study Combustion Characteristics of Sustainable Fuels
5	To study Emission Characteristics of IC Engines Using Biofuels
6	To study Life Cycle Assessment (LCA) of Sustainable Fuels
7	Performance Test on CI Engine Using Biodiesel
8	Performance of a hydrogen energy system: Powering an autonomous vehicle via water

	splitting
9	To conduct emission analysis of an internal combustion engine operating with different fuels.
10	To determine the flash point and fire point of different fuels.

a. Course Name: Special Purpose Vehicles

b. Course Code: 03010204PE03

c. Prerequisite: Knowledge of Automobile Powertrain and System

d. Rationale: The course is designed for students to learn about special purpose vehicles used for commercial purposes.

e. Course Learning Objective:

CLOBJ 1	Explain the classification, design features, and operating principles of special purpose vehicles.
CLOBJ 2	**Describe major vehicle subsystems** including transmission, steering, braking, electrical, pneumatic, and hydraulic systems.
CLOBJ 2	**Identify and compare various construction and utility vehicles** based on function and application.
CLOBJ 4	Analyze stability, control, and safety features of mobile cranes and similar equipment.
CLOBJ 5	**Apply ergonomic and human-factor considerations** related to comfort, safety, and performance in vehicle design.

f. Course Learning Outcomes:

CLO 1	Understand the design considerations and features of special purpose vehicles.
CLO 2	Describe the working principles of special purpose vehicles.
CLO 2	Understand the special type of vehicles based on the need and purpose.
CLO 4	Understand the design ergonomics in special purpose vehicles.
CLO 5	Explain the stability, control systems and safety systems of mobile cranes.

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, Principles and Special application:** Classification of Special Purpose Vehicles, wheel type & track type, applications. Study of transmission, final drive, lubrication, and electrical, braking, steering, pneumatic & hydraulic control circuits.	10%	4
2	**Special Purpose Vehicles for Construction:** Study of different types of earth moving machinery such as Rippers, Scrapers and shovels, Loaders, Excavators, Dumpers, Bulldozers, Fork Lifts, JCB and Road rollers, Study of Fire trucks, Ambulance features, Articulated vehicles, Tankers, Hovercraft and Harvester.	**50%**	**13**
3	**Tractors:** Classification and types of tractors- power transmission system- steering system- accessories of wheeled tractors- hydraulic control system- power take off unit.	14%	4
4	**Mobile Cranes:** Study of cranes, stability and design features, control systems and safety devices.	10%	4
5	**Design Ergonomics:** Human factors in special purpose vehicle design with reference to comfort, convenience and safety, effects of noise, vibration and thermal stresses on human performance.	**10%**	**3**
6	**Case Study on Special Purpose Vehicles:** Rippers, Scrapers and shovels, Loaders, Excavators, Dumpers, Bulldozers, Fork Lifts, JCB and Road rollers, Study of Fire trucks, Ambulance features, Articulated vehicles, Tankers, Crane, Tractor, Hovercraft and Harvester.	6%	**2**

i. Text Book and Reference Book:

1. Theory of Ground Vehicles (TextBook) By J. Y. Wong | John Wiley and Sons Inc., New York | 2001
2. Hand Book of Earth Moving Machinery Central Water & Power Commission (Govt. of India)
3. Construction Equipment Operation & Maintenance (TextBook) By Y. Pokras and M. Tushnyakov | MIR, Moscow
4. Truck Cranes (TextBook) By Astskhov | MIR, Moscow
5. Farm Machines and Equipment By C.P. Nakra | Dhanpat Rai Publications, New Delhi
6. Material Handling Equipment By N. Rudenko | M.R. Publishers

a. Course Name: Special Purpose Vehicles LAB

b. Course Code: 03010204PE04

c. Prerequisite: Knowledge of Automobile Powertrain and System

d. Rationale: The course is designed for students to learn about special purpose vehicles used for commercial purposes.

e. Course Learning Objective:

CLOBJ 1	Explain the classification, design features, and operating principles of special purpose vehicles.
CLOBJ 2	**Describe major vehicle subsystems** including transmission, steering, braking, electrical, pneumatic, and hydraulic systems.
CLOBJ 2	**Identify and compare various construction and utility vehicles** based on function and application.
CLOBJ 4	Analyze stability, control, and safety features of mobile cranes and similar equipment.
CLOBJ 5	**Apply ergonomic and human-factor considerations** related to comfort, safety, and performance in vehicle design.

f. Course Learning Outcomes:

CLO 1	Understand the design considerations and features of special purpose vehicles.
CLO 2	Describe the working principles of special purpose vehicles.
CLO 2	Understand the special type of vehicles based on the need and purpose.
CLO 4	Understand the design ergonomics in special purpose vehicles.
CLO 5	Explain the stability, control systems and safety systems of mobile cranes.

g. Teching & 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

Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Demonstration of technical & operational features of excavator, dumper & bulldozer.
2	Demonstration of technical & operational features of forklift.
3	Demonstration of technical & operational features of mobile cranes.
4	Demonstration of technical & operational features of a tractor.
5	Demonstration of technical & operational features of power scraper & ripper.
6	Demonstration of technical & operational features of a backhoe loader, power shovel & road roller
7	Demonstration of technical & operational features of a fire extinguishing vehicle, oil tanker & hover craft.
8	Demonstration of technical & operational features of ambulance, articulated vehicles, armed vehicles & harvester
9	Demonstration of Ergonomic application in SPV.
10	Demonstration of different types of system used in SPV.

a. Course Name: Automotive Certification & Homologation

b. Course Code: 03010204PE05

c. Prerequisite: Students should have basic knowledge of automobile engineering, internal combustion engines, vehicle systems, safety features, emission norms, and fundamental testing and measurement principles.

Rationale: The course bridges the gap between **automotive design and real-world regulatory implementation**, enabling students to understand how engineering decisions must align with legal requirements.

d. Course Learning Objective:

CLOBJ 1	**Understand** the need, scope, and significance of automotive certification and homologation in ensuring vehicle safety, environmental protection, and regulatory compliance.
CLOBJ 2	**Explain** national and international automotive regulatory frameworks, standards, and acts governing vehicle approval processes.
CLOBJ 2	**Identify** the roles and responsibilities of testing agencies, certification bodies, and regulatory authorities in the automotive sector.
CLOBJ 4	**Interpret** automotive safety, emission, and performance regulations applicable to different vehicle categories.
CLOBJ 5	**Apply** homologation concepts to evaluate compliance of vehicles, systems, and components with prescribed standards.

e. Course Learning Outcomes:

CLO 1	Explain the **fundamental concepts, objectives, and importance** of automotive certification and homologation in ensuring vehicle safety, environmental protection, and regulatory compliance.
CLO 2	Describe **national and international automotive regulations and standards s**uch as CMVR, AIS, UNECE, FMVSS, and ADR applicable to vehicles and automotive components.
CLO 2	Analyze the **homologation process** for whole vehicles and automotive components, including documentation, testing, conformity of production (COP), and approval stages.
CLO 4	Apply regulatory knowledge to **evaluate compliance of vehicles** (conventional, electric, and hybrid) with applicable certification and homologation requirements.
CLO 5	Recognize the **role of testing agencies and approval authorities** in India and globally, and assess their responsibilities in vehicle certification.

f. 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

g. Course Content:

Sr.	Topics	Weightage	Teaching Hours
1	**Introduction**: Importance of Automotive Certification & Homologation, Need for Regulations in the Automotive Sector, Classification of vehicles (including M, N and O layout), regulations overview (ECE, EEC, FMVSS, AIS, CMVR, ADR), specifications of vehicles & engines.	15%	5
2	**Vehicle Testing, Inspection & Safety Compliance:** Introduction to CMVR, Physical verification of vehicle, Vehicle weighment, Coast down test, Brake performance test, Anti-lock Braking System (ABS) requirements, Turning circle diameter test, Steering effort test, Speedometer calibration,Pass-by noise test, External projection test, Wheel guards requirements, Hood latch test, Tell-tale symbols, Gradability test, Accelerator control system, Horn installation requirements, Rear view mirror installation, Installation requirements for lighting and signaling devices, Windscreen wiping system, Wheel nuts, wheel cap and hub cap, Vertical orientation for dipped beam headlamp, Interior fittings, Driver's field of vision (M1 category), Steering impact test (GVW < 1500 kg), Body block test, Head form test, Fixture charges	25%	12
3	**Emission Testing, Crashworthiness & Homologation Documentation:** Crash test, Bumper testing, Safety belt assemblies, Safety belt anchorages, Seat anchorages and head restraints, Crash test with dummy, Engine power testing – Petrol engine, Engine power testing – Diesel engine, Engine power and smoke test (diesel engine), Drive cycle and chassis dynamometer, Vehicle mass emission testing, Evaporative emission test (petrol vehicles only), On-Board Diagnostics (OBD-I), Broad band / Narrow band EMI test, Documentation for VELDocumentation for SHL, Certification charges	20%	12
4	**Vehicle Safety Components & Structural Requirements:** Tyres: **Size and Ply Rating**, **Safety Glasses:**Windscreen laminated safety glass, Side window / door glass, Back light / rear toughened glass, **Hydraulic brake hose, Hydraulic brake fluid, Wheel rims, Wheel nuts, wheel discs & hub caps, Rear View Mirror Specifications:** Exterior mirrors, Interior mirrors, **Door locks and door retention systems, Fuel tank:** Metallic, Plastic (excluding fire resistance test), **Bumpers (Front & Rear), Safety belt assemblies, Safety belt anchorages, Seat anchorages and head restraints**	20%	8
5	**Lighting, Signaling Devices & Auxiliary Safety Equipment: Wiper blade, Reflectors, Horn, Automotive lamps – general requirements, Performance requirements for lighting and signaling devices, Head lamp assembly:** Glass lens, Plastic lens, **Head lamp + Front position lamp / Front direction indicator lamp / Front fog lamp, Independent Front position lamp / Front direction indicator lamp / Front fog lamp, Rear combination lamps:** Single function, Each additional function, **Warning triangle.**	20%	8

h. Text Book and Reference Book:

1. K. V. Fadadu & B. H. Kadiya — *Vehicle Testing and Homologation*
2. Joe Glassford — *The Hands-On Vehicle Testing Reference*
3. **Bosch Automotive Handbook** (Wiley)
4. **Dr. Kirpal Singh —** *Automobile Engineering* (Standard Publishers)
5. **N. K. Giri —** *Automobile Mechanics* (Khanna Publishers)

a. Course Name: Automotive Certification & Homologation

b. Course Code: 03010204PE06

c. Prerequisite: Students should have basic knowledge of automobile engineering, internal combustion engines, vehicle systems, safety features, emission norms, and fundamental testing and measurement principles.

d. Rationale: The course bridges the gap between **automotive design and real-world regulatory implementation**, enabling students to understand how engineering decisions must align with legal requirements.

e. Course Learning Objective:

CLOBJ 1	Understand the need, scope, and significance of automotive certification and homologation in ensuring vehicle safety, environmental protection, and regulatory compliance.
CLOBJ 2	Explain national and international automotive regulatory frameworks, standards, and acts governing vehicle approval processes.
CLOBJ 2	Identify the roles and responsibilities of testing agencies, certification bodies, and regulatory authorities in the automotive sector.
CLOBJ 4	Interpret automotive safety, emission, and performance regulations applicable to different vehicle categories.
CLOBJ 5	Apply homologation concepts to evaluate compliance of vehicles, systems, and components with prescribed standards.

f. Course Learning Outcomes:

CLO 1	Explain the fundamental concepts, objectives, and importance of automotive certification and homologation in ensuring vehicle safety, environmental protection, and regulatory compliance.
CLO 2	Describe national and international automotive regulations and standards such as CMVR, AIS, UNECE, FMVSS, and ADR applicable to vehicles and automotive components.
CLO 2	Analyze the homologation process for whole vehicles and automotive components, including documentation, testing, conformity of production (COP), and approval stages.
CLO 4	Apply regulatory knowledge to evaluate compliance of vehicles (conventional, electric, and hybrid) with applicable certification and homologation requirements.
CLO 5	Recognize the role of testing agencies and approval authorities in India and globally, and assess their responsibilities in vehicle certification.

g. Mapping of Experiment List with Course Learning Outcomes:

Sr. NO.	Experiment List
1	Study of Automotive Certification & Homologation Process
2	Study of Vehicle Mandatory Safety Accessories
3	Study of Automotive Regulatory Bodies
4	Study of Lighting and Signaling Devices
5	To measure and demonstate tyre Size and Ply Rating Identification on Vehicle
6	Demonstration of Head Lamp Alignment and Beam Inspection
7	Demonstration of Functional Test of Lighting and Signaling Devices
8	Study of Vehicle Categories and Classification

9	Study of Emission Norms and Compliance
10	Preparation of Homologation Checklist

a. **Course Name:** Two & Three Wheeler Technology
b. **Course Code:** 03010204PE07
c. **Prerequisite:** Automobile Systems, Automobile Engine
d. **Rationale:** This course provides an understanding of the design, construction, and operation of two- and three-wheeler vehicles to meet performance, safety, and mobility requirements in modern transportation systems.
e. **Course Learning Objective:**

CLOBJ 1	Explain the evolution, classification, and layout of two- and three-wheeler vehicles.
CLOBJ 2	Describe the construction and working of engine systems used in two- and three-wheelers.
CLOBJ 3	Analyze the transmission and power transfer systems of two- and three-wheelers.
CLOBJ 4	Explain steering, suspension, braking, wheel, tire, frame, and body systems of two- and three-wheelers.
CLOBJ 5	Describe the electrical systems and recent technological developments in two- and three-wheelers.

f. **Course Learning Outcomes:**

CLO 1	Explain the evolution, classification, and layout of two- and three-wheeler vehicles.
CLO 2	Describe the construction and working of engine systems used in two- and three-wheelers.
CLO 3	Analyze the transmission and power transfer systems of two- and three-wheelers.
CLO 4	Explain steering, suspension, braking, wheel, tire, frame, and body systems of two- and three-wheelers.
CLO 5	Describe the electrical systems and recent technological developments in two- and three-wheelers.

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.	Topics	Weightage	Teaching Hours
1	**Introduction to Two- and Three-Wheeler Vehicles:** Evolution and Historical Development of Two- and Three-Wheeler Vehicles; Classification of Two-Wheelers Based on Design and Application (Motorcycles, Scooters, Mopeds); Layout and Configuration of Two-Wheeler Vehicles; Classification of Three-Wheeler Vehicles Based on Application and Capacity; Layout and Functional Arrangement of Three-Wheeler Vehicles.	7%	2
2	**Power Unit Systems of Two- and Three-Wheeler Vehicles:** **I.C. Engine:** Classification of IC Engines Used in Two- and Three-Wheeler Vehicles; Construction, Working, and Types of Two-Stroke Engines; Port Timing Diagrams for Two-Stroke Engines; Construction and Working of Four-Stroke Engines; Engine Selection Criteria and Design Considerations for Two- and Three-Wheelers. **Fuel Supply Systems:** Classification of Fuel Supply Systems for Two- and Three-Wheelers; Carburetor: Construction and Working Principle; Types of Carburetors Used in Two-Wheeler Engines; Fuel Injection Systems for Two- and Three-Wheeler Engines. **Lubrication Systems:** Types and Properties of Lubricants Used in Two- and Three-Wheeler Engines; Engine Lubrication Systems Used in Two- and Three-Wheelers. **Scavenging Systems:** Scavenging Process in Two-Stroke Engines; Methods of Scavenging Used in Two-Stroke Engines. **Cranking (Starting) Systems:** Basic Engine Cranking Mechanism; Types of Cranking Systems Used in Two- and Three-Wheeler Vehicles	23%	7
3	**Transmission System:** Layout of Transmission System in Two- and Three-Wheeler Vehicles; Functional Requirements of Clutch in Two- and Three-Wheelers; Types of Clutches Used in Two- and Three-Wheeler Vehicles; Clutch Actuation and Release Mechanisms; Types of Gearboxes Used in Two- and Three-Wheeler Vehicles; Gear Shifting Mechanisms and Selector Systems; Continuous Variable Transmission (CVT) System; Chain Drive System: Construction and Working; Belt Drive System: Construction and Working; Shaft Drive System: Construction and	17%	5

	Working; Cush Drive: Function and Importance in Two- and Three-Wheelers.		
4	**Vehicle Steering Geometry and Suspension Systems:** **Steering Systems:** Steering Geometry for Two-Wheeler Vehicles; Effects of Steering Geometry on Stability and Handling; Construction and Working of Steering Column; Handlebar Systems: Types, Construction, and Ergonomics. **Suspension Systems:** Suspension Requirements for Two- and Three-Wheeler Vehicles; Design Considerations for Two- and Three-Wheeler Suspension Systems; Spring and Shock Absorber Assembly: Construction and Working; Types of Front Suspension Systems Used in Two-Wheelers; Types of Rear Suspension Systems Used in Two- and Three-Wheelers.	20%	6
5	**Vehicle Braking and Running Gear Systems:** Functional Requirements and Design Considerations of Braking Systems; Drum Brake System for Two-Wheeler Vehicles: Construction and Working; Disc Brake System for Two-Wheeler Vehicles: Construction and Working; Brake Control Systems Used in Two- and Three-Wheeler Vehicles; Anti-Lock Braking System (ABS) for Two-Wheeler Vehicles; Types of Wheels Used in Two- and Three-Wheeler Vehicles; Tire Construction: Components and Materials; Types of Tires.	13%	4
6	**Frame and Body Construction of Two-Wheelers:** Functional Requirements and Design Considerations of Two-Wheeler Frames; Components and Construction of Two-Wheeler Frame; Types of Frames Used in Two-Wheeler Vehicles; Materials Used for Two-Wheeler Frame Construction; Body Work and External Panels of Two-Wheeler Vehicles; Ergonomic Considerations in Two-Wheeler Design.	10%	3
7	**Automotive Electrical Systems for Two- and Three-Wheelers:** Battery Systems Used in Two- and Three-Wheeler Vehicles; Charging Systems: Construction and Working; Ignition Systems Used in Two- and Three-Wheeler Vehicles; Vehicle Lighting Systems and Safety Requirements; Handlebar-Mounted Electrical Controls; Instruments and Indicators for Vehicle Monitoring; Recent Developments in Two- and Three-Wheeler Electrical Systems.	10%	3

i. Text Book and Reference Book:

1. Panchal. D, Two and Three Wheeler Technology, PHI learning PVT LTD., New Delhi, 2015.
2. G.B.S. Narang, "Automobile Engineering", 5th Edition, Khanna Publishers, Delhi.
3. Newton Steed, "The Motor Vehicle", McGraw Hill Book Co. Ltd., New Delhi
4. Siegfried Herrmann, "The Motor Vehicle", Asia Publishing House, Bombay.
5. Workshop manuals for motorcycles and rickshaws.

a. **Course Name:** Two & Three Wheeler Technology Lab
b. **Course Code: 03010204PE08**
c. **Prerequisite:** Automobile Systems, Automobile Engine
d. **Rationale:** This course provides an understanding of the design, construction, and operation of two- and three-wheeler vehicles to meet performance, safety, and mobility requirements in modern transportation systems.
e. **Course Learning Objective:**

CLOBJ 1	Explain the evolution, classification, and layout of two- and three-wheeler vehicles.
CLOBJ 2	Describe the construction and working of engine systems used in two- and three-wheelers.
CLOBJ 3	Analyze the transmission and power transfer systems of two- and three-wheelers.
CLOBJ 4	Explain steering, suspension, braking, wheel, tire, frame, and body systems of two- and three-wheelers.
CLOBJ 5	Describe the electrical systems and recent technological developments in two- and three-wheelers.

f. **Course Learning Outcomes:**

CLO 1	Explain the evolution, classification, and layout of two- and three-wheeler vehicles.
CLO 2	Describe the construction and working of engine systems used in two- and three-wheelers.
CLO 3	Analyze the transmission and power transfer systems of two- and three-wheelers.
CLO 4	Explain steering, suspension, braking, wheel, tire, frame, and body systems of two- and three-wheelers.
CLO 5	Describe the electrical systems and recent technological developments in two- and three-wheelers.

g. **Mapping of Experiment List with Course Learning Outcomes:**

Sr. NO.	**Experiment List**
1	Study and Identification of Major Components of Two- and Three-Wheeler Vehicles
2	Study of Classification, Layout, and Technical Specifications of Two- and Three-Wheeler Vehicles
3	Demonstration of Two-Stroke and Four-Stroke Engines Used in Two- and Three-Wheelers with Port/Valve Timing Diagrams
4	Demonstration of Fuel Supply Systems Used in Two- and Three-Wheelers (Carburetor and Fuel Injection System)
5	Study of Lubrication and Scavenging Systems in Two-Stroke Two-Wheeler Engines
6	Demonstration of Clutch, Gearbox, and Final Drive Systems of Two- and

	Three-Wheelers
7	Demonstration of Steering Handle Bar Used in Two- and Three-Wheeler Vehicles
8	Demonstration of Suspension Systems Used in Two- and Three-Wheeler Vehicles
9	Demonstration of Braking Systems (Drum, Disc, ABS) and Wheel–Tire Assemblies of Two-Wheeler Vehicles
10	Demonstration of Electrical Systems of Two- and Three-Wheelers (Battery, Charging, Lighting, Instruments & Indicators)