

Domain - Automobile Engineering

Sl. No.	Course Code	Course Title	Course Type	Credits
1	DEAE0101	Introduction to Automobile Engineering	Theory	3
2	DEAE0102	Entrepreneurship Opportunities in Automobile Trade	Theory	2
3	DEAE0204	Maintenance of Automobile	Practice	5
4	DEAE0205	Design of Basic Automobile Components	Practice	2
5	DEAE0401	Subsystems of Automobile	Theory + Practice	5
6	DEAE0402	Design and Maintenance of Electric Vehicles	Theory + Practice	3
7	DEET0300	Project		6
8	DEET0800	Internship		4
Total				30

Domain Objectives:

- The students will gain knowledge about different systems and subsystems of automobile.
- Students will acquire basic skills in the maintenance of automobile.
- It will help them to explore the opportunities available in the industry or to start their own micro enterprises with great results.

Importance:

Automobile Engineering is a branch of engineering which deals with designing, manufacturing and operating automobiles that incorporates elements of mechanical, electrical, electronic, software and safety engineering as applied to the design, manufacture and operation of automobiles and their engineering subsystems. It also includes modification of vehicles. Automobile Engineering domain deals with the creation and assembling the whole parts of automobiles. The automotive engineering field is research intensive and involves direct application of mathematical models and formulas.

Employment Opportunities:

- The students can get jobs in automobile manufacturing companies in India and abroad.
- There are large number of job opportunities in automobile designing, research & development, sales & service.
- The students can also successfully run their own business in this field.

Courses Covered: The students will be taught the basics of automobile in introduction to automobile course. Then they will be exposed to different subsystems of automobile with requisite practices in subsystems of automobile course. The students will know the design, manufacturing and maintenance of electric vehicle in electric vehicle course. Students will be acquainted with various opportunities for business in entrepreneurship opportunities in automobile trade subject. They will learn the basic, periodic and preventive maintenance of two and four wheeler with trouble shooting in maintenance of two and four wheeler course. The students will be taught the maintenance and operation of forklift in diesel forklift course. Finally they will do a project on automobile and go for internship in automobile companies.

Approach of Delivery: The subjects in this domain will be taught either in ‘theory+ practice’ mode or ‘practice’ mode. After learning the theory, the students will do hands on practice. They will disassemble and assemble each system of automobile and will learn the maintenance of each part which creates good opportunities for employability in automobile in

Introduction to Automobile Engineering

Course Title	Course Code	Type of Course	T-P-PJ	Prerequisite
Introduction to Automobile Engineering	DEAE0101	Theory	3-0-0	Nil

Objective

- To understand the working of automobiles and its sub-systems
- To learn the modern technologies used in automobiles

Learning Outcome

- Familiarise and explain working principles of automobile and its sub-systems

Evaluation System:

	Component	% of Marks	Method of Assessment
Internal Examination	Internal Theory	30	Written examination
	Assignment	5	Report or Presentation + Learning Record
	Attendance	5	Based on class attended
External Examination	External Theory	60	Written examination
Total		100	

Module I: Automobile Architecture and Stability of Vehicles (7 Hours)

Automobile Architecture: Definition and Classification of Automobiles, Major Units of the Automobile, Types of Automobile Layouts, Automobile Chassis Types and Components, Automobile Body Types and Components, Automobile Safety Parameters, Automobile Regulatory Bodies in India.

Stability of Vehicles: Load Distribution, Calculation of Tractive Effort and Reactions for Different Drives, Stability of a Vehicle on a Slope, on a Curve and on Banked Road.

Module II: Various Units of an Automobile (7 Hours)

Various Units of an Automobile: Various Units of Automobile, Engine and its Subsystems, Transmission System, Steering System, Suspension System, Brake System, Automotive Electrical System, Automobile Battery.

Module III: Engine (5 Hours)

Engine: Classification of Engine, Engine Nomenclature, Components of Engine, Valve Timing Diagram of SI & CI Engines, Variable Valve Timing, Modern Engine Combustion Technologies (CRDI, GDI, HCCI, Dual Fuel Engine, Stratified Charge Engine).

Module IV: Carburetion & Fuel Injection (8 Hours)

Carburetion: Air-Fuel Ratio, Mixture Requirements for Different Load Conditions, Factors Affecting Carburetion, Principle of Carburetion, Limitations of Simple Carburettor, Additional Systems in Carburettor, Concept of Electronic Carburettor.

Fuel Injection: Construction and Working of Fuel Feed Pumps for Petrol and Diesel Engines, Types of Fuel Injection Pumps, Control of Fuel Injection Pumps, Types of Electronic Injection Systems for Petrol and Diesel Engines, Direct and Indirect Fuel Injection.

Module V: Transmission System (7 Hours)

Transmission System: Layout of Power Flow from Engine to Wheels, Brief Construction and Working Principles of - Clutch, Transmissions, Propeller Shaft, Final Drive and Differential, Front and Rear Axles.

Module VI: Cooling and Lubrication System (6 Hours)

Cooling and Lubrication System: Direct Air Cooled and Indirect Liquid Cooled Cooling Systems, Types and Components of Liquid Cooled Cooling System, Viscous Fan Drive, Engine Coolant and Antifreeze Solution, Desired Properties of Lubricants, Types of Lubricant, API System of Lubricant Classification, Construction, Working Principles and Components of Various Types of Lubricating Systems.

Module VII: Super Charging & Turbo Charging (5 Hours)

Super Charging & Turbo Charging: Naturally Aspirated and Forced Induction Engine, Effect of Forced Induction, Method of Supercharging, Types of Super Chargers, Working Principles, Components Principle and Types of Turbo Charging, Turbocharger Boost Pressure Control and Wastegate Turbocharger, Turbo Lag, Concept of Variable Geometry Turbocharging.

Text Books

1. Gupta R. B., Automobile Engineering, Satya Prakashan New Delhi.
2. Giri N. K., Automobile Technology, Khanna Publishers.

Reference Books

1. Gupta H. N., Fundamentals of Internal Combustion Engines, PHI Learning.

Session Plan

Topics	No. of Sessions (in hrs.)	Activity	Assignment	Suggested Reading
Module I: Automobile Architecture and Stability of Vehicles (7 hours)				
Definition and classification of automobiles, Major units of the automobile, Types of automobile layouts, Automobile chassis types and components, Automobile body	4	Lecture	Assignment-1	Text Book (TB)-1 Chapter(Ch)-1
Load distribution, Calculation of tractive effort and reactions for different drives, Stability of a vehicle on a slope, on a curve and on banked road.	3	Lecture	Assignment-1.1	TB-2 Ch-1
Module II: Various Units of an Automobile (7 Hours)				
Various units of automobile, Engine and its subsystems, Transmission system, Steering system, Suspension system, Brake system, Automotive Electrical system, Automobile Battery.	7	Lecture	Assignment-2	TB-2 Ch-2
Module III: Engine (5 Hours)				

Classification of engine, Engine nomenclature, Components of engine, Valve timing diagram of SI & CI Engines, Variable	5	Lecture	Assignment-3	TB-1 Ch-2
Module IV: Carburetion & Fuel Injection (5 Hours)				
Air-fuel ratio, Mixture requirements for different load conditions, Factors affecting carburetion, Principle of carburetion, Limitations of simple carburetor, Additional systems in carburetor, Concept of electronic carburetor.	4	Lecture	Assignment-4	TB-1 Ch-10
Construction and working of fuel feed pumps for petrol and diesel engines, Types of fuel injection pumps, Control of fuel injection pumps, Types of electronic injection Systems for petrol and diesel engines, Direct and indirect fuel injection	4	Lecture	Assignment-4.1	TB-1 Ch-8
Module V: Transmission System (7 Hours)				

Layout of power flow from engine to wheels, Brief construction and working principles of - Clutch, Transmissions, Propeller shaft, Final drive and differential, Front and Rear axles.	7	Lecture	Assignment-5	TB-2 Ch-19,20,21,22
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Module VI: Cooling and Lubrication System (6 Hours)

Direct air cooled and Indirect liquid cooled cooling systems, Types and components of liquid cooled cooling system, Viscous fan drive, Engine coolant and antifreeze solution, Desired properties of lubricants, Types of lubricant, API system of lubricant classification, Construction, working principles and components of various types of lubricating systems.	6	Lecture	Assignment-6	TB-1 Ch-11
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Module VII: Super Charging & Turbo Charging (5 Hours)

<p>Naturally aspirated and forced induction engine, Effect of forced induction, Method of supercharging, Types of superchargers, Working principles, components principle and types of turbocharging, Turbocharger boost pressure control and Wastegate turbocharger, Turbo lag, Concept of Variable geometry turbocharging.</p>	5	Lecture	Assignment-7	TB-2 Ch-6
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Entrepreneurship Opportunities in Automobile Trade

Course Title	Course Code	Type of Course	T-P-PJ	Pre-Requisite
Entrepreneurship Opportunities in Automobile Trade	DEAE0102	Theory	2-0-0	Nil

Objective

- To expose students to various opportunities in Automobile trade
- To provide basic knowledge on Entrepreneurship
- To expose them to business environment through Projects and Internship

Learning Outcome

- Explore various opportunities in Automobile trade
- Start their own business in Automobile sector

Evaluation System

	Component	% of Marks	Method of Assessment
Internal Examination	Internal Theory	30	Written examination
	Assignment	5	Report or Presentation + Learning Record
	Attendance	5	Based on class attended
External Examination	External Theory	60	Written examination
Total		100	

Module I: Opportunities in Trading (5 Hours)

Opportunities in Trading: Opportunities in Trading - Battery, Lubricant, Spares, Tyres, Paints, Upholstery, Welding & Machining Consumables, Hardwares, Oil Seals, Hoses, Tools, Garage Equipment, Inventory Management & Control.

Module II: Opportunities in Service & Repair Work Shops (4 Hours)

Opportunities in Service & Repair Work Shops: Layout, Location, Water, Electricity, Drainage, Manpower & HR, Financing, Reports & Records, Management Info Systems, Sales & Marketing, Customer Relationship Management.

Module III: Opportunities in Operating Dealerships (3 Hours)

Opportunities in Operating Dealerships: Opportunities in Operating Dealerships in Sales, Service & Spare.

Module IV: Preparation of Project Report (5 Hours)

Preparation of Project Report: Long Term Fund - Land, Building, Furniture & Fixtures, Machinery & Tools, Working Capital - Stock, Work In Progress, Receivables, Advance To Suppliers, Investment - Debt Equity Ratio, Debt Servicing Coverage Ratio, Break Even Point - Capacity & Capacity Utilization, Return On Investment - Gestation Period.

Module V: Basic Accounting (4 Hours)

Basic Accounting: Revenue Expenditure, Capital Expenditure, Debit, Credit & Journal Entry, Heads of Accounts, Trial Balance, Study of Balance Sheet, PL Account, Depreciation, Provisioning & Taxes.

Module VI: Banking (5 Hours)

Banking: Current Account, Savings Account, Loan Account, Term Loan, Cash Credit Loan, Bank Guarantee, Letter of Credit, Demand Draft, NEFT, Negotiable Instrument Act, Primary Security, Collateral Security, CGTMSE, Insurance.

Module VII: Statutory Laws and Compliance (4 Hours)

Statutory Laws and Compliance: Shop & Establishment Act, Labour Laws, Pollution Control, GST, Income Tax, Weight & Measure, Packaged Commodities Act.

Text Book

1. Arora M.N., Accounting for Management, Himalaya Publishing House.
2. Gordon and Natarajan, Banking Theory Law and Practice, Himalaya Publishing House.

Reference Book

1. Entrepreneurship Development, Small Business Enterprises, Chavantimath, Pearson.
2. The Dynamics of Entrepreneurial Development & Management, Vasant Desai, HPH. Entrepreneurship, Roy, Oxford

Session Plan

Topics	No. of Sessions	Activity	Assignment	Suggested Reading
Module I: Opportunities in Trading (5 Hours)				
Opportunities in Trading - Battery, Lubricant, Spares,	5	Lecture	Assignment-1	Text Book(TB)-1 Chapter(Ch)-1
Module II: Opportunities in Service & Repair Work Shops (4 Hours)				
Layout, Location, Water, Electricity, Drainage, Manpower	4	Lecture	Assignment-2	TB-1 Ch-6, Ch-17

& HR , Financing, Reports & Records, Management Info Systems, Sales & Marketing, Customer Relationship Management.				
Module III: Opportunities in Operating Dealerships (3 Hours)				
Opportunities in Operating Dealerships in Sales, Service & Spare.	3	Lecture	Assignment-3	TB-1 Ch-1
Module IV: Preparation of Project Report (5 Hours)				
Long Term Fund - Land, Building, Furniture & Fixtures, Machinery & Tools, Working Capital - Stock, Work in Progress, Receivables, Advance	5	Lecture	Assignment-4	TB-1 Ch-6
Module V: Basic Accounting (4 Hours)				
Revenue expenditure, Capital Expenditure, Debit, Credit & Journal Entry, Heads of Accounts, Trial Balance, Study of Balance Sheet, PL Account, Depreciation , Provisioning & Taxes.	5	Lecture	Assignment-5	TB-1 Ch-7
Module VI: Banking (5 Hours)				

Current account, Savings Account, Loan Account, Term Loan, Cash Credit Loan, Bank Guarantee, Letter of Credit, Demand Draft, NEFT, Negotiable Instrument Act, Primary Security, Collateral Security, CGTMSE, Insurance.	5	Lecture	Assignment-6	TB-2 Ch-1,6
Module VII: Statutory Laws and Compliance (4 Hours)				
Shop & Establishment Act, Labour Laws, Pollution Control, GST, Income Tax, Weight & Measure, Packaged Commodities Act.	5	Lecture	Assignment-7	TB-2 Ch-33

Maintenance of Automobile

Course Title	Course Code	Type of Course	T-P-PJ	Pre-Requisite
Maintenance of Automobile	DEAE0204	Practice	0-5-0	Nil

Objective

- To be aware with the basic maintenance of four wheeler and two wheeler
- To learn the overhauling of each system of four wheeler and two wheeler

Learning Outcome

- Disassemble and assemble each system of an automobile
- To detect faults in various systems of automobile

Evaluation System

Evaluation	Component	Marks	Method of Assessment
Internal Evaluation	Internal Practice	50 (40+10)	Lab work + Learning Record
External Evaluation	External Practice	50	Lab work
Total		100	

Practice

1. Safety Precautions in Automobile Maintenance.
2. Identification and Functions of Various Tools and Equipments used in Automobile Workshop.
3. Identification of Vehicle Chassis No. & Engine No, Identification of Different Parts Of Engine.
4. Disassembling and Assembling of Engine of a Four Wheeler.
5. Disassembling and Assembling of Engine of a Two Wheeler.
6. Engine Troubleshooting.
7. Nomenclature of a Spark Plug and Spark Plug Reading, Testing and Cleaning of Spark Plug.
8. Checking and Replenishing Lubricating Oil, Engine Coolant, Power Steering Hydraulic Oil and Wind Screen Wiper Water.

9. Overhauling and Servicing of Fuel System including Air Filter.
10. Overhauling and Servicing of Cooling System.
11. Disassembling and Assembling Of Clutch, Clutch Troubles And Remedies.
12. Repairing and Adjustment of Brake System.
13. Disassembling and Assembling of Propeller Shaft.
14. Inspection and Servicing of Gear Box.
15. Inspection and Servicing Of CVT.
16. Tire Change Operation, Wheel Balancing, Wheel Alignment, Tire Inspection (Tubeless & Tube) and Inflation.
17. Overhauling of Suspension System.
18. Disassembling and Assembling of Steering System and Adjustment of Drag Link.
19. Dismantling and Assembling Starter Motor.
20. Preparation of Electrical Circuits using Switches and Fuses.
21. Checking of Battery Terminal Voltage, Electrolyte Level and Specific Gravity.
22. Inspection of Different Electrical Circuits and ECU.
23. Setting Valve Timing, Engine Remounting on Two-Wheeler.
24. Checking of Ignition System Circuit & Components.

Reference Book:

1. Training Manual Of Four Wheeler Maintenance (Ashok Leyland)
2. Training Manual Of Two Wheeler Maintenance (Yamaha).

Design of Basic Automobile Components

Course Title	Course Code	Type of Course	T-P-PJ	Pre-Requisite
Design of Basic Automobile Components	EAE0205	Practice	0-2-0	Nil

Objective

- To Convert Basic Input Data into Engineering Design and Drawing using CATIA
- To Enable the Students to Design Basic Automobile Components using Prior Theoretical Knowledge.

Learning Outcome

- Understand the Advance Automobile Design Process
- Undertake Automobile Design Project

Evaluation System

Evaluation	Component	Marks	Method of Assessment
Internal Evaluation	Internal Practice	50 (40+10)	Lab work + Learning Record
External Evaluation	External Practice	50	Lab work
Total		100	

Practice

1. Design of Piston using CATIA.
2. Design of Crankshaft using CATIA.
3. Design of Connecting Rod using CATIA.
4. Design of Flywheel using CATIA.
5. Design of a Single Plate Clutch using CATIA.
6. Design of Differential using CATIA.
7. Design of Propeller Shaft using CATIA.
8. Design of Universal Joint using CATIA.
9. Design of Gear Box using CATIA.
10. Design of Air Conditioning System of E-Rickshaw
11. Design of Battery Pack for E-Rickshaw

12. Design of Bumper of a car.
13. Design of Frame of a Car.
14. Design of Pitman Arm of Steering System.

Subsystems of Automobile

Course Title	Course Code	Type of course	T-P-PJ	Pre-Requisite
Subsystems of Automobile	DEAE0401	Theory + Practice	3-2-0	Nil

Objective

- To understand the construction and working principle of different sub-systems of automobile
- To get knowledge on latest technologies used in automobile engineering

Learning Outcome

- Identify various subsystems of automobiles including their components
- Will be able to disassemble and assemble major aggregates of the automobile

Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Internal Theory	20	Written examination
	Internal Practice	30(20+10)	Lab work + Learning Record
External Examination	External Theory	30	Written examination
	External Practice	20	Lab work
Total		100	

Module I: Engine Emissions (10 Hours)

Theory

Engine Emissions: Sources of Air Pollution from Automobiles and Their Control, Crank Case Emission Control System, Evaporative Emission Control System, Exhaust Emission Control System: Air Injection, EGR, Catalytic Converters, Selective Catalytic Reduction (SCR) Technology, EURO/Bharat Stage Norms: I, II, III, IV, V And VI, Road Map for Implementation of Bharat Stage Norms In India.

Practice

1. Identification of Different Sub-Systems of Automobile.
2. Studies of Exhaust Gas Recirculation System (EGR) in KNOW Vehicle.

Module II: Ignition System (10 Hours)

Theory

Ignition System: Effect of Spark Timing on Emission And Ignition Timing Controls, Drawbacks of Conventional Ignition Systems, Electronic Ignition Systems (TCI And CDI), Engine Cylinder Numbering Scheme and Firing Order of Multi Cylinder Engines.

Practice

3. Study of Battery Ignition and Magneto Ignition System.
4. Disassembly and Assembly of 6-Cylinder Diesel Engine

Module III: Transmission System, Clutch System And Gear Box (20 Hours)

Theory

Transmission System: Power Transmission in Automobile (Front Wheel Drive, Rear Wheel Drive, Four-Wheel Drive, All-Wheel Drive).

Clutch System: Key Design Considerations of Clutches, Types of Clutches, Construction and Working Principle of Single Plate Friction Clutch, Diaphragm Clutch, Cone Clutch, Centrifugal Clutch, Dog Clutch, Vacuum Clutch, Hydraulic Clutches. Construction and Working Principle of Overrunning or Free Wheel Clutch.

Gear Box: Purpose of Gear Box, Types of Automobile Gear Boxes, Construction and Working Principle of Sliding Mesh, Constant Mesh, Synchronizer Mechanism and Synchromesh Gear Boxes, Planetary Gear Mechanism, Fluid Coupling and Torque Convertor, Construction and Working Principle of Automatic Transmission, Construction and Working Principle of Continuously Variable Transmission (CVT) and Automated Manual Transmission (AMT).

Practice

5. Study of Single Plate Friction Clutches (Coil Spring Type And Diaphragm Type).
6. Study of Synchronizer Mechanism And Synchromesh Gear Box, Continuously Variable Transmission (CVT).

Module IV: Propeller Shaft, Differential and Axles (20 Hours)

Theory

Propeller Shaft: Function and Need of Propeller Shaft, Hotchkiss Drive and Torque Tube Drive, Construction of Propeller Shaft, Universal/Hooke's Joints, Slip Joint, Types of Propeller Shafts, Need and Types of Constant Velocity (CV) Joints.

Differential: Constructional Features and Working Principle of Differential Mechanism, Types of Differentials (Locking Type Differential, Limited Slip Differential).

Axles: Types of Automotive Axles, Constructional Features, Types and Working Principle of Front Axles, Lift Axles, Rear Axle, Third Differential in Tandem Axle Vehicles, Construction and Working Principle of Manual Transaxles and Transfer Cases.

Practice

7. Study of Propeller Shaft, Universal Joints, Slip Joints, Centre Bearing.
8. Study of Front Axle System.
9. Study of Rear Axle System Including Differential Mechanism.
10. Disassembly and Assembly of Manual Transaxle of Front Wheel Drive Car.

Module V: Steering and Braking System (15 Hours)

Theory

Steering System: Purpose of Steering System, Components of Steering System, Steering Geometry (Castor, Camber, Toe-In, Toe-Out, King Pin Inclination, Ride Height, Turning Radius, Thrust Angle And Thrust Line), Types of Steering Gear Boxes and Their Construction and Working Principles, Hydraulic and Electrically Power Assisted Steering Systems.

Braking System: Requirement and Key Design Parameters of Braking System, Classification and Types of Braking Systems, Mechanical Brake, Hydraulic Brake, Air Brake, Vacuum Brake, Disc Brake. Construction, Working Principle and Components of Anti-Lock Braking System (ABS), Electronic Brake Force Distribution System.

Practice

11. Study of Steering Gear Box And Hydraulic Power Assisted Steering System.
12. Identifying the Different Components and Working Of Drum Brake, Disc Brake, Hydraulic Brake, Air Brake System.
13. Study of Anti-Lock Braking System (ABS) In KNOW Vehicle.

Note:“Study” Includes Understanding The Construction, Working Principle and Identifying Various Parts of the Sub-System.

Module VI: Auto Electric System & Suspension System (10 Hours)

Theory

Auto Electric System: Wiring Diagram of Horn Circuit, Lighting Circuit, Cut-Out Circuit, Voltage and Current Regulator Circuit in Commutator Type Generator, Combined Three-Unit Regulator Circuit, Voltage and Current Regulator In Alternating Current Type Generator And Flasher Circuit (Sketch And Description), Common Ignition Troubles And Its Remedies, Basic Electronic Ignition Trouble Shooting Charts, Spark Plugs: Purpose, Construction and Specifications.

Suspension System: Purpose and Classification of Suspension Systems, Sprung and Unsprung Mass, Major Components of Suspension System, Description of the Conventional Suspension

Systems for Rear and Front Axle. Panhard Rod, Macpherson Strut, Double Wishbone Suspensions. Description of Independent Suspension System Used In Cars (Coil Spring And Torsion Bars), Constructional Features and Working of Air Suspension System, Anti-Roll Bars, Constructional Features, Types and Working of Telescopic Shock Absorber.

Practice

14. Identification of Different Types of Suspension Systems: Coil Spring, Tension and Telescopic Suspension System.

Module VII: Trouble Shooting and Vehicle Maintenance (10 Hours)

Theory

Trouble Shooting and Maintenance: Onboard Diagnostic System, Symptoms for Engine Trouble and their Remedies.

Vehicle Maintenance: Types of Maintenance, Engine Tuning, Maintenance of Fuel And Air Filters, Monitoring of Lubricants and Other Fluids, Maintenance of Battery, Maintenance of Tyres.

Central Motor Vehicle Rules: Scope, Classification of Various Classes of Vehicles, GVW And GCW of Medium And Heavy Commercial Vehicles (Twin-Axle, Multi-Axle).

Checklist Preparation: Checklist for Daily Operator, Checklist for Accident Prevention, Checklist for Safety Precautions.

Automobile Technical Specification Sheets: Study of “Technical Specification Sheets”, Operation and Maintenance Manuals of Selected Car and Commercial Vehicle Models (Manufacturers in India And Abroad).

Text Book

1. Gupta R. B., Automobile Engineering, Satya Prakashan New Delhi
2. Giri N. K., Automobile Technology, Khanna Publishers

Reference Book

1. Crouse William H and Donald Anglin, Automotive Mechanics, Tata Mcgraw Hill Publications.
2. Newton K., Steeds W, and Garrett T K, The Motor Vehicle, Butterworth Heinemann

Session Plan

Topics	No. of Sessions (in hrs.)	Activity	Assignment	Suggested Reading
Module I: Engine Emissions (10 hours)				
Sources of Air pollution from automobiles and their control, Crank case emission control system, Evaporative emission control system, Exhaust emission control system: Air injection, EGR, Catalytic Converters, Selective Catalytic Reduction (SCR) Technology, EURO/Bharat Stage Norms: I, II, III, IV, V and VI, Road map for implementation of Bharat Stage norms in India.	Th-6, Pr-4	Lecture +Practice	Assignment-1	Text Book (TB)-1 Chapter (Ch)-1
Module II: Ignition System (10 Hours)				

Effect of Spark Timing on Emission And Ignition Timing Controls, Drawbacks of Conventional Ignition Systems, Electronic Ignition Systems (TCI And CDI), Engine Cylinder Numbering Scheme and Firing Order of Multi Cylinder Engines.	Th-3, Pr-4	Lecture+ Practice	Assignment- 2	TB-1 Ch-1
Module III: Transmission System, Clutch System And Gear Box (20 Hours)				
Power transmission in Automobile (Front wheel drive, Rear wheel drive, Four-wheel drive, All-wheel drive).	2	Lecture	Assignment- 3	TB-1 Ch-20
Key design considerations of clutches, Types of clutches, Construction and Working principle of Single plate friction clutch, Diaphragm clutch, Cone clutch, Centrifugal clutch, Dog clutch, Vacuum clutch, Hydraulic clutches. Construction and Working principle of Overrunning or Free wheel clutch	Th-6, Pr-2	Lecture+ Practice	Assignment- 3.1	TB-1 Ch-19

Purpose of gear box, Types of automobile gear boxes, Construction and working principle of Sliding mesh, Constant mesh, Synchronizer mechanism and Synchromesh gear boxes, Planetary gear mechanism, Fluid Coupling and Torque Convertor, Construction and Working principle of Automatic transmission, Construction and working principle of Continuously	Th-8, Pr-2	Lecture+ Practice	Assignment- 3.2	TB-1 Ch-20
Module IV: Propeller Shaft, Differential and Axles (20 Hours)				
Function and Need of Propeller shaft, Hotchkiss drive and Torque tube drive, Construction of Propeller shaft,	Th-3, Pr-2	Lecture+ Practice	Assignment-4	TB-1 Ch-22
Constructional features and working principle of differential mechanism, Types of differentials (Locking type differential, Limited slip differential).	3	Lecture	Assignment- 4.1	TB-1 Ch-22 TB-2 Ch-8

Types of automotive axles, Constructional features, types and working principle of Front axles, Lift axles, Rear axle, Third differential in Tandem axle vehicles, Construction and working principle of manual Transaxles and Transfer cases.	Th-6, Pr-6	Lecture + Practice	Assignment- 4.2	TB-1 Ch-24
Module V: Steering and Braking System (15 Hours)				
Purpose of Steering system, Components of Steering system, Steering geometry (Castor, Camber, Toe-in, Toe-out, King pin inclination, Ride height, Turning radius, Thrust angle and Thrust line), Types of Steering gear boxes and their construction and working principles, Hydraulic and Electrically power assisted steering systems.	Th-4, Pr-2	Lecture + Practice	Assignment-5	TB-1 Ch-24
Requirement and key design parameters of braking system, Classification and types of braking systems, Mechanical brake, Hydraulic	Th-5, Pr-4	Lecture +Practice	Assignment- 5.1	TB-2 Ch-7

brake, Air brake, Vacuum brake, Disc brake. Construction, working principle and components of Anti-lock braking system (ABS), Electronic Brake Force Distribution System				
Module VI: Auto Electric System & Suspension System (10 Hours)				
Wiring diagram of horn circuit, Lighting circuit, Cut-out circuit, Voltage and Current regulator circuit in Commutator type generator, Combined Three-unit regulator circuit, Voltage and Current regulator in Alternating current type generator and Flasher circuit (Sketch and description), Common ignition troubles and its remedies, Basic electronic ignition trouble shooting charts, Spark plugs: purpose, construction and specifications	Th-4, Pr-2	Lecture +Practice	Assignment- 6	TB-1 Ch-18
Purpose and Classification of Suspension systems, Sprung and Unsprung mass, Major components of	4	Lecture +Practice	Assignment- 6.1	TB-1 Ch-25

<p>suspension system, Description of the conventional suspension systems for rear and front axle. Panhard rod, Macpherson strut, Double wishbone suspensions.</p> <p>Description of independent suspension system used in cars (coil spring and torsion bars), Constructional features and working of Air suspension system, Anti-roll bars, Constructional features, types and working of telescopic shock absorber</p>				
Module VII: Trouble Shooting and Vehicle Maintenance (10 Hours)				

<p>Onboard Diagnostic system, Symptoms for Engine Trouble and their remedies.</p> <p>Types of maintenance, Engine tuning, maintenance of fuel and air filters, monitoring of lubricants and other fluids, maintenance of battery, maintenance of tyres.</p> <p>Scope, Classification of various classes of vehicles, GVW and GCW of Medium and Heavy Commercial vehicles (Twin-axle, Multi-axle).</p>	6	Lecture	Assignment-7	TB-1 Ch-28
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<p>Checklist for daily operator, Checklist for accident prevention, Checklist for Safety precautions.</p> <p>Study of “Technical Specification sheets”, Operation and Maintenance manuals of selected Car and Commercial Vehicle Models (Manufacturers in India and abroad).</p>	4	Lecture		
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Design and Maintenance of Electric Vehicles

Course Title	Course Code	Type of Course	T-P-PJ	Pre-requisite
Design and Maintenance of Electric Vehicles	DEAE0402	Theory+ Practice	2-1-0	Nil

Objective

- To study electric drive vehicles & its applications
- To study fundamentals of component design of electric vehicle
- To know the basic maintenance of different parts of electric vehicle

Learning Outcome

- Understand the importance of EVs for environment, energy sustainability and climate change
- Decide the power rating of electric vehicle

Evaluation System

Evaluation	Component	Marks	Method of Evaluation
Internal Evaluation	Internal Theory	20	Written Examination
	Internal Practice	30 (20+10)	Lab Work + Learning Record
External Evaluation	External Theory	30	Written Examination
	External Practice	20	Lab Work
Total Marks		100	

Module I: Principles of Energy and Conventional Vehicles (8Hours)

Theory

Principles of Energy: Motion, Force, Power, Work, Energy, Efficiency, Units of Forces (Drag, Lift, Inertia), Power and Energy.

Conventional Vehicles: Basics of Vehicle Performance, Vehicle Power Source Characterization, Performance Characteristics.

Practice:

1. Determination of Performance Parameters of Conventional Vehicle.

Module II: Introduction to Electric Vehicles (8Hours)

Theory

Introduction to Electric Vehicles: History of EV, EV Advantages and Disadvantages, EV Market and Promotion, Main Components of Electric Vehicle and Its Functions (Electrical and Mechanical).

Practice:

2. Study of Different Components of E-Rickshaw and Assembling Methods.
3. Working of Circuits in Controllers with respect to Current and Voltage Rating.

Module III: Electric Vehicle Drive Trains (4 Hours)

Theory

Electric Vehicle Drive Trains: EV Transmission Configurations, Basic Architecture of Electric Drive Trains, Single and Multi-Motor Drives, In Wheel Drives.

Module IV: Energy Sources (10 Hours)

Theory

Energy Sources: Working Principle of Battery, Types Of Batteries, Lead-Acid Battery, Nickel-Cadmium Battery, Nickel-Metal-Hydrate (Nimh) Battery, Lithium Batteries, Battery Parameters, Fuel Cells,

Practice:

4. Maintenance of Lead Acid Batteries.
5. Wiring & Harnessing of Battery Circuit.

Module V: Electric Motors (15 Hours)

Theory

Electric Motors: Classification of Electric Motors, DC Motor, Types of DC Motors, Brushless DC Motor, AC Motor, Types of AC Motors, Induction Motor, Synchronous Motor, Regenerative Braking.

Practice:

6. Study of Different Parts of D.C. Motor and Make Connection.
7. Performance Characteristics of a Shunt and Series DC Motor
8. Load Test on Three Phase Induction Motor.
9. Speed Control of DC Shunt Motor by Armature and Field Control.

Module VI: Electric Vehicle Maintenance & Safety (10 Hours)

Theory

Electric Vehicle Maintenance & Safety: Maintenance & Trouble Shooting of Different Components of EV, High Voltage Electrical Safety, Tool and Equipment Usage, High Voltage Safety Rules, Electrical Isolation.

Practice:

10. Maintenance of BLDC Motor.
11. Maintenance of Hub Motor.

12. Maintenance & Trouble Shooting Of Electric Circuit

Module VII: Design of Electric Vehicle (5 Hours)

Theory

Design of Electric Vehicle: Power and Torque Calculation of Electric Vehicles, Sizing of Components, Initial Acceleration, Maximum Velocity, Maximum Gradability.

Text Book

1. Hussein Iqbal, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press
2. Chau K. T., Electric Vehicle Machines and Drives: Design, Analysis and Application, Wiley.

Reference Book

1. Chan C.C. and Chau K.T., Modern Electric Vehicle Technology, London: Oxford University.

Session Plan

Topics	No. of Sessions (in hrs.)	Activity	Assignment	Suggested Reading
Module I: Principles of Energy and Conventional Vehicles (8Hours)				
Motion, Force, Power, Work, Energy, Efficiency, Units of Forces (drag, lift, inertia), power and energy.	3	Lecture	Assignment-1	Text Book(TB)-1 Chapter(Ch)-1
Basics of vehicle performance, Vehicle power source characterization, Performance characteristics.	Th-3, Pr-2	Lecture+ Practice	Assignment-1.1	TB-1 Ch-1
Module II: Introduction to Electric Vehicles (8Hours)				

History of EV, EV advantages and disadvantages, EV market and promotion, Main components of electric vehicle and its functions (electrical and mechanical).	Th-4, Pr-4	Lecture+ Practice	Assignment- 2	TB-1 Ch-1
Module III: Electric Vehicle Drive Trains (4 Hours)				
EV transmission configurations, Basic architecture of electric drive trains, Single and multi-motor drives, In wheel drives.	4	Lecture	Assignment- 3	TB-1 Ch-2
Module IV: Energy Sources (10 Hours)				
Working principle of battery, Types of batteries, Lead-Acid battery, Nickel-Cadmium battery, Nickel-Metal-Hydride (NiMH) battery, Lithium batteries, Battery Parameters, Fuel Cells,	Th-6, Pr-4	Lecture+ Practice	Assignment-4	TB-1 Ch-3
Module V: Electric Motors (15 Hours)				

Classification of electric motors, DC motor, Types of DC motors, Brushless DC motor, AC motor, Types of AC Motors, Induction motor, synchronous motor, Regenerative braking.	Th-7, Pr-8	Lecture+ Practice	Assignment-5	TB-1 Ch-5
Module VI: Electric Vehicle Maintenance & Safety (10 Hours)				
Maintenance & trouble shooting of different components of EV, High voltage electrical safety, Tool and equipment usage, High voltage safety rules, Electrical isolation.	Th-4, Pr-6	Lecturer	Assignment-6	TB-2 Ch-6
Module VII: Design of Electric Vehicle (5 Hours)				
Power and torque calculation of electric vehicles, Sizing of components, Initial Acceleration, Maximum Velocity, Maximum Gradability.	5	Lecturer	Assignment-7	TB-1 Ch-7