Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Technology and Science
Choice Based Credit System (CBCS) in Light of NEP-2020
B.Tech. in Automobile Engineering
(2021-2025)

COURSE CODE	CATE-GORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
	DE	EV BATTERIES AND CHARGING SYSTEM	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
To introduce the learners about batteries, their parameters, modeling and charging infrastructure, power transfer, and converters.

Course Outcomes (COs):
Students will:
1. Students would be able to elaborate on various technical parameters of batteries.
2. Students would be able to distinguish between various types of batteries used for EV applications.
3. Students would be able to develop battery chargers for an EV.
4. Students would be able to understand power transfer technology and charging station's work.

Syllabus

UNIT I

Introduction: Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life, Battery indicator, Cells connected in parallel, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging.

UNIT II

Batteries: Introduction, Types; Lead Acid Batteries, Nickel-based Batteries, Sodium-based Batteries, Lithium Batteries, Metal Air Batteries, Special characteristics of batteries, Battery life and maintenance, Battery charging.

UNIT III

EV Charging: Battery Chargers, Charge equalization, Charger circuits basic and Microprocessor based, Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive charging.

Charging Infrastructure: Introduction, understanding charging economics, Commercial charging and pricing models, Load managements for large scale EV integration, Domestic Charging Infrastructure, Public Charging Infrastructure.

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UNIT IV

Power Transfer & Converters: Overview of series, parallel and series-parallel resonance converter, LLC resonant converter, Dual Active Bridge (DAB) Converter; topology, operation and control.
Wireless Power Transfer (WPT) for Electric Vehicles (EVs): Basics of WPT Technology, Modelling the WPT System, WPT for EV Charging, Design Challenges and Optimization Candidates, Future Directions and Trends.
Battery Charger Impact on Grid: 1-phase fully controlled converter, 3-phase fully controlled converter strategy used for power factor correction, Harmonics Impact, Current Demand Impact and current demand minimization.

UNIT V

Electric Vehicles Charging station: Types, Selection and Sizing of charging station, Components of charging station, Single line diagram of charging station, Electric vehicle integration issues-Battery Performance and cost.

Text Books:

1. *"Advances in Battery Technologies for Electric Vehicles" by Bruno Scrosati, Jürgen Garche, Werner Tillmetz, Woodhead Publishing, 2015.*
2. *"Advanced Battery Management Technologies for Electric Vehicles" (Automotive Series) 1st Edition by by Rui Xiong (Author), Weixiang Shen, willy, 2020.*
3. *"Electric Vehicle Technology" Explained by James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK.*
4. *"Modern Electric Vehicle Technology" by C.C Chan, K.T Chau, Oxford University Press Inc., New York 2001.*
5. *"Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design" by Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, CRC Press, 2004.*

Reference Books:

1. *"Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market" by Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.*
2. *"Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles" by Sheldon S. Williamson; Springer, 2013.*

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3. *"Modern Electric Vehicle Technology" by C.C. Chan and K.T. Chau; Publisher: OXFORD University Press, 2001*
4. *"Hybrid Electric Vehicles Principles and Applications with Practical Perspectives" by Chris Mi, M. Abul Masrur, David Wenzhong GAO; Publisher: Wiley Publication, 2011.*
5. *"Electric Vehicle Technology Explained" by James Larminie, John Lowry Wiley, 2003.*
6. *"Battery management systems, Volume I: Battery modeling by Plett, Gregory L. Artech House, 2015.*
7. *"Battery management systems, Volume II: Equivalent-circuit methods by Plett, Gregory L. Artech House, 2015.*
8. *"Battery Management Systems - Design by Modelling" by Bergveld, H.J., Kruijt, W.S., Notten, P.H.L Philips Research Book Series 2002.*
9. *Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussein, CRC Press, 2003.*

List of Experiments

1. To study the various technical parameters and terminologies of batteries.
2. To observe the charging and discharging process, and plot graph of charging/load current, SOC, temperature, DOC, and terminal voltage.
3. To distinguish between various types of batteries used for EV's.
4. To analyze the effect of temperature on the performance of a Lead Acid battery model.
5. To analyze the effect of temperature on the performance of a Nickel-based battery model.
6. To analyze the effect of temperature on the performance of a Lithium-Ion battery model.
7. To study Lithium Battery Cell - One RC-Branch Equivalent Circuit and it's simulation.
8. To Simulation of Battery Charging by using AC – DC converter
9. To study the power transfer technology and charging station's work.
10. To study about electric vehicle charging system.

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	DE	**VEHICLE DIAGNOSTICS**	60	20	20	30	20	3	0	2	**4**

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Course Educational Objectives (CEOs):

The objective of the course is to describe the (A) Machine Faults, (B) Measurement of fault (C) Data acquisition and signal processing techniques, (D) Fault Diagnosis.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate the following:

1. Students would be familiar with vehicle fault diagnostic procedures.
2. Students would be able to identify, repair, solve, and prepare reports of various engine components and chassis systems-related problems.
3. Students would be able to identify, repair, solve, and prepare report of electrical system-related faults.
4. Students would be able to diagnose the faults of the lubrication system and cooling system etc.

Syllabus

Unit I

Maintenance Schedules and Records: Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, Maintenance of records and its formats; log sheets and other forms, safety precautions in maintenance.

Unit II

Engine Diagnostics: Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.

Transmission, Suspension and Steering Diagnostics: Diagnostics of automobile clutch and gear box, servicing/maintenance of propeller shaft and differential system. Diagnostics of suspension systems problems, Steering systems; overhauling and maintenance. Wheel alignment; computerized alignment and wheel balancing.

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Unit III

Electrical System Diagnostics: Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

Unit IV

Cooling System Diagnostics: Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems problems: braking systems, Traction control system, Stability Control system, air conditioning, water pump, radiator, thermostat, anti-corrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, Minor and major repairs. Door locks and window glass actuating system maintenance.

Unit V

Brake and Safety System Diagnostics: Active and passive safety, airbags, tightening system, forward collision warning systems, Brake systems problems and their rectification. child lock, anti-lock braking systems, EBD, traction control system and lane departure warning system, Adaptive cruise control system, Global positioning system, geographical information systems, navigation system, remote keyless entry, smart card system and number plate coding.

Text and References Books:

1. *"Advanced Engine Performance Diagnosis" by James D. Halderman, PHI, 2011.*
2. *"Bosch Automotive Handbook", Sixth Edition, 2004.*
3. *"Maintenance planning and control" by Higgin L.R. Mc Graw Hill, 1997.*
4. *"Practical Machinery Vibration Analysis and Predictive Maintenance" by C. Scheffer & Paresh Girdhar; Elsevier, 2004.*
5. *"Vehicle Maintenance and Garage Practice" by Jigar A. Doshi, D.U. Panchal and J. P. Maniar, PHI Learning Pvt. Ltd, 2014.*

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6. *"Advanced automotive fault diagnosis" by Tom Denton, Elsevier BH, 2006.*
7. *"Automotive Computer Controlled Systems" By Allan W. M. Bonnick, Butterworth-Heinemann A division of Reed Educational and Professional Publishing Ltd*
8. *"Intelligent Vehicle Technologies", by Ljubo Vlacic, Michel Parent and Fumio Harashima, Butterworth -Heinemann publications, Oxford, 2001.*
9. *"Sensors and Transducers" By Ronald K.Jurgen - SAE 2003*

List of experiments

1. Identify, repair, solve, and prepare reports on maintenance of automobile components & general vehicle architecture.
2. Identify, repair, test, and prepare reports of cylinder re-boring, valve grinding, and valve lapping.
3. To study and prepare report on the constructional details, working principles and operation of the automotive transmission systems.
4. To study and prepare report on the constructional details, working principles and operation of the automotive suspension systems.
5. To study and prepare a report on the testing of kingpin inclination, toe-in, and toe-out.
6. To study and prepare a report on the wheel balancing and 'wheel alignment – testing of camber, caster'.
7. Trace, test, and prepare reports of all electrical, and electronic components & circuits and to ensure the functionality of the system.
8. Identify battery pack components and check the performance of energy storage systems.
9. To study and prepare report on the constructional details, working principles and operation of the engine cooling systems.
10. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
11. Diagnose, repair, and testing of automotive vehicles safety system and components.

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	DE	ALTERNATIVE FUELS AND EMISSION CONTROL	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):

Student will be able to (A) understand about alternative fuels, their potential as replacements for conventional fossil fuels, (B) Associated pollution control technologies and (C) learn about emission reduction strategies for sustainable mobility.

Course Outcomes (COs):

After completion of this course the students will be able:

1. To understand the significance of alternative fuels in reducing environmental impact and achieving sustainable transportation.
2. To examine the different generations of biodiesel production techniques and understand their advantages and challenges.
3. To evaluate biodiesel quality standards and compatibility with existing diesel engines.
4. To explore the latest research and innovations in alternative fuel technologies.

Syllabus

Unit I

Introduction: Introduction to Alternative Fuel, need of alternative fuels in the automotive sector, Types of alternative fuels: biofuels: biodiesel, bio ethanol's and bio gas. hydrogen, natural gas, LPG etc., Production processes and sources of alternative fuels. Advantages and challenges of using alternative fuels in vehicles, bio ethanol's production, advantages and challenges, Challenges of alternative fuel production in Asian countries. Energy scenario of India, Crude oil and petroleum products availability in India.

Unit II

Hydrogen as an Automotive Fuel: Production methods; steam methane reforming, electrolysis, etc. Hydrogen storage and infrastructure challenges, Fuel cell vehicles and hydrogen combustion engines.

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Natural Gas and LPG as Fuels: Production methods, Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG), advantages and challenges, Impact on engine performance and emission, Infrastructure and storage considerations.

Unit III

Biodiesel generations and production: Introduction, what is Biodiesel, applications of biodiesel, Generation of biodiesel; benefits and comparison, Advantages and disadvantages of third-generation biodiesel, Biodiesel production process for different generations; Transesterification, Acid-Catalyzed Esterification, Enzymatic Transesterification, Supercritical Methanol Transesterification, Microwave-Assisted Transesterification, Ultrasonic Transesterification, Factors affecting transesterification reaction, Biodiesel Production steps, Advantages of biodiesel, The advantages and disadvantages of Petro diesel and biodiesel, Future prospects.

Unit IV

Biodiesel Quality, Standards and Properties: Deference between diesel and bio diesel, Biodiesel Properties, Biodiesel Properties comparison with diesel, Biodiesel standardization world-wide. Bio diesel blends properties impact on performance, combustion & Emission parameter of IC Engine.

Unit V

Emission Control: Greenhouse gas emissions (CO, CO_2, CH_4, N_2O) from various fuels, Air pollutants (NOx, CO, HC, PM) and their effects on air quality and health. Emission Control Technologies: Catalytic converters, Selective Catalytic Reduction (SCR) for NOx reduction, Particulate filters etc.
Policy and Regulatory Framework: Government incentives and policies promoting alternative fuels, Emission standards and regulations for cleaner vehicles, international efforts toward sustainable mobility, Overview of national biofuel policies, Technological barriers and limitations of alternative fuels, Future trends and innovations in pollution control and sustainable transportation.

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Text Books:

1. *"Internal Combustion Engines" by Ganeshan –Tata McGraw Hill, 2008.*
2. *"Internal Combustion Engines" by Heywood John-- McGraw Hill, 2018.*
3. *"Automotive Emission Control" by Crouse and Anglin –McGraw Hill, 1977.*
4. *"Non-conventional Energy Sources"by G.D. Rai, Khanna Pub, 1992.*
5. *"Alternative Fuels" by S.S. Thipse, Jaico Publishing House, 2010.*
6. *"Internal Combustion Engines" by Ferguseaon, John Wiley & Sons, 2001.*

Reference Books:

1. *"Handbook of Alternative Fuel Technologies" by James G. Speight and Sudarshan K. Loyalka, CRC Press, 2007.*
2. *"Biodiesel, combustion, performance and emissions characteristics" by Maroa S and Inambao F. Green Energy and Technology, Springer Nature, 2020.*
3. *"Alternative Fuels and Their Utilization Strategies in Internal Combustion Engines" by Akhilendra Pratap Singh, Yogesh C. Sharma, Nirendra N. Mustafi, Energy, Environment, and Sustainability, Springer, 2020.*
4. *"Biodiesel Production with Green Technologies" by Aminul Islam and Pogaku Ravindra, Springer International Publishing Switzerland 2017.*
5. *"Practical Handbook on Biodiesel Production and Properties" by Mushtaq Ahmad, Mir Ajab Khan, Muhammad Zafar and Shazia Sultana, Taylor & Francis Group, LLC 2013.*
6. *"Biodiesel – Quality, Emissions and By-Products" by Gisela Montero and Margarita Stoytcheva, Intech, 2011.*

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	DE	ENGINE TESTING AND CERTIFICATION	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):

Students will be equipped with the knowledge and practical expertise to (A) conduct engine tests, evaluate engine performance and emissions, and (B) understand the significance of certification in meeting environmental regulations and (C) developing efficient and environmentally friendly internal combustion engines.

Course Outcomes (COs):

Upon the successful completion of the course, students will be able:

1. To Understand the fundamentals of HCCI engines, including the principles of autoignition and combustion characteristics.
2. To Gain knowledge of engine testing methodologies and evaluate engine performance parameters, and emissions under controlled conditions.
3. To Familiarize with various engine testing equipment and sensors used for data acquisition.
4. To develop practical skills in engine performance testing, including conducting tests at various operating conditions and identify areas for optimization.
5. Explore engine emissions testing techniques to measure exhaust emissions and understand the standards for emissions certification.

Syllabus

UNIT I

HCCI Engine Fundamental: Introduction, Definition and concept of Homogeneous Charge Compression Ignition (HCCI), Comparison with conventional spark-ignition (SI) and compression-ignition (CI) engines, Advantages and challenges of HCCI combustion, HCCI Combustion Process, Temperature and pressure effects on auto-ignition & Compression ignition, Combustion timing and control, Operating Principles and Control Strategies. Combustion Chamber Design, Design considerations for HCCI engines, Piston and cylinder head design, Impact of chamber design on combustion efficiency.

UNIT II

Engine Testing: Introduction, Definition and scope of engine testing, Importance of engine testing in research, development, and quality assurance, Types of Engine Tests, Performance testing; Power output, torque, fuel consumption and efficiency measurement. Emission testing; Measurement

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and analysis of exhaust gases, Durability testing; Endurance and reliability assessment. Combustion analysis; Cylinder pressure, Cylinder temperature, ignition delay and heat release analysis.

UNIT III

Engine Testing Equipment's & Sensors: Engine's torque measurements: Dynamometers, Types; eddy current dynamometers, hydraulic dynamometers, and electric dynamometers, cylinder pressure measurements; Pressure Transducers, Exhaust gas temperatures, Coolant temperatures, and other critical engine temperatures measurement sensors and Thermocouples, Air-Fuel Ratio (AFR) Sensors, Lambda Sensors, Smoke Meters, Fuel Flow Meters, Opacity Meters, Ignition Analyzers, Exhaust Gas Analyzers, Data Acquisition Systems, Engine Management Systems (EMS), Combustion Analysis Systems, Humidity Measurement, Calibration Measurement.

UNIT IV

Engine Performance Testing: Measurement of Power Output; Calculation of brake power (BP) and indicated power (IP). Torque Measurement: Measuring engine torque using dynamometers or strain gauges, Relationship between torque and power. Fuel Consumption Measurement; Determining fuel flow rate and fuel consumption, Calculation of Brake Specific Fuel Consumption (BSFC), Measuring Air-Fuel Ratio (AFR), Calculation and significance of BMEP, Performance Testing at Different Speeds, Loads, Nozzle pressure, Compression ratio and Valve Timings. Heat Balance and Engine Efficiencies calculations.

UNIT V

Engine Emissions Testing: Definition and types of engine emissions (NOx, CO, HC, PM, etc.), Sources and factors influencing engine emissions, Environmental and Health Impacts, Emission Measurement Techniques; Gas analyzers for measuring exhaust gas concentrations, Particulate matter (PM) measurement techniques, Emission sampling and sample conditioning. Emission Control Technologies; Catalytic converters, Selective Catalytic Reduction (SCR) for NOx reduction, Particulate filters, Emission Regulations and Standards, Impact of Fuel Properties on Emissions, Advancements in emission control technologies.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
	DE	ENGINE TESTING AND CERTIFICATION	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Text Books:

1. *A.J.Martyr, M. A.Plint, "Engine Testing Theory and Practice", 3rd edition, SAE International, 2007.*
2. *Michael James Plint & Tony Martyr, "Engine Testing- Theory & Practice", 3rd edition, SAE International, 2007.*
3. *Willard W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine Second Edition. Pearson New International Edition, British Library cataloguing-in-publication data 2014; Harlow, United Kingdom.*
4. *Maroa S and Inambao F. Biodiesel, combustion, performance and emissions characteristics, Green Energy and Technology, Springer Nature, 2020.*
5. *"Engine Testing: Theory and Practice" by A. J. Martyr and M. A. Plint, Butterworth-Heinemann; 3rd edition, 2011.*
6. *B.P. Pundir, Engine Combustion and Emission, 2011, Narosa Publishing House.*
7. *Thipse.S.S., Alternative Fuels; Concepts, Technologies and Developments, Jaico Book Distributors, 2010*

Reference Books:

1. *Heniz Heisler, "Advanced Engine Technology", Vol. 1, SAE International 2002.*
2. *Richard D Atkins, "An Introduction to Engine Testing & Development", ISBN 978-0-7680-2099-1, SAE International 2009.*
3. *John B Heywood, "Internal Combustion Engines Fundamentals", McGraw Hill International Edition, 1988.*
4. *Hua Zhao "HCCI and CAI Engines for automotive industry" Wood Head Publishing in Mechanical Engineering, 2007.*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
	DE	LOGISTICS MANAGEMENT AND WAREHOUSING	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

Students will possess the knowledge and skills required to (A) efficiently plan, coordinate, and optimize logistics operations, (B) including warehousing and distribution, contributing to (C) enhanced supply chain performance, reduced costs, and improved customer satisfaction.

Course Outcomes (COs):

Students will be able to

1. Understand the fundamentals of logistic management and its significance in supply chain operations.
2. Analyze and comprehend commercial geography and its role in optimizing transportation routes and strategies.
3. Explore multimodal transport and its advantages in creating efficient and cost-effective transport solutions.
4. Familiarize with international transport conventions and documentation to facilitate seam-less global trade.
5. Gain insights into clearance processes and their importance in international logistics operations.

Syllabus

UNIT I

Basics of logistics management: Introduction to physical distribution, Logistics management and its elements, Modern concepts in logistics, Role of logistics in strategy, Inbound and outbound supply chain management, Container – types, Different types of cargo, Packaging and material handling.

UNIT II

Commercial geography: Definition, Nature and scope of commercial geography, Role of industries in economic development, Factors of Industrial Location, Weber's theory of industrial location, Major industrial regions of India, Need and importance of transportation in commercial development, Geographical factors affecting international Trade, Major logistics routes in India, Major trade routes in world, International logistics and economic development, Role of intermediaries in international trade.

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
	DE	LOGISTICS MANAGEMENT AND WAREHOUSING	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Multimodal transport: Introduction, Carriage by air, sea, road and rail, Types of vessels, Operators (Vessel and other), Freight forwarders and NVOCC, Outsourcing of logistics services, Overview of MMTG Act (1993).

UNIT III

International transport conventions: Legal agreements between countries and the UN, Multilateral transport agreements, Convention on road traffic, TIR procedures, CMR convention, Importance of international conventions.

Documentation and clearance processes: Foreign Trade Policy, Export and Import procedures, Documents Related to Export and Import, Instruments and terms of payment in Export – Import, Methods of export - import financing, Letter of credit and bill of exchange, foreign exchange regulations and formalities, Cargo insurance, International commercial terms, Procedure and documentation for availing export incentives, Bill of lading other documents, GST way bill and other documents.

UNIT IV

Trends in logistics: Introduction – recent developments in logistics, Transport and mobility technologies, green logistics, Cold chain logistics, Block chain and big data analytics in logistics, Transport services, Costing and performance, Administration and control and use of IT.

UNIT V

Warehousing: Introduction to warehousing, Warehouse functions, Warehouse types, Warehouse providing value added services, Warehouse internal operations, Warehousing equipment, Inventory, Safety and security in warehouses, Future trends in warehousing.

Text Books:

1. *"Fundamentals of Logistics Management" (The Irwin/McGraw-Hill Series in Marketing), Douglas Lambert, James R Stock, Lisa M. Ellram, McGraw-Hill/Irwin, First Edition, 1998.*
2. *"Logistic Management" (2nd Edition.) by Vinod V. Sople (2009), Pearson Limited.*

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
	DE	LOGISTICS MANAGEMENT AND WAREHOUSING	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

3. *"Logistical Management" by Donald J. Bowersox & David J. Closs, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2004.*
4. *"Logistics Management" by Satish C. Ailawadi & Rakesh Singh: Prentice-Hall of India Pvt Ltd., New Delhi, 2005.*
5. *"Management For International Business: Text and Cases" by Sudalaimuthu & S. Anthony Raj, PHI Learning, First Edition, 2009.*

Reference books:

1. *"Introduction to Shipping, Institute of Chartered Shipbrokers" by Witherby Seamanship International Ltd, 2nd Revised edition, 2009.*
2. *International Logistics, Second Edition by Donald F. Wood, Anthony P. Barone, Paul R. Murphy, Daniel L. Wardlow, American Management Association, 2002.*
3. *"Global Supply Chain Management and International Logistics" by Alan E. Branch, Routledge: Taylor & Francis group 2009.*

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BTAU503	DCS	AUTOMOTIVE TRANSMISSION SYSTEM	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

This course provides a fundamental understanding (A) To develop the basic knowledge of the students in mechanics torque conversion areas, (B) To develop the skills of the students in the areas of alternative drives and concepts, (C) To develop the basics of the students in the field of transmission system of the vehicle.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Students would be able to understand the working principle of the transmission system components.
2. Students would be able to understand the different types of clutches, gearboxes, driveline and final drive and its application.
3. Students would be able to understand about the multi stage and poly-phase torque converters and their performance characteristics.
4. Students would be able to understand about Automatic transmission.

Syllabus

Unit I

Transmission Requirements: Requirements of transmission system; general arrangement of power transmission; general arrangement of rear engine vehicle with live axles, general Arrangement of dead axle and axles transmission; four-wheel drive transmission.

Unit II

Clutches: Introduction, Types of clutches; Materials requirement for designing of clutches; working and principle of cone clutch, single plate, diaphragm spring, multiline, centrifugal, over running and free electromagnetic clutch.

Gear box: Need of gear boxes; types of gear boxes: sliding mesh, constant mesh, epicyclic gear boxes, synchronizers: principle, early and later Warner synchronizer, Vauxhall synchronizer gear materials lubrication and design of gear box.

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BTAU503	DCS	AUTOMOTIVE TRANSMISSION SYSTEM	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Unit III

Fluid coupling: Principle of operation, Construction details, Torque capacity, Performance characteristics, Problems on design, Reduction of drag torque.

Torque converter: Principle of operation, Constructional details, Performance characteristics; Converter coupling, Construction, Free wheel, Characteristic performance.

Unit IV

Automatic Transmission & Application of Automatic Transmission: Principle of working of Epicyclic gear train; Construction and working principle of Ford T model gear box, Wilson gear box, construction, working and derivation of gear ratios; Octal electromagnetic transmission; Automatic over-drive; Hydraulic control system for automatic transmission. Chevrolet Automatic transmission, Turbo glide transmission, Power glide transmission, Toyota "ECT-I" (Automatic transmission with intelligent electronic control systems) - Mercedes Benz automatic transmission; Hydraulic clutch actuation system for automatic transmission.

Unit V

Hydrostatic drives: Advantages and disadvantages; principles of hydrostatic drive systems, construction and working of typical hydrostatic drives; Janney Hydrostatic drive.

Electrical drives: Advantages and limitations, principles of Ward Leonard system of control Modern electric drive for buses and performance characteristics.

Reference Books:

1. *"Torque converters", by Heldt P.M; Publisher; Chilton Book Co., 4th ed., 1951.*
2. *"Motor Vehicles", by Newton, Steeds & Garret; Publisher: B.H. Publication, 2000.*
3. *"Modern Transmission Systems", by Judge, A.W., Publisher: Chapman& Hall Ltd, 1969.*
4. *"Automatic Transmission", by Cheek Chart; Publisher: Harper & Row Publication, 1973.*
5. *"Automobile Engineering" Vol. 1, by Dr. Kripal Singh; Publisher: Standard Publishers Distributors, 2017.*

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU503	DCS	AUTOMOTIVE TRANSMISSION SYSTEM	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

List of Experiments

1. Demonstration of garage, garage equipment sand tools, preparation of different garage layout.
2. Demonstration of washing & greasing of vehicle.
3. Engine oil change & periodic maintenance of vehicle.
4. Dismantling & assembly of clutch (light / heavy duty vehicle).
5. Dismantling & assembly of constant mesh gearbox and synchromesh gearbox.
6. Dismantling & assembly of drive line (universal joint, propeller shaft, and slip joint).
7. Dismantling & assembly final drive & differential.
8. Rear axle hub greasing.
9. Dismantling & assembly of automatic transmission.
10. Dismantling & assembly of fluid flywheel & torque converter.

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BTAU504	DCS	MANUFACTURING TECHNOLOGY	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The primary objective of the course is to describe the (A) Unconventional machining processes, Jigs and Fixtures (B) Gear manufacturing, (C) Group technology and flexible manufacturing system, (D) Computer integrated manufacturing.

Course Outcomes (COs):

After completion of this course the students will be able to describe the followings:

1. Students will be able to understand & describe concepts of unconventional machining process.
2. Students will be able to describe Jigs and fixtures and its uses.
3. Students will be able to describe the principles of gear manufacturing and its nomenclature.
4. Students will be able to understand the working principles Group technology and flexible manufacturing system.
5. Students will be able to understand the concepts of computer integrated manufacturing.

Syllabus

Unit I

Unconventional machining processes: Need for unconventional processes; Classifications of Unconventional Manufacturing Processes; Construction and working principal of unconventional machining processes such as USM, WJM, AJM, Chemical Machining, Electrolytic Grinding, EDM, LBM, EBM, Plasma Arc Cutting etc. and applications & limitations.

Unit II

Jigs and Fixtures:

Definition, Principles of location, locating method and devices; principles of clamping, clamping devices; drilling jigs and its types; drill bushes, fixture and economics; types of fixtures; milling, grinding, broaching, assembly fixtures indexing jig and fixtures, indexing devices.

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BTAU504	DCS	MANUFACTURING TECHNOLOGY	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Unit III

Gear Manufacturing

Types of gears; nomenclature of spur and helical gears; Gear generating and forming processes: concept, differences and applications, working and application of gear milling, gear hobbing and gear shaping machines; Nomenclature of gear hob and gear shaping cutter; Gear Cutting parameters for commonly used materials and work-piece; Gear finishing processes- shaving & grinding.

Unit IV:

Flexible Manufacturing System: definition, types of FMS and applications; concept of flexibility, need of flexibility, types of flexibilities and its measurement; economic justification for FMS; Functional requirements for FMS equipment's.

Unit V

Group Technology: GT concept, advantages of GT; part family formation-coding and classification Systems; part-machine group analysis; Production flow analysis; Methods for cell formation; FMS related problem and Solution Methodology.

Reference Book:

1. *"Workshop Technology" by W. A. J. Chapman part I, II & III, 5th ed., 2001.*
2. *"Automation, Production System & Computer Integrated Manufacturing" by Mikell P. Groover, Prentice Hall, 2008.*
3. *"Manufacturing Technology" by P. N. Rao, Vol. 1 and 2, 2018.*
4. *"Fundamentals of Machining and Machine Tools" by D. G. Boothroy and W.A. Knight, Marcel Dekker, NY, 2007.*

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BTAU504	DCS	MANUFACTURING TECHNOLOGY	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

5. *"Metal Cutting Theory and Practice" by Bhattacharya, New Central Book Agency, 2000.*
6. *"Fundamentals of Metal Cutting and Machine Tools" by B.L. Juneja and G.S. Sekhon, New Age International, 2003.*
7. *"Principles of Metal Cutting" by G. Kuppuswamy, Universities Press, 1996.*
8. *"Metal Forming-Fundamentals and Applications" by T Altan, Soo-Ik-Oh and H.L. Gegel, American Society of Metals,* Metal Park, 1983
9. *"Metal cutting Theory & Cutting Tool Designing" by V. Arshinov, G Alekseev, 1970.*
10. *"Elements of Workshop Technology" by Hazra Chaudhary Vol I, II, 12th ed., 2007.*

List of Experiments:

1. Explain working principles and working parameters of non-conventional machining methods.
2. To study various Non-traditional Machining processes
3. Study and experimentation with EDM
4. Study and experimentation with plasma arc cutting
5. To study various types of jigs used in production.
6. To study various types of fixtures used in production
7. Describe constructional features and working of various gear manufacturing machines
8. Explain procedural steps for producing accurate gears using gear milling machines
9. Explain procedural steps for producing accurate gears using gear hobbing machines
10. Explain procedural steps for producing accurate gears using gear shaping machines.
11. Describe the working principal of group technology system and its application.
12. Describe the working principal of Flexible manufacturing systems and its application.
13. To study of Computer integrated manufacturing

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			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU505	DCS	APPLICATIONS OF CAD IN AUTOMOBILE ENGINEERING	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

This course provides a fundamental understanding of (A) The Design concepts with the help of computer Application, (B) Comprehensive Knowledge of computer applications including geometric, Modeling, Assemblies and Manufacturing.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Student will be able to understand the various Design concepts with the help of computer application.
2. Students would be able to get familiarized with the computer graphics application in design and understand the basic 2D & 3D commands of CAD and distinguish the CAD from manual paper drafting, in current industrial & product development scenarios.
3. Students would be able to understand the solid and assembly modeling tools to develop virtual product and part programming for manufacturing in various experiments & real life.
4. Students will be able to acquire knowledge of the applications of computers in design and manufacturing of real-world product.

Syllabus

Unit I

Introduction: Introduction to CAD, Why CAD Software, Scope, objective, benefit, limitation & evaluation, Engineering design process, Considerations and formulation, Regulatory and social issues in Indian context. Conceptual Design; Product design cycle, Total life cycle. Digital Prototyping; Requirements of manufacturing organizations, business forecasting and aggregate production plan; MPS, MRP and Production Activity Control (PAC), CAE, CAM, CAP, CAPP, CATD and CAQ.

Unit II

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Shri Vaishnav Vidyapeeth	Shri Vaishnav Vidyapeeth	Vishwavidyalaya, Indore	Vishwavidyalaya, Indore
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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTAU505	DCS	APPLICATIONS OF CAD IN AUTOMOBILE ENGINEERING	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Graphics Fundamentals & Standards: Definition, Software configuration of a Graphic system, CAD Interface, Co-ordinate system, creating drawings, Inquiry Commands, Modify and Manipulating Objects, Hatching Objects, Utility Commands, Layers & Blocks, Text, Table & Dimensions.
Database for graphic modeling; PDM, PIM, EDM; define EDM, features of EDM, need for CAD data standardization, data exchange formats; GKS, PHIGS, CORE, IGES, DXF STEP DMIS AND VDI; ISO standard for data exchange.

Unit III

Geometric Modeling & Assembly: Introduction to Geometric Modeling, Types of models, Construction of 3D Solid Primitives, create 3D Solids from Objects, Extrude, Revolve, Sweep, Loft, Combine or Slice 3D Objects, Move Rotate & Scale 3D Objects, Object Sectioning, Wire frame Entities, Curve Representation.
Assembly Modeling: Mating conditions, Generation of assembling sequences, basics of boundary presentation- Spline, Bezier, B-Spline, and NURBS; Sculpture and Ruled surfaces, Precedence diagram, Liaison-sequence analysis. Mechanical tolerance: Tolerance concepts, Geometric tolerance, Types of geometric tolerances, Location tolerances, drafting practices in dimensioning and Tolerance, Tolerance Analysis.

Unit IV

Computer-Aided Manufacturing & Part Programming: Introduction, Applications and key Aspects of CAM in a Manufacturing System, Manufacturing Control; G Code & M Code Feature Technology; NC, DNC, CNC; Programmed Automations; Machine control unit, Part program, NC tooling, NC machine tools; Nomenclature of NC machine axes, Types of NC machine tools, Machining centers, Automatic tool changes (ATC), Turning centers; ISO codes for turning tools and holders; ATC, modular work holding and pallets; time and power estimation in milling, drilling and turning; adaptive control, sequence control and PLC.

Unit V

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Computer Integrated Manufacturing: Introduction and scope of Computer integrated Manufacturing, CIM Wheel; Types of Manufacturing systems; Machine tools and related equipment; Material handling systems; Computer control systems; FMS. Production Flow Analysis (PFA) and clustering methods; Concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; FMS; material handling robots, Computer Aided Process Planning (CAPP).

Reference Books:

1. *"CAD/CAM/CIM" by P. Radhakrishnan, Subramanian S and Raju V; New Age Pub., 2008.*
2. *"Principles of CIM", by S. Kant Vajpay; PHI, 1995.*
3. *"CAD/CAM" by Rao PN; TMH, 2010.*
4. *"CAD/CAM Computer Aided Design and Manufacturing", by Mikell P. Groover and Emory W. Zimmer, 2008.*
5. *"Computer Integrated Design and Manufacturing" by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe, McGraw-Hill, 1991.*
6. *"Mastering CAD", by George Omura with Brian Benton Autodesk, 2004.*
7. *"PTC Creo Parametric 3.0 for Designers" byTickoo S, Textbooks Published by BPB, 2015.*
8. *"SOLIDWORKS 2017 for Designers", by Tickoo S, Textbooks Published by BPB, 2017.*
9. *"CATIA V5-6R2016 for Designers", by Tickoo S, Textbooks Published by BPB, 2017.*
10. *"Autodesk Inventor Professional 2017 for Designers", byTickoo S, Textbooks Published by BPB, 2017.*

List of Experiments

The students will be required to carry out the following exercises using educational software (Auto CAD, Creo, Solid works, Master CAM etc).

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1. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
2. Layout drawing of a building using different layer and line colours indicating all Building details. Name the details using text commands, Make a title Block.
3. To Draw Orthographic Projection Drawings (Front, Top and side) of safety valve, knuckle joint, cotter joint & Plummer block etc.
4. Make an Isometric dimensioned drawing from orthographic drawings.
5. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
6. Draw 3D models by extruding, revolve, sweep, loft & other 3D Modelling commands in AutoCAD.
7. Prepare Assembled 3d cad models of knuckle joint, cotter joint & Plummer block through Creo cad modelling software.
8. Apply Constraints & Mechanism on 4 bar & piston cylinder mechanism through Creo Mechanism tools.
9. Generate G codes & M codes of any models through CAM tools of Creo Software.
10. Write the program prepare any work piece through CNC Machine.

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B. Tech in AU/ME/CE/EE/EEE/EC/EC-IOT/EI/R&A/MT

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BTME510	AESE	DESIGN THINKING AND INNOVATION	60	20	20	0	0	2	0	0	2

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The objective of this course is to provide (A) the new ways of creative thinking and learn the innovation cycle of design thinking process, (B) understand product design and prototyping and (C) develop innovative product.

Course Outcomes (COs):

After completion of this course student will able to

1. Compare and classify the various learning styles and memory techniques and apply them in their engineering education
2. Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products
3. Develop new ways of creative thinking and learn the innovation cycle of design thinking process for developing innovative products
4. Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development
5. Perceive individual differences and its impact on everyday decisions and further Create a better customer experience

Syllabus

Unit I **(6 Hrs)**

Learning: understanding the learning process, Kolb's learning styles, assessing and interpreting.

Memory: understanding the memory process, problems in retention, memory enhancement techniques.

Emotions: understanding emotions, experience & expression, assessing empathy, application with peers.

Unit II **(6 Hrs)**

Design Thinking: definition, need, objective, concepts & brainstorming, stages of design thinking process (explain with examples) – **empathize, define, ideate, prototype, test**.

Creative Thinking: understanding creative thinking process, understanding problem solving, creative problem solving test.

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BTME510	AESE	DESIGN THINKING AND INNOVATION	60	20	20	0	0	2	0	0	2

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Unit III **(6 Hrs)**

Product Design: process of engineering product design, design thinking approach, stages of product design, examples of best product designs and functions, assignment – engineering product design. Prototyping: What is prototype? Why prototype? Rapid prototype development process, testing, sample example, test group marketing

Unit IV **(6 Hrs)**

Celebrating the Difference: understanding individual differences & uniqueness, group discussion and activities to encourage the understanding, acceptance and appreciation of individual differences Customer Centricity: practical examples of customer challenges, use of design thinking to enhance customer experience, parameters of product experience, alignment of customer expectations with product design.

Unit V **(6 Hrs)**

Feedback. Re-design & Re-create: feedback loop, focus on user experience, address "ergonomic challenges, user focused design, rapid prototyping & testing, final product, final presentation – **"solving practical engineering problem through innovative product design & creative solution".**

Text and Reference Books:

1. E. Balaguruswamy "Developing Thinking Skills (The way to Success)" Khanna Book Publishing Company, 2022.
2. Gavin Ambrose and Paul Harris "Basics Design 08: Design Thinking" Bloomsbury Publishing India Pvt. Ltd. 2009.
3. Vijay Kumar "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization" Wiley Pub. 2012.
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
5. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
6. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.

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BTAU508	DCS	VEHICLE MAINTENANCE RECONDITIONING LAB	0	0	0	0	50	0	0	4	2

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

To knowledge of (A) Maintenance and Safety, Engine Subsystem, (B) Clutch, Steering, Brake, suspension, (C) Wheel, Air Conditioning and Electrical Components.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Students would be able to understand the need of maintenance and safety.
2. Students would be able to understand about maintenance of engine subsystem.
3. Students would be able to understand transmission and driveline, i.e. propeller shaft, rear axle etc.
4. Students will be able to understand the maintenance of steering, brakes and wheel.
5. Students would be able to understand automobile safety and their need.
6. Students would be able to understand the maintenance of air conditioning and electrical components.

Syllabus

Unit I

Introduction of Maintenance: Maintenance need, importance, primary and secondary functions; classification of maintenance work; vehicle insurance; basic problem diagnosis, automotive service procedures, workshop operations vehicle maintenance; vehicle identification. **Safety:** personnel safety, machines and equipment safety, vehicles, fire safety - first aid; basic tools – special service tools – measuring instruments; condition checking of seals, gaskets and sealants; scheduled (preventive) maintenance, unscheduled (breakdown) maintenance; service intervals - towing and recovering, reports, log sheets, trip sheets and other forms.

Unit II

Maintenance of Engine Subsystem: General engine service, dismantling of engine components, engine repair, working on the underside, front, top, ancillaries service of basic engine parts;

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cooling and lubricating system; fuel system, intake and exhaust system; electrical system, electronic fuel injection and engine management service; fault diagnosis; emission controls.

Unit III

Transmission and Driveline Maintenance: General checks, adjustment and service dismantling, identifying, checking and reassembling transmission, removing and replacing propeller shaft; servicing of cross and yoke joint and constant velocity joints; rear axle service, points removing axle shaft and bearings; servicing differential assemblies error diagnosis.

Unit IV

Steering: maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering service; worm type steering, power steering system.
Brake: maintenance and service of hydraulic brake, drum brake, disc brake, parking brake, bleeding of brakes.
Suspension: maintenance and service of coil spring, leaf spring, shock absorbers; dismantling and assembly procedures.
Wheel: wheel alignment and balance; removing and fitting of tyres; tyre wear and tyre rotation.

Unit V

Air Conditioning: maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator, replacement of hoses, leak detection, AC charging, fault diagnosis; body repair like panel beating, tinkering, soldering, polishing, painting.
Electrical Components: Maintenance of batteries, starting system, charging system and body electrical -fault diagnosis using scan tools.

Reference Books:

1. *"Automotive Mechanics" by Ed May, Volume 1 and 2, McGraw Hill Publications, 2003*
2. *"Fleet Management" by John Doke, McGraw Hill Co., 1984*

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3. *"Engineering: Lightweight", by Brian Cantor, Patrick Grant, Colin Johnson Automotive Functional, and Novel Materials, Taylor and Francis, 2008.*
4. *"Automobile and Mechanical Electrical Systems", by Tom Denton, Butterworth-Heinemann, 2011.*
5. *"The Automobile Chassi", by Jornsen Reimpell Helmut Sto; Engineering Principles, Jurgen Betzler (P) Ltd, 2nd Ed., 2001.*

List of Experiments

1. Study of cylinder re-boring-checking the cylinder bore.
2. Study of valve grinding, valve lapping.
3. Setting the valve angle and checking for valve leakage
4. Calibration of fuel injection pump
5. Wheel alignment – testing of camber, caster
6. Testing kingpin inclination, toe-in and toe-out
7. Chassis alignment testing
8. Brake adjustment and brake bleeding.
9. Head light adjustment.
10. Tyre changing.
11. Wheel balancing.

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