



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102601

Course/Subject Name: Automotive Electrical Equipments

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Fundamental

Prerequisite:	Basic knowledge of electrical systems
Rationale:	The course aims to impart basic skills and understanding of Automotive Electrical and Electronic components, systems, and their working details.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
4	0	2	5	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Automobile Electrical Systems: Storage, Distribution systems & Generation of electric energy, Lighting system, 12 Volt & 24 Volt systems. Insulation and earth (negative and positive earthing) system, types of cables used, color codes, cable connectors, wiring, fuse system, circuit breakers, Relays, Switches. Layout and Wiring diagram for 2, 3 and 4 wheeler vehicles, Buses and Commercial vehicles. Wiper System and Trafficator, power windows, Central Locking system. Convertible Mechanism.	8	20
2.	Batteries and Starting system: Various types of Automotive batteries. Principle, Construction & working of lead acid battery, dry battery & Alkaline battery. Designation & Rating of Batteries. Performance tests: Battery Capacity, Efficiency, Gravimetric test and efficiency. Battery failures. Recharging: Electronic circuits, battery charging current, charging methodology & precautions. Principle of Starting system, Starting torque, engine resistance torque, and power required for starting of engine. Starter motor and its circuit. Types of drive mechanisms: bendix drive, pinion type, axial sliding armature starter. Slipping and overrunning of clutches, automatic switches for starting, cold starting devices: Glow plug & choke.	12	20



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

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3.	<p>Charging system and Lighting Auxiliaries: Need of Charging circuit, Types of charging system: D.C. dynamo, AC dynamo, flywheel magneto charging system and Alternator, Charging system controlling & regulator system: Relay/cut-out, voltage and current regulator, compensated voltage and current regulator, electronic regulator, regulator characteristics. Drive for Charging system.</p> <p>Lighting system of vehicle: head lamp, tail lamp, brake lamp, parking lamp etc, other types of lamps used. Reflector purpose and design, head lamp angle and position, fog lamp, side indicator lamp, warning lights and flashers, instrument panel lights, body interior lights. Safety indicator lights. Engine compartment & Rear boot lamps.</p>	14	20
4.	<p>Electronic Fuel Injection and Ignition Systems: Introduction, Feedback carburetor systems (FBC), Throttle body injection and multi-port or point fuel injection, Fuel injection systems, injection system controls, Types of solid state ignition systems and their principle of operation Contactless electronic ignition system, Electronic spark timing control.</p>	6	10
5.	<p>Electronic Systems: Current Trends in Automotive Electronic Engine management system, Types of EMS: Electromagnetic interference Suppression, Electromagnetic Compatibility, Electronic dashboard instruments, onboard diagnostic system, Security warning system infotainment and Telemetric.</p>	6	10
6.	<p>Sensors and Actuators: Introduction, basic sensor arrangement; types of sensors such as - oxygen sensors; Crank angle position sensors - Fuel metering /vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor Throttle position sensors, solenoids, stepper motors, relays</p>	8	10
7.	<p>Horns- A.C. & D.C. horns, wind tone horn/air horns, electronic horn, reverse horn. Horn relay. Warning buzzer. sensors - Instrument cluster panel, fuel gauges, oil temperature gauge, warning light sensors, coolant temperature gauge, speedometer, Odometer, tachometer, trip meter, oil level indicator, parking brake indicator, direction indicators.</p>	6	10
	TOTAL	60	100



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	25%	30%	15%	10%	10%

Where R: Remember; U: Understanding; A: Application; N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Describe the basic electrical systems and working of different electrical components used in automobiles.	Remembering (R)
2	Evaluate, characteristics and maintenance of battery, lighting system, charging system and starting system.	Evaluating (E)
3	Categorize and select ignition system sensors and actuators in automobile systems	Analyzing (A)
4	Appraise electronic system components controls , instrumentation of automobile	Evaluating (E)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping				
PO \ CO	CO-1	CO-2	CO-3	CO-4
PO-1 Basic Engg Knowledge	1	3	2	2
PO-2 Problem Analysis	2	3	3	2
PO-3 Design/Development	1	2	2	3
PO-4 Investigations	-	2	2	2
PO-5 Modern Tool Usage	2	2	3	3
PO-6 Engineer & Society	-	-	-	-
PO-7 Environment & Sustainability	-	-	-	-
PO-8 Ethics	-	-	-	-
PO-9 Individual & Team Work	-	-	-	1
PO-10 Communication	2	2	1	2
CO-PSO Mapping				



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

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Course/Subject Name: Automotive Electrical Equipments

PSO \ CO	CO-1	CO-2	CO-3	CO-4
PSO1 (Automobile Manufacturing Skills)	3	3	3	3
PSO2 (Design and Analysis)	2	3	3	2

References/Suggested Learning Resources:

(a) Books:

1. Automotive Electrical Equipments by P. L. Kohli, Tata McGraw Hill Pub. Co. Ltd.
2. Automobile Electrical & Electronic Systems by Tom Denton, Allied Publishers Pvt. Ltd., Chennai.
3. Automobile Electrical and Electronics by A. L. Statini, Delmar Publications.
4. Automobile Electrical & Electronic Equipments by Young, Griffiths, The English Language Book Co., London.
5. Understanding Automotive Electronics by William B. Riddens, 5th Edition, Butterworth-Heinemann, Woburn, 1998.
6. Understanding Automotive Electronic by Bechtold, SAE, 1998.

(b) Open source software and website:

<http://nptel.ac.in>

(C) Suggested Course Practical List:

- 1 Study of automobile electrical systems.
- 2 Performance testing of automobile battery System.
- 3 Study of electrical engine starting system.
- 4 Study of different types of battery charging system.
- 5 Study of different types of ignition systems.
- 6 Study of different color code system used in automotive wiring system
- 7 Study of different types of gauges, sensors, actuators and meters of an automobile.
- 8 Study of automobile electronic systems.



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102601

Course/Subject Name: Automotive Electrical Equipments

(D) List of Laboratory/Learning Resources Required:

- 1 Layout model of automobile wiring system
- 2 Demonstration model of Battery charging mechanism
- 3 Different types of Ignition systems

Suggested Project List:

1. Design and Fabrication of Automobile Wiring Harness Model
2. Battery Charging and Health Monitoring System
3. Working Model of Vehicle Lighting and Indicator System
4. Demonstration of Starter Motor Circuit with Safety Features
5. Digital Dashboard Display Using Arduino or Microcontroller
6. Wireless Keyless Entry and Central Locking System
7. Diagnostic Tool for Battery and Charging System
8. Reverse Parking System with Proximity Sensors



**SWAMINARAYAN
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Faculty of Engineering (Degree)

Semester – 6th

Course Title – Energy Conservation and Management

Course Code - BE101604

Types of Course - Professional Elective -3

Prerequisite - Nil

Rationale -

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				150
L	T	P		Theory Marks		Practical Marks		
				E	M	I	V	
3	0	2	4	60	40	20	30	

Detailed Syllabus –

Unit	Content	Hours
1	Energy Scenario: Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future. Energy Conservation Act 2001 and related policies: Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction.	5
2	Financial Management, Energy Monitoring and Targeting: Investment-need, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity	6

	analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)	
3	Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering	5
4	Energy Efficiency in Thermal Utilities and systems: Boilers: Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation. Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment of steam system, thermo-compressor, steam pipe insulation, condensate pumping, steam dryers. Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery. Forging furnace heat balance, Cupola, non-ferrous melting, Induction furnace, performance evaluation of a furnace. Insulation and Refractories: Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss. Cold insulation. Heat Exchangers: Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc. Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential. Cogeneration: Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine. Heating, ventilation, air conditioning (HVAC) and Refrigeration System: Factors affecting Refrigeration and Air conditioning system performance and savings Opportunities. Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system and saving potential, heat pumps and their applications, section on ventilation system, and performance assessment of window and split room air conditioners and star labels	22
5	Energy and environment, air pollution, climate change: United Nations Framework Convention on Climate Change (UNFCCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).	4
	Teaching hours	42

Course Outcomes –

- To summarize the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation
- To infer the concept of financial management, energy monitoring and targeting.
- To apply the knowledge of energy audit for the energy management and operation of energy audit instruments.
- To analyze the energy saving area and improvement in efficiency of various thermal utilities and systems.
- To evaluate the net present worth in financial management and performance assessment of various thermal utilities and systems.

Reference Books –

- Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
- Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press.
- Bureau of Energy Efficiency Reference book: No.1, 2, 3, 4.
- Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication.
- Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by E J Wilson and D Gerard, Blackwell Publishing.
- Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994.

List of Practical –

- To study the various Acts and policy for the energy conservation.
- To study the financial analysis techniques, energy performance contracts, role of energy service companies and evaluate net present worth for the finance.
- To study the elements of energy monitoring and targeting, techniques, CUSUM and Energy Management Information Systems (EMIS).
- To study and perform the use of energy audit instruments and prepare the energy audit report.
- To study and performance evaluation, analysis of losses and energy saving opportunities for the boiler.
- To study and performance evaluation, analysis of losses and energy saving opportunities for the steam system.
- To study the types of insulation and refractories, economic thickness of insulation and selection criteria for the insulation and refractories.
- To study and performance evaluation, analysis of losses and energy saving opportunities for the furnace.
- To study and performance evaluation and energy saving opportunities for the window and split air-conditioner.
- To study the framework for climate change, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures and case of CDM

Open Sources –

- <https://nptel.ac.in/courses/>



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Design of Heat exchangers

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Professional Elective -I

Prerequisite:	Nil
Rationale:	The course is design to provide fundamental knowledge of different type of heat exchangers used for various thermal applications and to learn the sizing of heat exchangers, thermal analysis for various heat exchange applications.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Different classification and basic design methodologies for heat exchanger: Classification of heat exchanger, selection of heat exchanger, overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi-pass and cross flow heat exchanger, e-NTU method for heat exchanger analysis, fouling, cleanliness factor, percent over surface, techniques to control fouling, additives, rating and sizing problems, heat exchanger design methodology	11	25
2.	Design of double pipe heat exchangers: Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop	8	20
3.	Design of Shell & tube heat exchangers: Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method	10	25



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Design of Heat exchangers

4.	Design of compact heat exchangers: Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, plate heat exchanger, heat transfer and pressure drop	10	20
5.	Heat Transfer Enhancement and Performance Evaluation: Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.	6	10
Teaching hours		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
8%	23%	27%	17%	15%	10%

Where R: Remember; U: Understanding; A: Application; N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	To select appropriate heat exchanger for the given application and to measure the performance degradation of heat exchangers subject to fouling	Evaluating (E)
2	To analyse thermal and hydraulic performance of different types of compact heat exchangers.	Applying (A)
3	To compare various heat transfer enhancement techniques and to apply process optimization techniques for heat exchanger design	Applying (A)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping			
PO \ CO	CO-1	CO-2	CO-3
PO-1 Basic Engg Knowledge	3	3	3
PO-2 Problem Analysis	2	3	2
PO-3 Design/Development	2	3	3
PO-4 Investigations	2	2	2
PO-5 Modern Tool Usage	2	1	2
PO-6 Engineer & Society	1	1	1



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Design of Heat exchangers

PO-7 Environment & Sustainability	1	1	1
PO-8 Ethics	1	1	1
PO-9 Individual & Team Work	1	2	2
PO-10 Communication	2	2	3
CO-PSO Mapping			
PSO \ CO	CO-1	CO-2	CO-3
PSO1 (Automobile Manufacturing Skills)	3	2	3
PSO2 (Design and Analysis)	2	3	3
PSO3	2	2	3

References/Suggested Learning Resources:

(a) Books:

1. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press
2. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication
3. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill
4. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press
5. Heat Exchanger Design Hand Book by Schunder E.U., Hemisphere Pub.
6. Process Heat transfer by Donald Q Kern, McGraw Hill

(b) Open source software and website:

- <http://nptel.ac.in/>
- www.learnerstv.com
- <http://auto.howstuffworks.com/>

(C) Suggested Course Practical List:

1. Design of heat exchange equipment by using LMTD method.
2. Design of heat exchange equipment by using effectiveness– NTU method.
3. Measure the effectiveness of shell and tube heat exchanger.
4. Design and analysis of Parallel flow and Counter flow heat exchanger.



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Design of Heat exchangers

5. Design and analysis of Shell and tube type heat exchanger.
6. Design and analysis of Plate type heat exchanger.

(D) List of Laboratory/Learning Resources Required:

1. Shell and tube heat exchanger,
2. Plate type heat exchanger,
3. Tube and tube heat exchanger,
- 4 Compact heat exchanger.

Suggested Project List:

1. Design and Fabrication of a Shell and Tube Heat Exchanger
2. Thermal Performance Analysis of Plate Type Heat Exchangers
3. Comparison of LMTD and NTU Methods in Heat Exchanger Design
4. Design Optimization of Compact Heat Exchanger for Automotive Applications
5. Effect of Fouling on Heat Exchanger Efficiency and Its Control Techniques
6. Design of Double Pipe Heat Exchanger for Industrial Cooling Systems
7. Simulation of Heat Exchanger Performance Using ANSYS/CFD Tools
8. Performance Evaluation of Heat Transfer Enhancement Techniques
9. Economic and Thermal Comparison of Different Heat Exchanger Types
10. Pinch Analysis-Based Optimization of Heat Exchanger Networks



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Professional elective-2

Prerequisite:	Nil
Rationale:	This course introduces students to renewable energy sources and their applications. It helps them understand solar, wind, bio, and other energy systems, along with their design, performance, and economic analysis. The course supports the shift towards sustainable and clean energy solutions.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Scenario of Renewable Energy (RE) Sources: Need of RE, advantages and limitations of RE, present energy scenario of conventional and RE sources.	1	10
2.	Solar Energy: Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements, empirical equations for prediction of availability of solar radiation on horizontal, radiation on and tilted surface. Solar energy conversion into heat, types and working of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, losses in liquid flat plate collector, thermal analysis of liquid flat plate collector, air heater and cylindrical parabolic concentrating collector, solar energy thermal storage, Solar space heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air-conditioning, solar pond, heliostat, solar furnace, photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages.	19	30



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

3.	Wind Energy: Energy available from wind, basics of lift and drag, basics of wind energy conversion system, Betz limit theory, effect of density, angle of attack and wind speed, wind mill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm, Safety and environmental aspects, wind energy potential and installation in India	8	20
4.	Bio Energy: Biomass energy – modern energy carrier, energy plantation, gasification, types and applications of gasifiers, types of biogas plants, design of biogas plant, factors affecting biogas generation. advantages and disadvantages.	4	10
5.	Ocean Energy: OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations Wave energy: Wave energy conversion devices, advantages and disadvantages, Present scenario. Geothermal energy: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications. MHD Power generation: concept and working principle.	7	10
6.	Economic Analysis: Initial and annual cost, Basic definitions Fundamentals of economic analysis, time value of money, payback period, present worth calculations, repayment of loan in equal annual installments, annual solar savings, cumulative saving and life cycle cost analysis, economic analysis of solar system, clean development mechanism	6	20
		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	25%	30%	15%	10%	10%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	To design and develop solar systems for various applications .	Create (C)
2	To estimate solar radiation on the various surfaces and its applications for thermal and photovoltaic system.	Apply (A)
3	To analyze the performance of various solar collectors	Analyze (N)
4	To evaluate the potential of wind energy conversion systems	Evaluate (E)
5	To illustrate Bio energy, Wave energy, Ocean energy and Geothermal Energy.	Understand (U)
6	To evaluate the life cycle cost and carry out economic analysis of renewable energy sources.	Create (C)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping						
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6
PO-1 Basic Engg Knowledge	2	2	2	2	2	2
PO-2 Problem Analysis	2	3	2	2	2	3
PO-3 Design/Development	3	3	3	3	2	2
PO-4 Investigations	2	2	3	2	1	3
PO-5 Modern Tool Usage	2	2	1	2	1	1
PO-6 Engineer & Society	1	1	1	1	1	2
PO-7 Environment & Sustainability	2	2	1	2	2	2
PO-8 Ethics	0	0	0	0	1	0
PO-9 Individual & Team Work	1	1	1	1	1	1
PO-10 Communication	2	1	1	1	1	2
CO-PSO Mapping						
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5	CO-6
PSO1 (Automobile Manufacturing Skills)	3	3	2	2	2	3
PSO2 (Design and Analysis)	2	3	3	2	2	2



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

References/Suggested Learning Resources:

(a) Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, McGrawHill Education
2. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley, New York
3. Non-conventional Energy Resources, B. H. Khan, Tata McGraw Hill
4. Non-Conventional Resources of Energy, G. S. Sawhney, PHI
5. Non-conventional energy resources, Shobh Nath Singh, Pearson India
6. Solar Energy Engineering, Soteris Kalogirou, Elsevier/Academic Press.
7. Principles of Solar Energy, Frank Krieth & John F Kreider, John Wiley, New York

(b) Open source software and website:

- <http://nptel.ac.in/>
- www.learnerstv.com
- <http://auto.howstuffworks.com/>

(C) Suggested Course Practical List:

1. To study and measure the solar radiation on horizontal and tilted surface using solar radiation measuring instruments.
2. To evaluate the performance of solar liquid flat plate collector.
3. To evaluate the performance of solar air heater.
4. To evaluate the performance of concentrating collectors.
5. To evaluate the performance of solar still.
6. To evaluate the performance of box type solar cooker.
7. To study the various types of wind mill and evaluate the performance parameter of wind. mill.
8. To study the various types of gasifier and biogas plant.
9. To study the ocean energy, wave energy, geothermal energy conversion systems.
10. To estimate the economics of the solar energy conversion equipment.
- 11.

(D) List of Laboratory/Learning Resources Required:

1. Pyranometer
2. Sunshine Recorder
3. Solar Power Meter



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Renewable Energy Engineering

4. Solar Liquid Flat Plate Collector
5. Solar Air Heater
6. Cylindrical Parabolic Collector
7. Compound Parabolic Collector
8. Box-type Solar Cooker
9. Solar Drier
10. Solar Still

Suggested Project List:

1. Design and Fabrication of a Portable Solar Water Heater
2. Performance Analysis of a Box-type Solar Cooker
3. Development of a Low-cost Solar Dryer for Agricultural Use
4. Design and Testing of a Solar-Powered Mobile Charging Station



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102606

Course/Subject Name: Special Purpose Vehicle

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Advanced /Application

Prerequisite:	Automobile Systems
Rationale:	The subject is designed to provide application of automotive systems in special purpose vehicles. The course is essential to build higher skill by studying the details of construction, working and design aspects of special purpose vehicles such as agriculture vehicles, earth moving machines, load caring and lifting machines.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Introduction : Classification of Special Purpose Vehicles, wheel type & track type, applications, Vehicles for differently challenged persons.	03	10
2.	Principles and design considerations of special purpose vehicles: Study of working principles and design considerations of different systems involved such as power system, transmission, final drive, lubrication, electrical, braking, steering, pneumatic & hydraulic control circuits.	10	20
3.	Earth Moving Machines: Construction and working features of different types of earth moving machinery such as Tippers, Scrapers and shovels, Loaders, Excavators, Dumpers, Bulldozers, Fork Lift and Road rollers.	10	20
4.	Tractors: Classification of tractors-layout of wheeled tractor- power transmission system & drive line - steering system - accessories of wheeled tractors-	06	20



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102606

Course/Subject Name: Special Purpose Vehicle

	hydraulic control system- power take off unit.		
5.	Mobile Cranes: Basic characteristics of truck cranes, stability and design features, control systems and safety devices.	05	10
6	Special purpose vehicles: Features of Oil tankers- Articulated vehicles, working -features of Ambulance, fire extinguishing vehicle and Tipper-working of Hover craft.	06	10
7	Ergonomic considerations: Human factors in special purpose vehicle design with reference to comfort, convenience and safety, effects of noise, vibration and thermal stresses on human performance. Economics of special purpose vehicle utilization.	05	10
	Teaching hours	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	23%	27%	17%	13%	10%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Classify special purpose vehicles and its ergonomic considerations	Understanding (U)
2	Enumerate design considerations of special purpose vehicles	Remembering (R)
3	Examine different features of various types of earth moving machinery such as Tippers, Scrapers and shovels, Loaders, Excavators, Dumpers, Bulldozers, Fork Lift and Road rollers, Tractors	Analyzing (N)
4	Assess design features of Mobile Cranes:	Evaluating (E)
5	Summarize Features of Articulated vehicles, Ambulance, fire extinguishing vehicle and Tipper-working of Hover craft.	Applying (A)



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102606

Course/Subject Name: Special Purpose Vehicle

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PO-1 Basic Engg Knowledge	2	2	3	2	2
PO-2 Problem Analysis	1	1	2	2	2
PO-3 Design/Development	2	2	3	3	3
PO-4 Investigations	1	1	2	3	2
PO-5 Modern Tool Usage	1	1	2	2	2
PO-6 Engineer & Society	2	1	2	2	1
PO-7 Environment & Sustainability	3	1	2	2	1
PO-8 Ethics	2	1	1	1	2
PO-9 Individual & Team Work	2	1	2	2	2
PO-10 Communication	2	1	1	2	2
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PSO1 (Automobile Manufacturing Skills)	2	2	3	3	2
PSO2 (Design and Analysis)	1	2	3	3	2
PSO3	2	2	2	2	3

References/Suggested Learning Resources:

(a) Books:

1. Y. Pokras and M. Tushnyakov, "Construction Equipment Operation & Maintenance", MIR, Moscow.
2. Astskhov, "Truck Cranes", MIR, Moscow.
3. E.G. Poninson, "Motor Graders", MIR, Moscow.
4. Hand book of Earth Moving Machinery - Central Water & Power Commission (Govt. of India)
5. N. Rudenko, "Material Handling Equipment", M.R. Publishers.
6. Sheldon, R.Shacket, "Electric Vehicles", Domus Books, New York.
7. David A. Day, Neal B. H. Benjamin, "Construction Equipment Guide", Wiley.
8. C.P. Nakra, "Farm Machines and Equipment", Dhanpat Rai Publications, New Delhi.
9. Donnell hunt and L .W.garver - Farm machinery and mechanism - Iowa state university press.
10. J.Y Wong - Theory of Ground vehicles - John Wiley and Sons.



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102606

Course/Subject Name: Special Purpose Vehicle

(b) Open source software and website:

- <http://nptel.ac.in/>
- www.learnerstv.com
- <http://auto.howstuffworks.com/>

(C) Suggested Course Practical List:

1. Study of tipping mechanism of a dumper
2. Study of forklift truck
3. Study of operation of a truck crane
4. Study of technical & operational features of a tractor
5. Study of technical & operational features of a power scraper
6. Study of technical & operational features of a power hoe and shovel.
7. Study of a fire extinguishing vehicle
8. Study of a Ambulance
9. Study of features of mobile cranes
10. Study of Ergonomics considerations of special purpose vehicles.

(D) List of Laboratory/Learning Resources Required:

1. Earth Moving Machinery Cut Section Models
2. Tractor Transmission and PTO Demonstrator
3. Truck Crane and Forklift Mechanism Setup
4. Ambulance and Fire Vehicle Feature Models
5. Ergonomic Simulation and Vibration Demo Kit

Suggested Project List:

1. Design and Analysis of Hydraulic System for a Tipper Vehicle
2. Study and Simulation of Forklift Mechanism with Load Balancing
3. Development of Ergonomically Designed Cabin for Earth Movers



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102606

Course/Subject Name: Special Purpose Vehicle

4. Design Modification in Tractor PTO System for Multi-Use Tools
5. Performance Evaluation of Firefighting Vehicle Layout and Safety Systems
6. Fabrication of a Miniature Model of a Truck Crane
7. Comparison Study of Wheeled vs Tracked Special Purpose Vehicles
8. Design and Control Logic for an Electrically Operated Ambulance Lift
9. Retrofitting Hovercraft Features into a Multi-Terrain Vehicle
10. Economic Feasibility Study of Using SPVs in Agriculture Logistics



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102605

Course/Subject Name: Two and Three Vehicle Technology

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Advanced /Application

Prerequisite:	Basics and Fundamental
Rationale:	Nil.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Introduction: History and classification of Two and Three wheeler vehicles, Layout of different two and three wheeler vehicles, Basic systems.	04	10
2.	Power Plant: Classification of engines used for two and three wheeler vehicles, Construction, working and types of two stroke engines, Port timing diagrams, Construction and working of four stroke engines, selection criteria and design considerations for suitable engine for two and three wheeler vehicles, Different types of fuel supply systems, Construction and working of a carburetor, different types of carburetor used for two wheeler engines, Fuel injection system, Types of lubricants, Different types of lubrication system, Scavenging process for two stroke engines, Scavenging methods, Basic engine cranking mechanism, Different types of cranking mechanism for two and three wheeler vehicles.	10	20



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102605

Course/Subject Name: Two and Three Vehicle Technology

3.	Transmission: Layout of transmission system in two and three wheeler vehicle, Types of primary reduction, Requirements of clutch, Types of clutch used for two and three wheeler vehicles, Clutch release mechanism, Types of gearbox for two and three wheeler vehicles, different gear shifting mechanisms, Continuous variable transmission (CVT), Chain drive, Belt drive, Shaft drive, Cush drive.	08	20
4.	Steering and Suspension System: Steering Geometry for two wheeler vehicles and Effects, Steering Column Construction, Handlebar–Types & Construction, Suspension Requirements for two and three wheeler vehicles, Design Considerations for Suspension System, Spring & Shock Absorber Assembly, Types of front suspension system, types of rear suspension system, Suspension damping control system.	10	20
5.	Brakes, Wheels and Tires: Design Considerations for brakes, Drum brake and Disc brake for two wheeler vehicles, Brake control systems, Anti-lock braking system for two wheeler vehicles, Types of wheels, Construction details of tires, Types of tires.	04	10
6	Frame for Two Wheelers: Design considerations for frame, Components of frame, Types of frames, Frame material, Body work, Ergonomics considerations.	04	10
7	Electrical Systems and Instruments: Battery, Charging system, Ignition system, Lighting system, Horn, Handlebar controls, Instruments and indicators, Recent developments in electrical system for two and three wheeler vehicles.	05	10
Teaching hours		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
8%	23%	27%	17%	13%	12%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102605

Course/Subject Name: Two and Three Vehicle Technology

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Classify types of two and three wheeler vehicles and explain different Layouts.	Understanding (U)
2	Demonstrate working of different engines and supporting systems.	Applying (A)
3	Illustrate transmission, suspension and steering systems.	Understanding (U)
4	Exemplify construction and working of different chassis components like brakes, wheels, tires and frames.	Applying (A)
5	Identify and explain different electrical systems.	Analyzing (N)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping						
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5	
PO-1 Basic Engg Knowledge	3	3	2	2	3	
PO-2 Problem Analysis	2	2	2	2	2	
PO-3 Design/Development	1	3	3	3	2	
PO-4 Investigations	1	2	2	2	2	
PO-5 Modern Tool Usage	1	1	2	2	1	
PO-6 Engineer & Society	1	1	1	1	1	
PO-7 Environment & Sustainability	1	1	1	1	2	
PO-8 Ethics	1	1	1	1	1	
PO-9 Individual & Team Work	1	1	2	2	1	
PO-10 Communication	1	2	2	2	2	
CO-PSO Mapping						
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5	
PSO1 (Automobile Manufacturing Skills)	2	2	3	2	1	
PSO2 (Design and Analysis)	1	3	2	3	2	
PSO3	2	3	2	3	2	



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102605

Course/Subject Name: Two and Three Vehicle Technology

References/Suggested Learning Resources:

(a) Books:

- 1 Panchal. D, Two and Three Wheeler Technology, PHI learning PVT LTD., New Delhi, 2015.
- 2 Foale .T, Motorcycle Handling and Chassis Design, Spain, 2002.
- 3 Lear. G, Mosher. L., Motorcycle Mechanics, Prentice-Hall, New Jersey, 1977.
- 4 Zimmerman. M, The Essential Guide to Motorcycle Maintenance, Motorbooks, 2016.
- 5 Workshop manuals for motorcycles and rickshaws

(b) Open source software and website:

- <http://nptel.ac.in/>
- www.learnerstv.com
- <http://auto.howstuffworks.com/>

(C) Suggested Course Practical List:

- 1 To identify the major components on two and three wheeler vehicle layout.
- 2 To study about two stroke and four stroke engines.
- 3 To study about fuel supply and lubrication system used for two and three wheeler vehicles.
- 4 To study about scavenging process of two stroke engine.
- 5 To study construction and working of different types of clutches.
- 6 To demonstrate different transmission system and its components.
- 7 To study about steering and suspension systems of two and three wheeler vehicles.
- 8 To demonstrate working of different types of brakes.
- 9 To study about construction of different types of frames.
- 10 To study the different electrical systems.

(D) List of Laboratory/Learning Resources Required:

- 1 Two stroke and Four stroke Engines
- 2 Cut section models for Fuel supply and lubrication systems
- 3 Single plate, Multi-plate and Centrifugal clutch assemblies
- 4 Cut section of Constant mesh, Sequential, Differential and CVT gearbox assemblies
- 5 Cut section of Leaf springs, Telescopic suspension and Mono suspension system
- 6 Single and double cradle frames, Engine based frame



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102605

Course/Subject Name: Two and Three Vehicle Technology

7 Layout of Electrical systems

Suggested Project List:

- 1 Design and Fabrication of a Miniature Two-Wheeler Chassis Frame
- 2 Comparative Study of Drum and Disc Braking Systems in Two-Wheelers
- 3 Analysis of Fuel Efficiency in Two-Stroke vs Four-Stroke Engines
- 4 Development of an Electric Scooter Prototype with Basic Controls
- 5 Performance Testing of CVT vs Manual Transmission in Two-Wheelers
- 6 Design Optimization of Front Suspension System for Motorcycles
- 7 Implementation of Smart Lighting and Horn Control System in Bikes
- 8 Study and Analysis of Ergonomics in Scooter Frame Design
- 9 Development of a Mobile-Based Vehicle Diagnostic System
- 10 Comparative Testing of Tubeless vs Tube Tires in Rough Conditions



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102604

Course/Subject Name: Vehicle Testing and Homologation

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Advanced /Application

Prerequisite:	Zeal to learn the subject
Rationale:	This subject will give preliminary idea regarding some of the practices and standards followed in automobile industry for their testing and homologation.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Introduction: Need of vehicle testing and homologation, Vehicle testing organizations, Hierarchy of testing: Individual component approval, System level approval and Whole vehicle approval. Type Approval & Conformity of Production tests, Approval for Safety systems (Active & Passive).	03	5
2.	Engine ,Fuel systems and Emissions Testing: Laboratory testing of basic engine parameters: Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers hydraulic, eddy current etc., engine analyzers- for petrol and diesel engines, FIP calibrating and testing. Emission test for CO, HC, NOx, CO2, PM, etc. using exhaust gas analyzers, Spectroscopic methods, NDIR (Non Dispersive Infrared), FID (Flame Ionization Detector), Chemiluminescent analyzers, Gas Chromatograph, Smoke meters.	06	10



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102604

Course/Subject Name: Vehicle Testing and Homologation

3.	Noise vibration and Harshness Testing: Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods. Pass by Noise testing method.	04	10
4.	Vehicle Performance Testing: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, and emission and fuel economy, Operation of full load and part load conditions. Gradeability test, Turning circle diameter test, Steering Impact test, Steering effort test. Road and track testing: Maximum speed and acceleration, brake testing, lane changing, handling and ride characteristics. Track testing on Multi Friction Braking Track, High Speed Track, Wet skid pad, Test slopes, External noise test track, Accelerated fatigue track, Water wade, Salt water wade, Gravel road and off road track, Dry handling circuit, Comfort track.	08	25
5.	Vehicle testing on chassis dynamometers: Two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, Emission testing on Chassis dynamometer ,Climate chamber tests. Emission testing on chassis dynamometers, Driving Cycles- USA, Japan, Euro and India. Test procedures – European driving cycles, Modified Indian Driving Cycle, SHED (Sealed Housing for. Evaporative Determination) Test on chassis dynamometers.	07	25
6	Automobile testing standards: Introduction, overview and study of testing standards like; AIS testing standards, Euro Standards, SAE standards. ISO26262 standards for functional safety of electrical and/or electronic systems in automobiles. Understanding of some AIS Standards: AIS-008 (Installation requirements of lighting and light-signaling devices for motor vehicles having more than three wheels, trailer and semi- Trailer excluding agricultural tractor and special purpose vehicles), AIS-018:2001 (Automotive Vehicles - Speed limitation Devices – Specifications),	14	25



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102604

Course/Subject Name: Vehicle Testing and Homologation

	AIS-037 (Procedure for Type Approval and establishing conformity of production for safety of critical components), AIS093 (Code of practice for construction and approval of truck cabs & truck bodies), AIS- 003 (Automotive Vehicles - Starting Gradeability -Method of Measurement and Requirements), AIS-038 (Battery Operated Vehicles – Requirements for Construction and Functional Safety).		
	Total hours	42	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	20%	30%	16.67%	13.33%	10%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand the need of vehicle testing and homologation.	Understanding (U)
2	Apply fundamental knowledge to measure the emissions and calculate the vehicle performance with reference to standard reference conditions.	Applying (A)
3	Identify the testing procedures of evaluating the vehicle performance, road test and track test.	Analyzing (N)
4	Understand standard procedures for vehicle certification and approval as per rules and regulations.	Understanding (U)
5	Interpret and understand various automotive testing standards	Analyzing (N)



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102604

Course/Subject Name: Vehicle Testing and Homologation

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PO-1 Basic Engg Knowledge	3	3	2	2	3
PO-2 Problem Analysis	1	3	2	1	2
PO-3 Design/Development	1	2	3	2	2
PO-4 Investigations	1	2	2	1	1
PO-5 Modern Tool Usage	1	2	2	1	1
PO-6 Engineer & Society	1	1	1	1	2
PO-7 Environment & Sustainability	1	2	2	1	2
PO-8 Ethics	1	1	1	1	2
PO-9 Individual & Team Work	1	1	1	1	1
PO-10 Communication	1	1	2	1	2
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PSO1 (Automobile Manufacturing Skills)	2	3	2	1	2
PSO2 (Design and Analysis)	1	2	3	2	3
PSO3	1	2	2	1	3

References/Suggested Learning Resources:

(a) Books:

1. Raymond M. Brach and R. Matthew Brach, "Vehicle Accident Analysis and Reconstruction Methods", SAE International, 2011
2. J. G. Giles – Vehicle operation and performance, Wildlife Publications, London, 1969.
3. W. H. Crouse and L. Angling – Motor vehicle inspection, McGraw Hill Book Co. 1978.
4. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009
5. Ulrich Seiffert and Lothar Wech, "Automotive Safety Handbook", SAE International, 2007
6. ISO Standards, ICS: 43.020, 43.040, 43.100
6. Indian emission Standards.



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102604

Course/Subject Name: Vehicle Testing and Homologation

(b) Open source software and website:

<http://nptel.ac.in>

(C) Suggested Course Practical List:

1. To study the performance and emission characteristics of automobile Petrol engines with Gasoline and CNG, LPG.
2. To study the performance and emission characteristics of automobile Diesel engines with Diesel and Biodiesel.
3. To study the performance characteristics of Hybrid Electric vehicles.
4. Calibration of fuel injection pump and testing, Calibration of injectors Petrol and Diesel Engines.
5. Measurement of Brake stopping distance.
6. Vehicle testing on chassis dynamometers.
7. Gradeability test.
8. Turning circle diameter test.
9. Measurement of steering effort.
10. Pass by noise test.

(D) List of Laboratory/Learning Resources Required:

1. **Engine Test Rigs (Petrol and Diesel)** – For performance and emission analysis.
2. **Chassis Dynamometer (2WD & 4WD)** – For full vehicle testing and emissions.
3. **Emission Gas Analyzers** – NDIR, FID, smoke meters for exhaust analysis.
4. **Fuel Injection Pump Calibration Setup** – For injector and FIP calibration.
5. **Sound Level Meter and Pass-by Noise Test Setup** – For NVH testing.

Suggested Project List:

1. Emission Testing and Analysis of Different Fuel Types in IC Engines
2. Development of Low-Cost Chassis Dynamometer for Two-Wheelers
3. Comparative Study of Pass-by Noise Levels in Petrol vs Diesel Vehicles
4. Performance Evaluation of Hybrid Electric Vehicles Under Indian Driving Cycle
5. Design and Implementation of Vehicle Gradeability Test Rig



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Automobile Chassis and Body Engineering

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Advanced /Application

Prerequisite:	Fluid mechanics, Automobile manufacturing.
Rationale:	Subject is designed to cover various aspects and considerations to be concerned over body and chassis building of different types of vehicle like car, bus and commercial vehicles with safety and ergonomic aspects, structure and aerodynamic aspects of the vehicle.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Automobile Chassis: Types, Layout with reference to Power Plant Location and Drive, Automotive Frames - Material Selection and its Constructional Details, Various types, Different Loads acting on Frame, Testing of Automotive Frames.	05	20
2.	Car Body : Classification of vehicle based on body types, Types of car bodies, Integral body construction details: Requirements of body, Loads on the vehicle body: Static load, Acceleration and Braking, Moments and Torque due to driving conditions (torsion and bending moments), Types of materials used in body construction, Analysis and Selection of body member sections, Body sub frame and under floor structure, car front and rear end structure, Vehicle Structure Analysis by Simple Structural Surface (SSS) Method: Saloon and simple van. Crashworthiness: Features and requirements for occupant protections, crumple zones; Description of Body zones/assemblies/components, Body trims, Engine, transmission and body structure mounting;	12	20



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Automobile Chassis and Body Engineering

3.	Bus Body and Commercial Vehicle body: Classification of bus bodies – Based on distance travelled, Based on capacity of the bus and based on style & shape. Types of metal section used in the construction and regulations. Construction of conventional and integral type buses and comparison. Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Driver cabin design for compactness Design of frames for bus and commercial vehicles.	12	30
4.	Vehicle Aerodynamics : External and Internal flow problems, Performance of cars and light vans, Resistance to vehicle motion, Drag, Types of drag, Flow field around car, Aerodynamic development of cars, Optimization of car bodies for low drag.	06	10
5.	Ergonomic and Safety: Introduction of ergonomics, anthropometric dimensions of standard occupant, Concept of H-point referencing, interior design for ergonomics and comfort, seat design for ride comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, pedal controls and electronic displays. Driver seat design of bus body and commercial vehicle body. Safety aspects in design, Types of safety (Active and Passive), Safety features: overview of requirement for occupant protection (frontal, side, rear and rollover impact) and pedestrian safety, Airbags and Seatbelts, Visibility: Regulation, Driver's visibility, Methods of improving visibility, Introduction of crash test, Chassis and body alignment test.	10	20
	Teaching hours	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	25%	30%	15%	10%	10%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Choose and suggest a suitable chassis layout, frame and body.	Understanding types
2	Construction type for different cars & bus and commercial vehicles.	Understanding types
3	Analyze the effects of structural forces, aerodynamic forces and moments.	Analysis type



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Automobile Chassis and Body Engineering

4	Develop modern safety system for car, bus and commercial vehicle.	Understanding types
5	Develop modern vehicle body to meet the current requirements.	Understanding types

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PO-1 Basic Engg Knowledge	2	2	1	1	1
PO-2 Problem Analysis	2	3	2	2	2
PO-3 Design/Development	2	2	3	3	3
PO-4 Investigations	1	2	2	2	3
PO-5 Modern Tool Usage	2	1	2	2	2
PO-6 Engineer & Society	1	1	1	2	2
PO-7 Environment & Sustainability	1	1	1	1	2
PO-8 Ethics	1	1	1	2	2
PO-9 Individual & Team Work	1	1	1	2	2
PO-10 Communication	2	1	1	2	2
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	CO-5
PSO1 (Automobile Manufacturing Skills)	2	3	2	2	3
PSO2 (Design and Analysis)	2	2	3	2	2

References/Suggested Learning Resources:

(a) Books:

- 1 K.V James, D Halderman “Automotive Chassis Systems” 6th Edition, Prentice Hall Publisher.
- 2 Jnusz Pawlowski, “Vehicle Body Engineering”, Business books limited.
- 3 J H Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann.
- 4 J Brown, A J Roberstson, S Serphento, “Motor Vehicle Structure: Concepts and Funtamentals, Butterworth-Heinemann.



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Automobile Chassis and Body Engineering

- 5 Heinz Heizler, “Advanced Vehicle Technology”, Butterworth-, London.
- 6 David A. Crolla, “Automobile Engineering :Power train, chassis system and vehicle body”,Elsveir
- 7 V D Bhinse, “Ergonomics in Automotive Design”, CRC Press.
- 8 SAE J4004
- 9 John Fenton, Handbook of Automotive Body and Systems Design, Wiley India.
- 10 ARAI / GTR for occupant and pedestrian protection.

(b) Open source software and website:

<http://nptel.ac.in>

(C) Suggested Course Practical List:

- 1 Study of Layout of automobile
- 2 Experimental study of mechanism for air flow over different geometry of vehicles.
- 3 Experimental studies of measurements of drag and lift coefficient for different geometry vehicle using wind tunnel apparatus.
- 4 Study of agronomical considerations of automobile body.
- 5 Study of safety provisions in modern auto vehicle.
- 6 Design of chassis of auto vehicle its section and subsections.
- 7 Study of crash test of Auto vehicle
- 8 Study of Alignment of auto vehicle.

(D) List of Laboratory/Learning Resources Required:

- Wind tunnel test rig

Suggested Project List:

- 1 Design and Fabrication of a Lightweight Chassis for an Electric Vehicle
- 2 Crash Analysis and Improvement of Crumple Zones Using Simulation Tools
- 3 Aerodynamic Optimization of Car Body Using Wind Tunnel and CFD
- 4 Development of Ergonomic Driver Seat with Adjustable Suspension System
- 5 Design and Testing of Roll Cage for Off-Road Vehicles
- 6 Retrofitment of Safety Features in Old Commercial Vehicles



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102603

Course/Subject Name: Automobile Chassis and Body Engineering

- 7 Structural Analysis of Bus Frame Using Finite Element Method
- 8 Design and Fabrication of Dashboard with Enhanced Driver Visibility
- 9 Design of Smart Cabin Layout Based on Anthropometric Data
- 10 Comparison of Integral vs. Conventional Bus Body Construction Techniques



Swaminarayan University

Teaching & Examination Scheme
Course – Faculty of Engineering (Degree)
Branch – Automobile Engineering
Semester – 6th

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100601	Contributor Personality Development Program	Personality Development (Elective)	2	0	0	2	60	40	20	30	150
BE100602	Integrated Personality Development Course		2	0	0	2	60	40	20	30	150
BE102601	Automotive Electrical Equipments	Professional Core	4	0	2	5	60	40	20	30	150
BE102602	Vehicle Service book	Professional Elective - 1	3	0	2	4	60	40	20	30	150
BE101601	Computer Aided Design		3	0	2	4	60	40	20	30	150
BE101602	Design of Heat exchangers		3	0	2	4	60	40	20	30	150
BE102603	Automobile Chassis and Body Engineering	Professional Elective - 2	3	0	2	4	60	40	20	30	150
BE102604	Vehicle Testing and Homologation		3	0	2	4	60	40	20	30	150
BE101603	Renewable Energy Engineering		3	0	2	4	60	40	20	30	150
BE102605	Two and Three Vehicle Technology	Professional Elective - 3	3	0	2	4	60	40	20	30	150
BE102606	Special Purpose Vehicle		3	0	2	4	60	40	20	30	150
BE101604	Energy Conservation and Management		3	0	2	4	60	40	20	30	150
BE100602	Entrepreneurship and E-business	Open Elective - 2	3	0	0	3	60	40	0	0	100
BE100603	Industry 4.0		3	0	0	3	60	40	0	0	100
	Total		18	0	8	22					

L=Lecture, T=tutorial, P=Practical, E=Theory External, M=Theory Internal, I=Practical Internal, V=Practical External



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Vehicle Service book

w.e.f. Academic Year:	2024-25
Semester:	6 TH Semester/ 3 Year
Category of the Course:	Fundamental

Prerequisite:	Basic knowledge of vehicle garage practice.
Rationale:	

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				(E)	(M)	(I)	(V)	
3	0	2	4	60	40	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weight age
1.	Maintenance Basics: Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, safety precautions in maintenance: General safety, tool safety.	02	5
2.	Tools, Equipment and Instruments: Study and application of hand tools, power tools, Special purpose tools, measuring and gauging instruments. Study of Service/Repair equipment with operating process.	05	5
3.	Workshop management practices: Types, functions, operations and activities of service stations. Layouts of modern service station/workshop. Study of workshop documents & records like Inspection schedule, job cards, parts catalogue, parts price list, vehicle history sheet, warranty card, bill & billing procedure of vehicle, logbook of vehicle, customer satisfaction sheet, service book, etc. Activities and responsibilities of workshop management. Study of workflow in service station. Customer complaint Handling & consumer cases in case of any dispute.	06	10



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Vehicle Service book

4.	Maintenance & Overhauling of engine: Engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components. Engine assembling process. Diagnosis causes and remedies of Engine related problems. Fuel, Lubrication and Cooling Systems: Servicing and maintenance of fuel system, Engine tune-up, cooling system: water pump, radiator, and thermostat. Lubrication system maintenance, Anticorrosion and anti-freeze additives	08	20
5.	Maintenance & Overhauling of Transmission Systems: Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential and final drive. Diagnosis, causes and remedies of transmission related problems. Maintenance & Overhauling of Braking System: Maintenance of hydraulic brakes; brake adjustments and bleeding of brakes. Maintenance of air brake.	06	10
6.	Maintenance & Overhauling of Steering, Suspension and Wheels and tyre: Maintenance of steering system. Lubrication and maintenance of suspension system. Maintenance of wheel and tyre. Tyre rotation, Wheel balancing and Wheel Alignment, Diagnosis, causes and remedies of steering system, wheels and suspension related problems.	06	10
7.	Maintenance of Electrical Systems: Servicing and maintenance of battery, starter motor, alternator, ignition system, lighting system, electric horn, and wiper motor	06	20
8	Maintenance & repair of vehicle body: Maintenance of vehicle body; minor and major repairs. Body repair tools & equipment. Introduction to denting & painting process of vehicles.	06	20
Teaching hours		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	25%	30%	15%	10%	10%

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Vehicle Service book

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Understand the importance of vehicle inspection, maintenance, and application of tools.	Understand (U)
2	Diagnose the causes of engine problems and provide remedial actions. Identify the causes and service/maintain the clutch, gearbox, universal joints, propeller shaft, differential, and braking system.	Analyze (A) / Apply (Ap)
3	Possess the knowledge about the inspection and maintenance of suspension, steering system, wheels, and tyres.	Apply (Ap)
4	Apply the basic knowledge to rectify electrical system problems and maintain the vehicle body.	Apply (Ap) / Evaluate (E)

Course Outcome to Program Outcome (CO-PO) Mapping

CO-PO Mapping					
PO \ CO	CO-1	CO-2	CO-3	CO-4	
PO-1 Basic Engg Knowledge	2	2	2	2	
PO-2 Problem Analysis	2	2	2	2	
PO-3 Design/Development	2	3	3	3	
PO-4 Investigations	1	2	2	2	
PO-5 Modern Tool Usage	2	2	2	2	
PO-6 Engineer & Society	1	1	1	2	
PO-7 Environment & Sustainability	1	1	1	1	
PO-8 Ethics	1	1	1	1	
PO-9 Individual & Team Work	1	1	1	1	
PO-10 Communication	2	2	2	2	
CO-PSO Mapping					
PSO \ CO	CO-1	CO-2	CO-3	CO-4	
PSO1 (Automobile Manufacturing Skills)	2	3	3	3	
PSO2 (Design and Analysis)	2	2	2	2	



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Vehicle Service book

References/Suggested Learning Resources:

(a) Books:

1. Automotive Mechanics by William H. Crouse & Donald L. Anglin; Tata McGrawHill Publishing Company Ltd.
2. Automobile systems by Anil Chikara, Satya Prakashan.
3. Automobile Engineering by K.K.Ramlingan, SciTech Publication.
4. Auto mechanics by Joseph Heitner, East West Press.
5. Automotive Service Basics by Pattern and Donald, Pearson Publications
6. Vehicle Service book
7. Vehicle Workshop Manual.
8. Parts Price List
9. Parts catalogue of service station.
10. Job cards of modern service station.

(b) Open source software and website:

<http://nptel.ac.in>

(C) Suggested Course Practical List:

1. Study of modern workshop layout
2. Study of different types of job cards & maintenance schedule chart
3. Study of measuring, gauging & service equipment
4. Performance on wheel balancer
5. Performance on wheel aligner
6. Cleaning and testing of petrol injector
7. Cleaning and testing of different types of nozzles
8. Bleeding of hydraulic brakes
9. Overhauling of any component or system of a vehicle
10. Study of different workshop documents & records

(D) List of Laboratory/Learning Resources Required:

1. Hydraulic hoist
2. Electronic tyre inflator
3. Tyre changer
4. Wheel aligner



SWAMINARAYANUNIVERSITY

Program Name: Engineering Level: Degree

Course/ Subject Code: BE102602

Course/Subject Name: Vehicle Service book

5. Wheel balancer
6. Petrol injector cleaner test setup
7. Diesel nozzle tester and cleaner setup
8. Measuring and gauging instruments

Suggested Project List:

- 1 Design and Layout of a Modern Vehicle Service Station
- 2 Development of a Preventive Maintenance Schedule for Passenger Cars
- 3 Diagnosis and Repair Report of an Engine Problem
- 4 Study and Performance Comparison of Wheel Alignment and Balancing
- 5 Overhauling Report of a Gearbox or Clutch System
- 6 Troubleshooting and Servicing of Automotive Electrical Systems
- 7 Hydraulic Brake System: Bleeding and Maintenance Demonstration
- 8 Fuel Injector Cleaning and Performance Testing
- 9 Service Record and Job Card Management System
- 10 Basic Vehicle Painting and Denting Project