

Jharkhand University of Technology
Ranchi, 834010



SYLLABUS

For Diploma Program in
Automobile Engineering/Mechanical Engineering Automobile
(Effective from 2024-25)

DEPARTMENT OF AUTOMOBILE ENGINEERING

(4th – SEMESTER)

Diplomawallah.in

Advanced Automotive Systems

Subject code – AUT401

1. Rationale: The automotive industry has observed a drastic evolution since 2010 with many advancements in technology. The traditional 4-wheeled cars, which were earlier equipped with basic features have transformed into connected cars with advanced features such as cloud computing, big data, and the Internet of Things (IoT), among others. There is increasing number of electronic embedded systems in 2- wheelers as well as passenger and commercial vehicles such as Antilock Braking System (ABS), Electronic Control Units (ECUs) for engine management, park assist, Electronic Stability Programme (ESP), glow plug timers, Capacitive Discharge Ignition (CDI), etc., that are nowadays being installed not only in luxury cars but also in mid-segment cars by manufacturers. This course focusses on developing skill on these advanced automotive systems.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Test, Service and troubleshoot advanced automotive and electronic components of the given vehicle.
CO-02	Select an appropriate sensor and/or actuator for a given automated application, demonstrate collection of measurement data and explain process variables using sensors and transducers.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Computer operation (ECU) - Block diagram of computer (ECU) with its microprocessor-functions working principle. 2. Microprocessors-design-program-information storage-information retrieval. 3. Typical multipoint fuel injection system input/output pin configuration	Refer Table 1	1. Identification of pin configuration of ECU of different engines. 2. a) Identification of pin configuration of ECU of other systems of vehicle. b) Study different error codes of different makes of ECU.
			1. Open loop and closed loop control systems 2. Multiplexing-concept. Computer networking-concept need-Controlled Area Network (CAN)-concept-merits-types. 3. Sensors- Definition, construction and working- throttle position sensor-crankshaft position sensor-types-	Refer Table 1	1. Demonstration of computer area network and Identify TPS and crankshaft position sensor and their locations used in vehicle. 2. Diagnose and troubleshoot TPS and crank position sensor with engine scanner (and multi-meter).

			<ol style="list-style-type: none"> 1. Construction and working of magnetic pickup coil type, Hall effect. 2. Construction and working- Piezoelectric combustion, Knock sensor, temperature sensor. 3. Strain gauge type manifold absolute sensor-exhaust gas oxygen sensor. 	Refer Table 1	<ol style="list-style-type: none"> 1 Identify piezoelectric knock sensor and temperature sensor and their locations used in vehicle. 2. Diagnose and troubleshoot piezoelectric knock sensor and temperature sensor with engine scanner (and multi-meter).
			<ol style="list-style-type: none"> 1. Mass air flow Sensor-types 2. construction and working of hotfilm and hot wire type sensors. 3. Potentiometer type -need-working. principle. 	Refer Table 1	<ol style="list-style-type: none"> 1. Diagnose and troubleshoot Potentiometer with enginescanner (and multi-meter). 2. Build circuit to demonstrate the testing and working of Potentiometer, LVDT type ride height sensors, rain sensor.
			<ol style="list-style-type: none"> 1. LVDT type ride height sensors, rain sensor-need-working. principle. 2. Actuator-Definition, pulse width modulation of input voltage-duty cycle-need. 3. On/off solenoid proportionate solenoid-stepper motor-servo motor-relays-construction and working - applications. 	Refer Table 1	<ol style="list-style-type: none"> 1. Diagnose and troubleshoot LVDT type ride height sensors, rain sensor with engine scanner (and multi-meter). 2. Build circuit of On/off and proportionate solenoid stepper motor.
			<ol style="list-style-type: none"> 1. Power steering - types, construction and working- HPS. 2. Construction & working -linkage power steering, Integral powersteering. 3. electronic rack and pinion power steering-electronic power steering. 	Refer Table 1	<ol style="list-style-type: none"> 1. Servicing and troubleshooting of hydraulic power steering. 2. Service and troubleshoot electronic rack and pinion power steering.
			<ol style="list-style-type: none"> 1. Continuously variable transmission-construction and working. 2. Hydraulic automatic transmission-gear shifting process. 3. Automated manual transmissions-modes-working principle. 		<ol style="list-style-type: none"> 1. Service and troubleshoot of CVT. 2. Service and troubleshoot of Hydraulic automatic transmission.
			<ol style="list-style-type: none"> 1. Torque converter- construction and working, torque converter. 2. Limited slip differential-need-types. 3. Working principle of clutch type LSD. 	Refer Table 1	<ol style="list-style-type: none"> 1. Servicing of torque converter 2. Service and troubleshoot clutch type LSD.

		<ol style="list-style-type: none"> 1. Anti-lock brakes-Need and types, construction and working. 2. Anti-lock brake modulator. 3. Servo brakes -types, vacuum servo brakes-layout- working, 	Refer Table 1	<ol style="list-style-type: none"> 1. Test and troubleshoot wheel speed sensor of anti-lock braking system. 2. Servicing of servo brakes.
		<ol style="list-style-type: none"> 1. Electronic stability control-working principle. 2. Hill assistance and traction control system – working principle. 3. Air bag system-need-types-layoutof accelerometer-based air bag system. 	Refer Table 1	<ol style="list-style-type: none"> 1. Virtual Demonstration of Electronic stability control. 2. Virtual demonstrationof air bag systems.
		<ol style="list-style-type: none"> 1. Collision avoidance warning system-tyre pressure warning system- need-working. 2. Computer based instrumentation-working principle. 3.Trip information computer working principle, working principle-vehicle speed measurement. 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<ol style="list-style-type: none"> 1. Test and troubleshoot of tyre pressure warning system. 2. Demonstration of computer-based instrumentation.
		<ol style="list-style-type: none"> 1. Navigation- types- GPS navigation system. 2. Four-wheel drive system & all-wheel drive -types. 3.construction and working of permanent 4-wheel drive with viscous coupling. 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<ol style="list-style-type: none"> 1. Demonstration of GPS navigation system. 2. Service and troubleshoot 4-wheel drive system.
		<ol style="list-style-type: none"> 1. Air spring-types. construction and working- Bellows' air spring, piston air spring. 2. Hydro-elastic spring construction and working. 	Refer Table 1, Study the latest technological changes in	<ol style="list-style-type: none"> 1. Servicing and troubleshooting of air springs 2. Servicing and troubleshooting of hydro-elastic spring.

		3. Working principle-electronically controlled shock absorber.	this course in this course and present the impact of these changes on industry.	
Total in hours				

* PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)

5. Reference:

Sl. No.	Description
1	Understanding Automotive electronics, William Ribben, Butterworth-Heinemann Publications.
2	Automotive Computer Controlled Systems (Diagnostic tools and techniques), Allan. W. M Bonnick, Butterworth-Heinemann Publications.
3	Automobile electrical and electronic systems, Tom Denton, Butterworth-Heinemann Publications.
4	Electronic Engine Controls, Steve. V. Hatch, Cengage Learning.
5	Truck engines Fuel & computerized management systems, Sean Bennett, Cengage Learning.
6	Automobile engineering Vol I by Anil Chikara (Satya Prakashan)
7	Advanced vehicle technology by Heinz Heisler (Butterworth-Heinemann)
8	A Systems Approach to Automotive technology by Jack Erjavec (Cengage Learning)
9	Mechatronics by Prof C R Venkataramana
10	Mechatronics by W Bolten (Longman Pearson publications)

Design and Drafting

Subject code – AUT402

1. Rationale: Machine design is the most important activity in the mechanical industries. Success or failure of any industry is product design. Designers are individuals who use their talents to solve user-product problems on an on-going basis. Since design is the first step toward manufacturing, it is important that potential designers have some experience in manufacturing and industrial engineering. Design drawing will develop in detail from block drawings and sketches to very detailed technical drawings describing every component in a way that will enable them to be constructed and operated. This course enables the students to design and draw simple machine components using 3D modelling software.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Analysis the behaviour of simple load carrying members which are subjected to an axial and shear loading and record the resulting impact of both loads.
CO-02	List the standards and codes used in the design process.
CO-03	Design automobile components and draft machine components used in a given automobile by computer-based techniques.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			<ol style="list-style-type: none">1. Introduction to design. Simple stress and strains – tensile compressive, shear and Hooke's law. Factor of safety.2. Young's modulus, modulus of rigidity, bulk modulus. Centre of gravity & moment of Inertia – importance.3. Moment of Inertia about C.G for L-section and Channel section.	Refer Table 1	<ol style="list-style-type: none">1. Drawing stress-strain diagram using UTM machine and record the resulting impact of both loads.2. Finding Centre of gravity and moment of inertia of different shapes using analytical method and software like AutoCAD/Solid edge etc.

		<p>1. Moment of Inertia about C.G for I Section, tubular section.</p> <p>2. Limits-Need for limit system. Fit-Types of Fit – Clearance fit, interference fit, transition fit and their designation.</p> <p>3. Allowance, Tolerance – System of tolerance dimensions (system of writing tolerance). Unilateral system and bilateral system.</p>	Refer Table 1	<p>1. a) Represent and interpret tolerances given in drawings.</p> <p>b) List the standards and codes used in the design process.</p> <p>2. Practice to insert different fit, tolerance, precision and limit symbols using any CAD software.</p>
		<p>1. Specifying tolerances in assembly. Geometrical tolerance, positional tolerance.</p> <p>2. Terminologies used in limits and fits – shaft, hole, basic size, actual size, zero-line, upper deviation, lower deviation.</p> <p>3. System of Fits - Hole Basis System-Shaft Basis system.</p>	Refer Table 1	<p>1. Practice to insert appropriate ISO system of Limits, Fits and tolerances.</p> <p>2. Practice calculating limits for a given tolerance case.</p>
		<p>1. Fasteners-types-screw terminology-types of screw profiles.</p> <p>2. Locking of bolts-need-types.</p> <p>3. Stresses acting in a bolt. Stresses in screw fastening due to external loading- Tensile-compressive-combined tensile & shear stress. Simple problems</p>	Find the max stress in the bolt using any CAD software.	<p>1. Using part modelling work bench tools and assembly workbench tools create a square nut and bolt.</p> <p>2. Using part modelling work bench tools and assembly workbench tools create a hexagonal nut and bolt using any CAD software like-solid edge, UG-NX etc.</p>
		<p>1. Types of shafts, shaft materials, standard sizes.</p>	Refer Table 1	<p>1. Create a model of shaft and key using any</p>

			<p>2. Design of Shafts subjected to twisting & bending moment (Hollow and Solid) using strength and rigidity criteria. Simple problems</p> <p>3. Keys-need, types. Design of keys under different load conditions- shear and crush. Simple problems.</p>		<p>CAD software like-solid edge, UG-NX etc.</p> <p>2. Create an 3D-assembly model of shaft and key then create a 2D drawing using any CAD software like-solid edge, UG-NX etc.</p>
			<p>1. Couplings-purpose-requirements-types- applications.</p> <p>2. Design of Muff coupling. Simple problems.</p> <p>3. Design of Flange coupling- Unprotected. Simple problems.</p>	Refer Table 1	<p>1. Create an 3D-assembly model of Muff coupling and then create a 2D drawing using any CAD software like-solid edge, UG-NX etc.</p> <p>2. Create an 3D-assembly model of flange coupling and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.</p>
			<p>1. Coil spring-terms used in helical compression spring. Simple problems</p> <p>2. Stresses & deflection of helical spring. Simple problems</p> <p>3. Leaf springs- Effective & ineffective length, camber, stresses& deflection of semi elliptic leaf. Simple problems.</p>	Refer Table 1	<p>1. Using part modelling work bench tools create a helical spring CAD software like-solid edge, UG-NX etc.</p> <p>2. Using part modelling work bench tools and assembly workbench tools create a leaf spring assembly.</p>
			<p>1. Design concepts of piston.</p> <p>2. Design of piston, piston pin & piston rings based on strength and heat transfer.</p> <p>3. Simple problems.</p>	Refer Table 1	<p>1. Create an 3D-assembly model of piston, piston rings and piston pin and then create a 2D drawing using any CAD software</p>

					<p>like-solid edge, UG-NX, etc.</p> <p>2 Create an assembly model of piston, piston rings and piston pin and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.</p>
			<ol style="list-style-type: none"> 1. Forces acting on connecting rod. 2. Design parameters of connecting rod. 3. Design of connecting rod. Simple problems. 	Refer Table 1	<ol style="list-style-type: none"> 1. Create an 3D-assembly model of connecting rod and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc. 2. Create an assembly model of connecting rod and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.
			<ol style="list-style-type: none"> 1. Design of flywheel. Simple Problems. 2. Cam and followers-types, Cam profile-types. 3. Construct a cam profile using uniform velocity method. Simple Problems. 	Refer Table 1	<ol style="list-style-type: none"> 1. Create an assembly 3D-model of flywheel and ring gear and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc. 2. Create an 3D-assembly model of camshaft and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc..
			<ol style="list-style-type: none"> 1. Torque transmitted through single and multi-plate clutches. 	Refer Table 1,	<ol style="list-style-type: none"> 1. Create an 3D-assembly model of single plate-clutch assembly and then

			<p>2. Uniform intensity of pressure-uniform rate of wear conditions.</p> <p>3. Design of single plate clutch and multi-plate clutch. Simple problems.</p>	<p>Study the latest technological changes in this course and present the impact of these changes on industry.</p>	<p>create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.</p> <p>2. Create an assembly 3D-assembly model of single plate clutch assembly and then create a 2D drawing using any CAD software like-solid edge, UG-NX, etc.</p>
			<p>1. Gear-terminology of gear-gear teeth profiles.</p> <p>2. Design of spur gear. Simple problems.</p> <p>3. Find gear ratio, number of teeth and distance between lay shaft and main shaft.</p>	<p>Refer Table 1, Study the latest technological changes in this course and present the impact of these changes on industry.</p>	<p>1. Create an 3D- assembly model of spur gear and then create a 2D drawing using any CAD software like-solid edge/UG-NX.</p> <p>2. Create an 3D- assembly model of a helical gear and then create a 2D drawing using any CAD software like- solid edge/UG-NX.</p>
			<p>1. Find different vehicle speed at different engine speed and gear ratios.</p> <p>2. Brakes: Stopping distance, braking efficiency, Braking torque. Leading and trailing shoe,</p> <p>3. Equation for Braking Torque on Leading and Trailing Shoe. Simple Problems.</p>	<p>Study the latest technological changes in this course and present the impact of these changes on industry.</p>	<p>1. Create an 3D- assembly model of pinion and gear and then create a 2D drawing using any CAD software like-solid edge/UG-NX.</p> <p>2. Create an 3D- assembly model of Leading and trailing shoe (drum brake) and then create all 2D views using any CAD software like-solid edge/UG-NX.</p>
Total in hours					

4. Reference:

Sl. No.	Description
1	A Text book of Machine Design by R.S. Khurmi&J.K.Gupta (S. Chand publication).
2	Design Of Machine Elements Vol I, Vol II by J.B.K. Das, P.L. Srinivas Murthy (Sapna Publication).
3	Auto Design by R B Gupta (Satya Prakashan).
4	Automobile Engineering Drawing by R B Gupta (Satya Prakashan).
5	CADD software for Engineers and Designers by Prof. Sham Tickoo (Dream tech press).
6	Automotive Mechanics by Dr.N.K. Giri (Khanna Publishers))
7	Automobile design Problem by R.S. Agarwal
8	Machine Drawing by K R Gopalakrishna (Subhas Stores)

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Vehicle Body Engineering and Dynamics

Subject code – AUT403

1. Rationale: In automobile, the body work is the main structure which protects the occupants and any other payload. Thus, the body engineering plays an important role in construction of body and providing comfort and safety to the passengers. The automobile when rolling on the road is subjected to various types of forces. The main goals are reducing drag and wind noise, minimizing noise emission, and preventing undesired lift forces and other causes of aerodynamic instability at high speeds. The main goal of this course is to impart skill of vehicle body construction, repair and dynamics of the vehicle which also improves the performance of vehicle.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Identify the body and glass material for a given vehicle type and demonstrate replacement of windshield and vehicle body repair while complying with all necessary safety protocols.
CO-02	Select accessories for a given vehicle and list the right adhesives used to affix them.
CO-03	Check for metal corrosion on structural panel for a given vehicle, prepare corrosion spots and perform spray painting process.
CO-04	Test and troubleshoot or service the air conditioning system of a given vehicle.
CO-05	Design an aerodynamic vehicle body ensuring appropriate load distribution along with ergonomic interiors.
CO-06	Design the steering system, braking system and bus body ensuring appropriate design parameters.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Vehicle body -Need- body styles- Materials. 2. Composite materials - Advantage - types- Application. GRP, FRP, carbon reinforced plastics, insulating materials- need-types- properties. 3. Automotive Adhesives & Sealant - Need-Types, Structural adhesive. Application of Adhesive in Automobile	Refer Table 1	1. Identify and compare different materials in a vehicle body. 2. Practice on using of different adhesives and sealant in vehicle body. Note: Use Personal Protective gears & follow the safety rules.

		<p>1. Automotive Glass – types- toughened glass, laminated glass, Bullet resistance glass. Difference between Toughened glass, sheet glass & Laminated glass.</p> <p>2. Defrosting of windshield glass. Window winding mechanisms-types-mechanical & electrical.</p> <p>3. Automatic window regulating mechanism and center locking Mechanism</p>	Refer Table 1	<p>1. Identify the glass material for a given vehicle. Practice on removing and refitting wind shield glasses.</p> <p>2. Servicing of window regulating mechanisms.</p> <p>Note: Use Personal Protective gear & follow the safety rules.</p>
		<p>1. Vehicle body repair - Identification of location of parts and panels. Techniques/ procedure required to Repair of body panel, minor and major structural damage.</p> <p>2. Damages on chassis and body- diamond type, banana damage, twist damage, mash damage, dents and scratches, weld burrs.</p> <p>3. Body & chassis alignment- Reasons & effects.</p>	Refer Table 1	<p>1. a) Remove and refit body panels, doors, floors and fenders.</p> <p>b) Demonstrate different processes for removing dents.</p> <p>2. Checking and correcting the body and chassis alignment Note: Use Personal Protective gears & follow the safety rules.</p>
		<p>1. Body painting- objectives – Paint types. Elements of paint-pigment-resins- solvents.</p> <p>2. Paint drying process-Types-drying principle of each type.</p> <p>3. Composition & functions- primer paint- putty paint.</p>	Refer Table 1	<p>1. Practice on removing paint from the damaged area, practice on mixing and applying body filler.</p> <p>2. Practice on applying primer, practice on feather edge sanding and masking.</p> <p>Note: Use Personal Protective gears & follow the safety rules.</p>

			<p>1. Spray painting - Types, air spray painting-procedure.</p> <p>2. Corrosion: Causes and effects of corrosion on automobile bodies. Methods of corrosion protection.</p> <p>3. Interior aesthetics: -Introduction, Seat ergonomics, seat belt -need-types. seat adjustment mechanisms.</p>	Refer Table 1	<p>1. Practice on cutting, scuffing, rubbing and polishing in painting.</p> <p>2. Demonstrate and practice on anti - corrosion and rust prevention procedure on vehicle body.</p> <p>Note: Use Personal Protective gears & follow the safety rules.</p>
			<p>1. HVAC system - Functions- Working of vehicle air condition system and its layout</p> <p>2. Construction and working of expansion valve and Accumulator/ drier.</p> <p>3. Working of heating and ventilation system in automobile.</p>	Refer Table 1	<p>1. Air conditioner maintenance and service using automatic AC refilling machine.</p> <p>2. HVAC system troubleshooting.</p>
			<p>1. Body Dynamics: Different types of engines and drive location with their merits and demerits.</p> <p>2. Different resistance to body motion. Wind resistance, rolling resistance and gradient resistance.</p> <p>3. Power required for propulsion. Traction and tractive effort. Surplus power, acceleration, gradability, draw bar pull, Equivalent weight.</p>	Refer Table 1	<p>1. Case study on load distribution of a vehicle under different conditions (on level road and while ascending the hill). or Using the simulation software examine on load distribution of a vehicle under different conditions</p> <p>2. Case study on resistance to vehicle motion and surplus power of different wheel drive.</p>

			<p>1. Maximum acceleration, max tractive effort, reactions for front wheel, 4 wheel and rear wheel drive.</p> <p>2. Simple Problems.</p> <p>3. Simple Problems.</p>	Refer Table 1	<p>1. Find different performance parameters of a given vehicle by analytical method using its specification and compare it with actual parameters.</p> <p>2. Using the simulation software examine the different performance parameters of a given vehicle.</p>
			<p>1. Vehicle Aerodynamics: Objectives, aerodynamic forces and moments.</p> <p>2. Various body optimization techniques for minimum drag.</p> <p>3. Various body design features to improve safety. Sources of noise and vibration- various noise and vibration reduction techniques.</p>	Refer Table 1	<p>1. Case Study on determining different type of flow on vehicle body and effects of aerodynamic forces and moments on vehicle body.</p> <p>Or</p> <p>Observe the aerodynamic drag forces using simulation software /set up.</p> <p>2. Practice on Sources of body noises testing and methods of elimination.</p> <p>Water leakage test.</p>
			<p>Braking System:</p> <p>1. Different forces acting on the vehicle moving on a level road and gradient - when-front wheel brakes applied,</p> <p>2. Different forces acting on the vehicle moving on a level and gradient- when rear wheel brakes applied and all wheel brakes applied.</p>	Refer Table 1	<p>1. Case study on load distribution of a vehicle under different conditions while braking.</p> <p>Or</p> <p>Using the simulation software examine load distribution of a vehicle</p>

			3. Weight transferred during braking, stopping distance, stopping time and efficiency of brakes.		<p>under different conditions while braking.</p> <p>2. Case study on weight transfer, stopping distance and time improvement under various conditions.</p> <p>Or</p> <p>Using the simulation software examine the weight transfer, stopping distance and time improvement under various conditions.</p>
			<p>Steering System:</p> <p>1. True steering, over steering, under steering, minimum turning circle radius of vehicle.</p> <p>2. Collapsible steering column- types, - Construction and working.</p> <p>3. tilt-telescopic steering columns- construction and working.</p>	<p>Refer Table 1,</p> <p>Study the latest technological changes in this course in this course and present the impact of these changes on industry.</p>	<p>1. Finding minimum turning radius- analytical/ practical method.</p> <p>2. Demonstration of different types of collapsible steering. Or</p> <p>Using the simulation software analyse the working of collapsible steering column.</p>
			<p>1. Bus Body Details: Types, Bus Body Lay Out: Floor height, engine location, entrance and exit location.</p> <p>2. seating dimensions, Dimensions of driver's seat in relation to controls, driver's cabin design.</p>	<p>Refer Table 1</p> <p>Study the latest technological changes in this course</p>	<p>1. Practice on checking of frame alignment and its correction.</p> <p>2. Practice on Bus body dent removal and painting.</p>

			3. Constructional details: Frame construction, Double skin construction- Types of metal section used- Regulations- Conventional and Integral type construction.	in this course and present the impact of these changes on industry.	Note: Use Personal Protective gears & follow the safety rules.
			<p>1. Wind tunnels for automotive aerodynamics: Introduction – Principles of wind tunnel technology.</p> <p>2. Flow visualization techniques. Testing with wind tunnel balance (scale models).</p> <p>3. Road Testing -Need-Equipment used in road testing. Crash test- need- types- Equipment needed- government regulation- rating.</p>	Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<p>1. Case study on Analysis of flow visual technique.</p> <p>Case study on wind tunnel technology.</p> <p>Or</p> <p>Using the simulation software analyse the flow visual technique.</p> <p>2. Case study to improve safety rating of a given vehicle.</p>
Total in hours					

* PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)

5. Reference:

Sl. No.	Description
1	Vehicle body engineering by Giles J Pawlowsky (Business books limited)
2	Vehicle body layout and analysis by John Fenton (Mechanical Engg.Publication ltd, London.)
3	Aerodynamics of Road Vehicles by W.H. (Butter worth's 1987)
4	Automobile Engineering (Paint Technology) Vol V by Anil Chhikara, Satya Prakashana New Delhi
5	Automotive Engineering (Heating & Air conditioning) class room manual, Mark Schnubel, Cengage Learning
6	A. Pope - "Wind Tunnel Testing" - John Wiley & Sons - 2nd Edition, New York - 1974.
7	Vehicle maintenance and Garage practice by jigar A. Doshi, Dhruv U. Panchal, Jayesh P. Maniar.
8	Siemens NX 2019 for Designers, 12 Edition by Prof. Sham Tickoo, Purdue University Northwest, USA. (Tickoo-CADCIM Series)
9	Beginning MATLAB and Simulink: From Novice to Professional by Sulaymon Eshkabilov.
10	MATLAB and SIMULINK for Engineers by Agam Kumar Tyagi
11	Siemens NX 2021 for Designers, 14th Edition by Prof. Sham Tickoo, Purdue University Northwest

Fuels and Pollution Control

Subject code – AUT404

1. Rationale: Automobiles burn different kinds of fuels to generate mechanical power. Fuel burning also generates exhaust emissions, which pollutes the atmosphere. Increase in number of automobiles has resulted in atmospheric pollution beyond permissible limits in cities. Thus, automobile emissions have become a social concern and engineers are supposed to reduce it. Emission standards are therefore set in every country to control this problem. These standards specify maximum amount of pollutants that can be released into the environment by different types of vehicles. The students should therefore have knowledge about the pollutants produced by automobiles and ways to reduce the pollution by the use of the various emission control devices maintain level of pollutants in emissions of various kinds of automobiles.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Differentiate between petroleum and alternative fuels and analyse emission performance of an engine using alternative fuels.
CO-02	Test and troubleshoot or service a fuel feed system, supercharger, turbocharger and Micro-Hybrid Vehicle.
CO-03	Explain the formation of pollutants, its measurement techniques and list the appropriate methods to be used to control pollutions from vehicles.
CO-04	List emission standards & the regulations applicable to vehicles manufactured in India and carry out emission tests to record emission levels as per each standard.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			1. Petroleum fuels. Refining process. 2. Properties of liquid and gaseous fuels. Types – merits – demerits. 3. Alternative fuels –Methanol – properties merits- demerits -storage emissions.	Refer Table 1	1. Determination of flash point, fire point and viscosity of petrol fuel. 2. Determination of flash point, fire point and viscosity of Diesel fuel.
			1. Ethanol – properties merits- demerits -storage emissions. 2. Biodiesel - properties merits- demerits -storage emissions- Biodiesel production processes.	Refer Table 1	1. Determination of Calorific value of methanol and Ethanol using Bomb's calorimeter.

			3. Hydrogen - properties merits- demerits -storage emissions. CNG - properties merits- demerits -storage emissions- CNG fuel feed system layout.		2.a) Installation CNG kit to the car, setting and maintenance. b) Determination of Calorific value of CNG using Junker's calorimeter.
			1. Fuel feed system in SI engine- Requirements-types- Layout - Working of 2-wheeler carburetor. 2. Fuel feed system in CI engine- requirements-types- Layout- Inline and distributor system. 3. Governor- need- types- working of mechanical governor. single cylinder fuel injector pump. Multi hole fuel injector.	Refer Table 1	1. Servicing of 2-wheeler fuel feed system. 2.a) Servicing of typical CI engine fuel feed system. b) Trouble shooting of fuel feed systems
			1. Stratified engine -Need- types. 2. Supercharging- need. Supercharger-types. 3. Turbocharging- need- types construction- working of turbocharger.	Refer Table 1	1. Servicing of super charger. 2. Servicing of a turbocharger.
			1. Pollutants from an automobile – Sources of pollutants in SI engine & Diesel engine 2. Formation of Particulate emission in Diesel engine. 3. Mechanism of nitrogen oxide, carbon monoxide and unburnt hydrocarbon in SI engine.	Refer Table 1	1. Measurement of HC, CO, CO ₂ , O ₂ using exhaust gas analyzer. 2. Measurement of smoke of Diesel engine using Smoke meter.
			1. Methods of controlling pollution: Crankcase ventilation system- need- layout. Exhaust gas recirculation-need- layout.	Refer Table 1	1. Servicing of PCV and EGR system 2. Servicing of catalytic converter.

		<p>2. Catalytic converters -need-types - construction and working of 3-way catalytic converter.</p> <p>3. SCR and Particulate filters to control particulate emission of diesel engine.</p>		
		<p>1. Electronic fuel injection- Advantage. Construction and working - single point-multipoint fuel injectors. Variable valve timing- need-types.</p> <p>2. Multipoint direct injection system- operating modes of direct injection. construction and working-petrol injectors. Variable length intake system-need.</p> <p>3. CI Engine Electronic Fuel injection- types-construction and working- Electronic Diesel Control.</p>	Refer Table 1	<p>1. Service and troubleshoot single point injection system.</p> <p>2. Service and troubleshoot multipoint injection systems.</p>
		<p>1. In line- Distributor pumps, construction and working.</p> <p>2. Unit Injector-Common rail injection System</p> <p>3. Electrohydraulic injector of CRDI system.</p>	Refer Table 1	<p>1. Servicing, calibrating and troubleshooting of Inline fuel pump system.</p> <p>2. Servicing and troubleshooting of CRDI system.</p>
		<p>1. Battery operated vehicle-working principle -regenerative braking-working principle.</p> <p>2. Fuel cells-types- construction and working of polymer electrolyte membrane type.</p> <p>3. Hybrid vehicles-types- layouts of series and parallel.</p>	Refer Table 1	<p>1. Servicing and maintenance of battery-operated two-wheeler.</p> <p>2. Servicing and maintenance of micro hybrid vehicles</p>

		<ol style="list-style-type: none"> 1. Emission norms-need- different emission standards for different engines in India. Driving cycles-need-types. 2. Bharath stage emission standards and norms. 3. Comparison of Bharath stage with European standards. 	Refer Table 1	<ol style="list-style-type: none"> 1. Case study on implantation of BS VI norms. 2. Test fuel consumption of a vehicle under different driving cycles.
		<ol style="list-style-type: none"> 1. ARAI- Formation- functions. 2. Formulation of standards. Central Motor vehicle rules. Automotive pollution – air pollution & human health 3. Exhaust manifold- function, Exhaust manifold components, Muffler, Electronic muffler, Exhaust manifold reactor. 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<ol style="list-style-type: none"> 1. Case study on standardization/ Formulation/ Certification. 2. Case study on effects of exhaust gas and advancement in exhaust manifold to control exhaust emission level.
		<ol style="list-style-type: none"> 1. Performance of SI engine using different blends of ethanol- modifications to engine and fuel feed system. 2. Performance of SI engine using different blends of methanol. modifications to engine and fuel feed system. 3. Comparison of above emissions (1 & 2). 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	<ol style="list-style-type: none"> 1. Measure ethanol & methanol emission on a SI engine. 2. Conduct an experiment to measure various performance parameters of a SI engine using ethanol blend.
		<ol style="list-style-type: none"> 1. Performance of Diesel engine using CNG- Modifications to engine and fuel feed system. 2. Performance of Diesel engine using biofuel- Modifications to engine and fuel feed system. 3. Comparison of above emissions (1 & 2). 	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these	<ol style="list-style-type: none"> 1. Measure CNG emission on CI engine. 2. Conduct an experiment to measure various performance parameters of a CI engine using biofuel blend.

				changes on industry.	
Total in hours					

* PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)

5. Reference:

Sl. No.	Description
1	Alternative fuels, Thipse, Jaico publications.
2	Alternative Fuels & the Environment, Frances S. Sterrett, Hardback Publications.
3	Alternative fuels, V.Ganeshan, McGraw Hill Education (India) Private Limited, New Delhi
4	Internal combustion Engine, M.L. Mathur and R.P. Sharma, Dhanpat Rai Publications.
5	SAE Transactions, "Vehicle Emission", 3 volumes, 1982
6	Automobiles and Pollution SAE Transaction, 1995.
7	Engine Emissions: pollution Formation and advances in control technology by B.P. Pundir.