

Program Name : Diploma in Mechanical Engineering
Program Code : ME
Semester : Sixth
Course Title : Automobile Engineering
Course Code : 22656

1. RATIONALE

Automobile sector has been helping the world for the overall development and it has been creating wage and self employment opportunities both in public and private sectors. A Mechanical engineering technologist should have an overall understanding of various aspects of Automobile Systems. This course provides a broad knowledge about the different vehicle layouts, transmissions and controls, electrical and electronics systems, vehicle safety and security, features of Motor Vehicle Acts along with automobile maintenance systems. This knowledge will be helpful to the students in co-relating various automobile systems with each other and provide good practical input with theoretical knowledge for technological advancement of the industry/society.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Interpret the required automotive component based on the analysis of the automobile specifications.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Prepare vehicle layouts with chassis specification.
- Interpret power flow diagrams of transmission systems.
- Select suitable braking and steering systems for different applications.
- Select suspension system for different applications.
- Prepare simple electrical-electronic circuits for automobile systems.
- Select service tools for relevant service operation in automobile shops.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P – Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment



5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

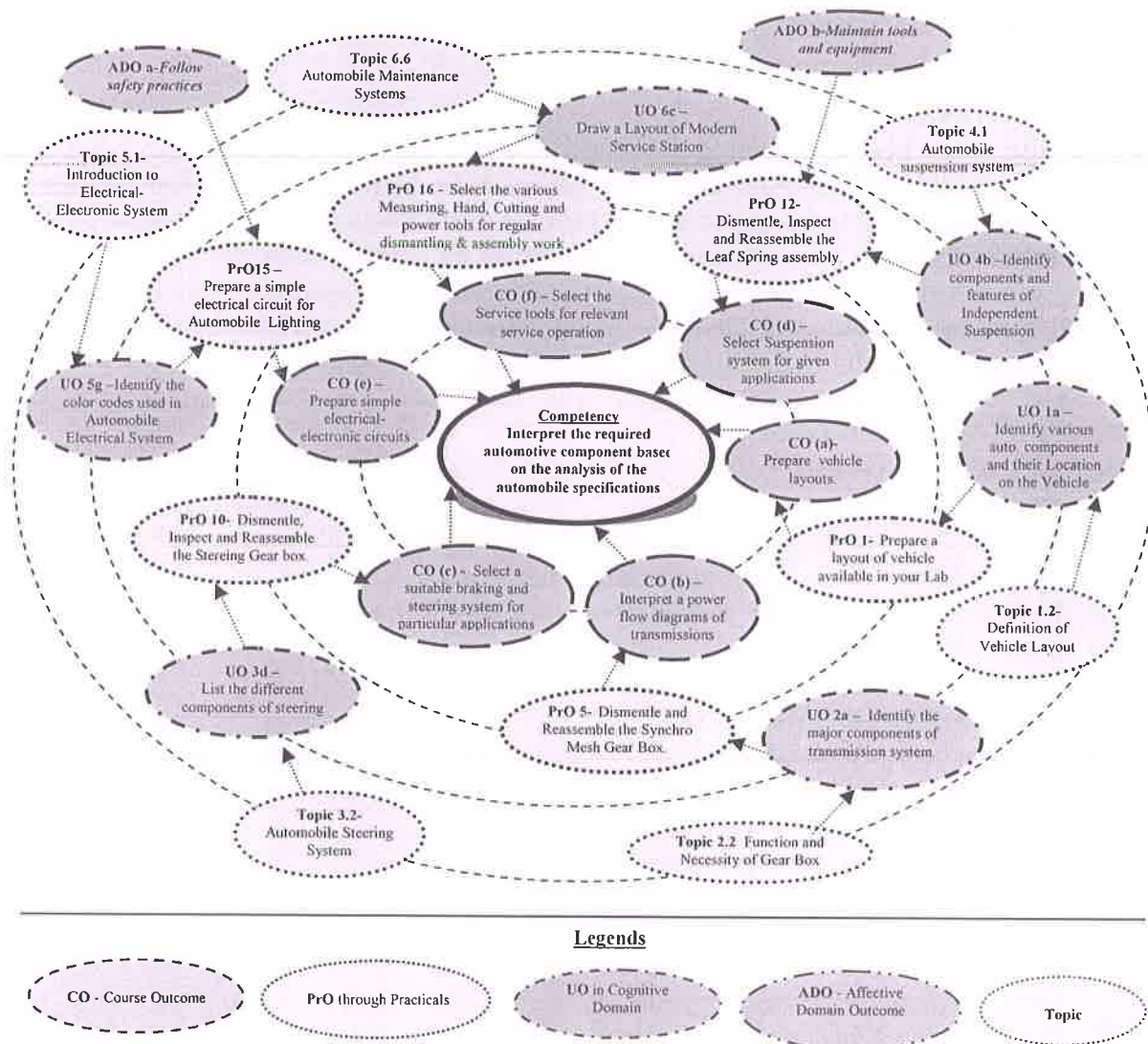


Figure 1: Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Prepare a layout of vehicle available in your Laboratory.	I	02*
2	Dismantle, inspect and reassemble the Single Plate Clutch. (Coil Spring Type/Diaphragm Type)	II	02
3	Dismantle/Assemble the Multiplate Clutch.	II	02*
4	Dismantle/Assemble the Centrifugal Clutch.	II	02
5	Dismantle/Assemble the Synchro Mesh Gear Box.	II	02*
6	Dismantle/Assemble the Propeller shaft Assembly.	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
7	Dismantle/Assemble the Differential Assembly.	II	02*
8	Dismantle/Assemble the Drum/Disc Brake.	III	02
9	Dismantle/Assemble the Steering Gear box. (Rack and Pinion/Recirculating Type/Worm and Wheel)	III	02
10	Dismantle/Assemble the Power Steering system. (Hydraulic/Electronic Type)	III	02
11	Dismantle/Assemble the Leaf Spring assembly.	IV	02*
12	Dismantle/Assemble the Wheel and Tyre assembly.	IV	02
13	Test a Lead Acid Battery for Open Voltage and Specific Gravity.	V	02*
14	Dismantle/Assemble the Distributor used in Battery Ignition System.	V	02*
15	Prepare a simple electrical circuit for Automobile applications like Lighting/Horn/Wiper/Flasher/Indicators/Gauges etc.	V	02
16	Maintain given simple automobile component using various Service Tools.	VI	02*
Total			32

Note:

- i. For Practical Nos. 2,3,4,5,8,9,10,12 students should rectify the particular troubles in respective system with probable causes and remedies for the same and prepare a Trouble Shooting Chart.
- ii. For Practical Nos. 1,6,7,10,11,13,14 students should identify the various components of respective system and state their functions and location.
- iii. A suggestive list of PrO's is given in the above table. More such PrO's can be added to attain the CO's and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- iv. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of practical set up	10
2	Handling of service tools carefully while performing the practicals	20
3	Select the sequence of operation of dismantle and assembly	20
4	Safety measures and standard practices	10
5	Inspection, record keeping and reassembly	10
6	Identify the Probable Causes of the Troubles	10
7	Prepare the Trouble shooting chart with causes and remedies	10
8	Submission of the practical report with conclusion	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a) Follow safety practices.
- b) Practice good housekeeping.
- c) Practice energy conservation.
- d) Work as a leader/a team member.
- e) Follow ethical practices.



The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organisation Level' in 2nd year
- 'Characterisation Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No	Equipment Name with Broad Specifications	PrO. No.
1	Any Two/Four Wheel drive (2WD/4WD) Vehicle	1
2	Working Model of Coil Spring Single Plate Clutch used in Cars	2
3	Working Model of Diaphragm Spring Type Single Plate Clutch used in Cars	2
4	Working Model of Multiplate Clutch used in Scooter/Motor cycles	3
5	Working Model of Centrifugal Clutch used in Mopeds	4
6	Working Model of Synchro Mesh Gear Box used in four wheelers	5
7	Propeller Shaft Assembly along with two U-joints and one slip joint	6
8	Working Model of Differential Assembly of four wheeler	7
9	Working Model of Drum Brake (Mechanical/Hydraulic Linkage)	8
10	Working Model of Disc Brake (Hydraulic Linkage)	8
11	Working Model of Rack and Pinion Steering Gear used in cars	9
12	Working Model of Recirculating Ball Type Steering Gear Box	9
13	Working Model of Worm and Wheel Steering Gear Box	9
14	Working Model of Hydraulic/Electronic Power Steering System	10
15	Working Model of Semi Elliptical Leaf Spring with shackle and Shock ups	11
16	Tyre Removing Tool Kit/Tyre Remover	12
	Tyre Inflator: 12 V Air Compressor Pump	
17	Air Compressor: AC Single Phase, Air Cooled, Capacity: 160- 500 Litre, Speed: 690-925 RPM, Power: 2 to 20 HP, Working Pressure: 10.5-12 Kg/cm ³	
18	12 Volt Lead Acid Battery in Working Condition, 7-50 AH	13
19	Voltmeter, Ammeter, Cell Tester, Multi Meter	13
20	Hydrometer for Specific Gravity Test. (For Large and Small Battery with a Sp. Gravity range of 1.100-1.300, 77°F)	13
21	Working Model of Distributor used in Battery Ignition System.	14
22	Working Model of Auto. Electrical System (2/4 Wheeler) (Model consists; <i>Electrical Circuit</i> -Horn, Buzzer, Starting, Ignition, Earthing etc. <i>Lighting Circuit</i> -Head, Tail and Side Lamps, Indicators/Flashers, Parking Light)	15
23	Minimum 02 sets of Automobile Service Tool Kit preferably with Trolley. (<i>Service Tool Kit</i> : It includes Cutting Tools, Hand Tools, Measuring Tools, Power Tools, Torque Wrenches, Bearing Pullers.)	1,2,5,16
24	Axle Stand/ Scissor/ Hydraulic Screw Jack (Capacity of 4 to 50 Ton)	1,2,5,16

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to Automobiles	1a. Identify various automobile components and their location on the given vehicle. 1b. Describe with sketches the the function of the given part of the specified automobile chassis/frame/ body 1c. Select relevant type of alternative fuel for the given application with justification. 1d. Draw labeled vehicle layout of the given vehicle.	1.1 Automobile: Definition, Classification of Automobiles, Major Components of Automobiles with their Function and Location 1.2 Vehicle Layout: Definition Significance of Vehicle Layout, Different types of Vehicle layouts (FEFWD, FERWD, RERWD, 4WD), Advantages, Disadvantages, Applications and Comparisons of Different types of vehicle layouts. 1.3 Function of Chassis, Frame and Body: Requirement of Chassis, Frame and Body, Load acting on Frame, Classification of Chassis Frames with advantages, disadvantages and applications (Conventional, Unitized Body, Sub Frame), Basic Body Nomenclature. 1.4 Significance of Body Streamlining: Need and Importance of aerodynamic Aspects, Basic terms related with Car Aerodynamics (e.g. Drag, Lift, Skin Friction, Form Drag, Wake, Coefficient of Drag) 1.5 Alternative Fuels: LPG and CNG: Need, Fuel Characteristics, Construction and Working, Advantages, Limitations; Layout of Electric Vehicles: Need, Working , Advantages, Limitations. Hydrogen as fuel.
Unit-II Automobile Transmission Systems	2a. Identify the major components of the given transmission system. 2b. Select type of transmission for the given application with justification. 2c. Explain with sketches the working principle of the given overdrive with labelled diagram. 2d. Differentiate the features of the given two components based on the specified criteria. 2e. Explain the working principle of Differential for the given vehicle.	2.1 Function and Necessity of Clutch: Requirement of Clutch, Classification of Clutch, Working Principle of Clutch, Construction and Working of Single Plate (Coil Spring and Diaphragm), Multiplate Clutch and Centrifugal Clutch. 2.2 Function and Necessity of Gear Box Manual Transmission: Classification of Gear Box, Construction and working of Constant Mesh and Synchro Mesh Gear Box with power flow diagrams. 2.3 Semi Automatic Transmission: Function, Construction and Working of Overdrive, Automatic Transmission: Fluid Flywheel: Function, Construction and Working of Fluid Flywheel;

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2f. Interpret power flow diagram of the given transmission system.	<p>Torque Converter: Function, Construction and Working of Torque Converter; Epicyclic Gear Train: Function, Construction and Working of Epicyclic Gear Train.</p> <p>2.4 Propeller Shaft Assembly: Function, Necessity and Types of Propeller Shaft, Function and necessity of Universal and Slip Joint.</p> <p>2.5 Final Drive: Function and Necessity of Final Drive, Differential, Working Principle, Construction and Working of Differential.</p> <p>2.6 Axles: Significance of Live and Dead Axle, Function and Requirement of Front Axle, Types of (Front) Stub axle, Function, Construction and Working of Semi Floating and Fully Floating Rear Axle.</p>
Unit- III Automobile Control Systems	<p>3a. Sketch the labelled layout of the given type of Braking System.</p> <p>3b. Explain with sketches the working of the given ABS.</p> <p>3c. Explain with sketches the terms related to Steering System</p> <p>3d. Explain with sketches the working principle of the given type of Steering gearbox for the given vehicle.</p> <p>3e. Select relevant braking systems for the given application with justification.</p> <p>3f. Select relevant steering systems for the given application with justification.</p>	<p>3.1 Automobile Braking System: Function and Requirement of Braking System: Principle of Braking, Basic Terms related to Braking (Stopping Distance, Braking Efficiency, Fading of Brakes)</p> <p>3.2 Types of Braking System: Layout, Construction, Working of Drum, Disc, Hydraulic and Air Brakes.</p> <p>3.3 Master Cylinder, Wheel Cylinder, Tandem Master Cylinder, Significance and general procedure of Bleeding of Brake.</p> <p>3.4 Review of Anti lock braking System: Layout of ABS, Pressure Modulation, Types of ABS.</p> <p>3.5 Automobile Steering System: Function and Requirements of Steering System: Basic Terms related to Steering (Steering Ratio, Turning Radius, Understeering and Oversteering), Basic Components of Steering Linkages.</p> <p>3.6 Types of Steering Gear Boxes: Construction and Working of Rack and Pinion, Recirculating Ball Type Steering Gear Box, Necessity and Principle of Power Steering, Construction and Working of Hydraulic and Electronic Power Steering.</p> <p>3.7 Steering Geometry: Necessity of</p>

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		Steering Geometry, Significance and ranges of Caster (Positive, Negative), Camber (Positive, Negative), Toe-in, Toe out, King Pin Inclination (KPI), Steering Axis Inclination (SAI)
Unit– IV Automobile Suspension, Wheels and Tyres	<p>4a Define the given terms related to the given suspension system.</p> <p>4b Explain with sketches the working principle of the given type of Suspension System for the given vehicle.</p> <p>4c Explain with sketches the working principle of the given type of Shock Absorbers/Air Suspension.</p> <p>4d Select relevant procedure, tool and equipment for Wheel Alignment and Balancing for the given vehicle with justification.</p> <p>4e Describe with sketches the terms related to Wheel alignment/wheel balancing.</p> <p>4f Select relevant suspension systems for the given application with justification.</p>	<p>4.1 Automobile Suspension System: Function and Requirement of Rigid Suspension System: Basic Terms Related with Suspension System: (Jounce, Rebound, Sprung and Unsprung Weight, Spring Rate, Elasticity), Types and Constructional Features of Leaf Springs,.</p> <p>4.2 Function and Requirement of Independent Suspension System: Advantages of Front Wheel Independent Suspension, Construction and Working of Mac-Pherson Strut Type, Wishbone Type Suspension system.</p> <p>4.3 Shock Absorbers and Air Suspension: Layout, Construction and Working of Air Suspension, Function and Types of Shock Absorber, Principle of Hydraulic Shock Absorber, Construction and Working of Telescopic Shock Absorber, Constructional Features and working of Gas Filled Shock Absorber.</p> <p>4.4 Wheels, Rims and Tyres: Function, Necessity and Requirement of Wheel, Rim and Tyres: Types of Wheels, Rims and Tyres, Construction and Working of Different Types of Wheels, Rims and Tyres.</p> <p>4.5 Tyre Economy: Consideration in Tyre Tread Design, Factors affecting to Tyre Life, Tyre Wear and Rotation, Tyre Designation.</p> <p>4.6 Wheel Alignment and Balancing: Purpose of Wheel Alignment, Procedure of Wheel Alignment, Purpose of Wheel Balancing, Significance of Static and Dynamic Balancing, Procedure for Static and Dynamic Balancing.</p>
Unit –V Automobile Electrical and Electronics Systems	<p>5a Define the given terms related to the automobile electrical system.</p> <p>5b Select the relevant battery for the given</p>	<p>5.1 Introduction to Electrical-Electronic System: Basic Electrical-Electronics Principles (Current, Voltage, Resistance, Electricity, Magnetism, Electromagnetism, Induction,</p>

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	<p>application.</p> <p>5c Explain with sketches the working principle of the given electrical component of the vehicle.</p> <p>5d Differentiate between the given two terms related to the automobile electrical system.</p> <p>5e Select the relevant sensors and actuators for the given application with justification.</p> <p>5f Prepare simple electrical/electronic circuits for given type of automobile.</p>	<p>Rectification etc.) Basic Electrical-Electronics Components used in automobiles with their conventional symbols.</p> <p>5.2 Battery: Function and Requirements of Battery, Types of Battery, Principle of Lead Acid Battery, Construction and Operation of Lead Acid Battery, Significance of Battery Rating and Battery Capacity, Battery Open Volt and Specific Gravity Test, Salient Features of Maintenance Free Battery.</p> <p>5.3 Starting System: Function and Requirement of Starting System, Components of Starting System, Construction and Working of Standard Bendix Drive.</p> <p>5.4 Charging System: Function and Requirement of Charging System, Components of Charging System, Construction and Working of Alternator.</p> <p>5.5 Ignition System: Function and Requirement of Ignition System, Types of Ignition System, Construction and Working of Battery Ignition, Magneto Ignition and Electronic Ignition System with advantages, disadvantages, applications. .</p> <p>5.6 Lighting System: Function and Requirements of Lighting Systems, Types of Lights, Necessity and Importance of Cable Color Codes, Wiring Harness.</p> <p>5.7 Miscellaneous: A Brief Review of Different types of Gauges, Windscreen wiper, Function and Location of Major Sensors and Actuators used in Automobile Electronics.</p>
<p>Unit-VI Motor Vehicle Act, Road Safety and Garage Practices</p>	<p>6a. Explain the meaning of the given Road Traffic signs.</p> <p>6b. Draw labeled layout of a Modern Service Station for the given situation.</p> <p>6c. Differentiate between the given two terms related to the motor vehicle act.</p> <p>6d. Describe with sketches the the function of the</p>	<p>6.1 Introduction and Objectives of Motor Vehicle Act: Salient Features of M. V. Act 1988 and Central Motor Vehicle Rules 1989. 6.1.2 Types and Significance of Traffic Signs, Important Transport Terms (Definitions) in M. V. Act (Motor Vehicle, Motor Cycle, HGV, MGW, LGV, Public Service Vehicle, Transport Vehicle, Driver, Passenger, Accident)</p>

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	specified type of passenger comfort/safety component. 6e. Select the relevant service tools for relevant service operation in automobile shops with justification.	6.2 Organization Structure of Motor Vehicle (RTO) Department, Duties and Responsibilities of RTO, AIMV. 6.3 Passenger Comfort and Safety: Function and requirements of Passenger Safety System. Features of Air Bags, Seat Belts, Collapsible Steering Column. 6.4 Automobile Maintenance Systems: Significance of Garage, Workshop, Service Station, Dealership. 6.5 Types of Maintenance, Need and importance of Record Keeping, List of Records to be kept in Service Stations 6.6 Site selection and amenities/facilities required to set up your own Garage/Service Station, Role and Responsibilities of Service Manager, Service Supervisor, Customer Care Manager in Service Stations.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Automobiles	08	02	04	04	10
II	Automobile Transmission Systems	10	02	04	08	14
III	Automobile Control Systems	08	02	02	06	10
IV	Automobile Suspension, Wheels and Tyres	08	02	04	06	12
V	Automobile Electrical and Electronics Systems	08	02	04	08	14
VI	Motor Vehicle Act, Road Safety and Garage Practices	06	02	04	04	10
Total		48	12	22	36	70

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare

reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a) Attend, observe and Prepare a brief report for Computerized Wheel alignment of vehicles with various types of suspension and steering system at nearby service station.
- b) Attend, Observe and Prepare a brief report for Computerized Wheel Balancing of Vehicles with static and dynamic conditions at nearby service station.
- c) Apply for the Learner's Licence. Fill online form and appear for Virtual Driving Test at RTO Office. Prepare a brief report on "Procedure of Issuing Driving Licence by RTO".
- d) Visit to nearby Authorised Service station preferably Four Wheelers/Heavy Vehicles and observe the organization structure, Different sections, Modern Tools and Equipments used, Records to be kept, Work Profile of Diploma Engineer in Service Station, and prepare a visit report with schematic layout and concluding remarks.
- e) Visit to nearby MSRTC Divisional Workshop/Depot, observe the organization structure, Work profile of Diploma Engineer, different Sections and systems, Service activities at Workshop and prepare a brief report with schematic layout and concluding remarks.
- f) Conduct a PUC test of 2/4 Wheeler on exhaust gas analyser according to M. V. Act and prepare a brief report on "Automobile Emission Norms in India".
- g) Visit to 2/3/4 Wheeler Automobile Manufacturer's, observe the Organization Structure, Different Sections, Work Profile of Diploma Engineer, Safety precautions to be followed and prepare a detail report with schematic layout.
- h) Attend an expert talk of RTO Officials in your city/town arrange by Department/Institute for your Class on following Topics;
 - i. Road Safety and Security:Challenges and Opportunity
 - ii. Motor Vehicle Act 1988 and CMV Rules 1989
 - iii. Career Opportunities to Mechanical Engineer in RTO Department.
 - iv. Disaster Management at Road Accidents.
 - v. Traffic Offences and penalties as per M.V. Act.
- i) Try to attend the event of "Indian Auto Expo" jointly organized by the Automotive Component Manufacturers Association (ACMA), Confederation of Indian Industry (CII) and Society of Indian Automobile Manufacturers (SIAM)]. Observe the various new production launches, their features and concepts behind design and technical specifications. Prepare a detailed report on visit and share the experience with colleagues.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) '**L**' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c) About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d) With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- e) Guide student(s) in undertaking micro-projects.
- f) Before starting practical, teacher should demonstrate the working of System.



- g) Instructions to students regarding care and maintenance of Model/Equipment.
- h) Show video/animation films to explain functioning of various Automobile Systems.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

- a) Prepare a chart of Symbolic representation of different electrical-electronic components used in automobiles. (e.g. Earthing, Fuse, Circuit Breaker, Capacitor, Resistor, Coil, Switch, Diode, Motor, Semi conductor etc.)
- b) Collect information of Chassis Specifications of different vehicles.
- c) Perform comparative study of different alternative fuels available in India.
- d) Visit to Modern Service Station and Prepare a Layout indicating various sections, Specialized Equipments, Machines and basic amenities provided.
- e) Prepare a case study on following topics related with Transport Management through Group Discussion:
 - i. Current Public Transport Scenerion in India
 - ii. RTO Policies for enhancing Road Safety
 - iii. Importance of Metro Rail in Rapid transiotion System
 - iv. Review of worldwide effective Rapid Transition Systems
 - v. (E.g. BRT System in Bogota, Singapore, Japan, Malesiya)
 - vi. Traffic crisis in Metro Cities: Causes and Cures
 - vii. Role of Motor Vehicle Department in Transport Management
- f) Information Search and Market Survey through Magazines like Overdrive, Autocar, Auto India, internet surfing and site visits on following topics:
 - i. Automobile Manufacturers in India.
 - ii. Aerodynamic Optimization in Automobiles.
 - iii. Current (Indian/Worldwide) Automobile Market of 2/4 Wheeler Industry.
 - iv. Upcoming vehicles on alterntive fuel sources in Indian Auto Industry.
 - v. Adaptive Suspension System
 - vi. On Board Diagnostics Systems (OBD-I/II)
- g) Prepare a Chart of road traffic signs in categories of Mandatory, Cautionary, Informatory. Display it to your Departmnet/Institute and make aware to your collegues for the same.
- h) Prepare a simple Automobile Lighting Circuit (2/4 Wheeler) Display and indicates the relevant cable color codes on it.
- i) Information Search and Market Review on “Different types of Automobile Service tools and Specialized Equipment and Machines” used in Modern Service Stations.
 - a. Prepare a report on Electric and Hybrid vehicles.



13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	A Text Book of Automobile Engineering	Rajput R. K.	Laxmi Publications Pvt. Ltd., New Delhi, (2008) ISBN: 97881170089919
2	Automobile Engineering	Kamaraju Ramakrishna	PHI Learning Pvt. Ltd., New Delhi, (2012) ISBN: 9788120346109.
3	Automobile Engineering (Vol I and II)	Dr. Kirpal Singh	Standard Publishers, New Delhi. (2004) ISBN: 9788180141034.
4	Automotive Mechanics	Crouse W.H., Anglin D.W.	Tata McGraw Hill Publications, Delhi (1965) ISBN: 978007070148215
5	Motor Vehicle Act, 1988	CMV Rules	Eastern Book Company, Mumbai, (1989) ISBN: 8171771629.
6	Compendium of Transport Terms	CIRT, Pune	Central Institute of Road Transport, (2007) CIRT Publications, Bhosari Pune
7	The Drivers Manual	Pasricha P.S.	Nasha Publications, (1994) Mumbai
8	Road Safety Guide	Pasricha P.S.	Nasha Publications, (1991) Mumbai
9	Automobile Electrical and Electronic Systems	Tom Denton	Elsevier Butterworth Heinemann, Oxford/ Routledge, (2013) ISBN: 9780750662192.
10	Indian Journal of Transport Management (Quarterly Published Journal)	IJTM, CIRT, Pune	Central Institute of Road Transport (CIRT), CIRT Publications, Bhosari, (1876, starting year) Pune ISSN: 0972-5695.

14. SUGGESTED VIDEOS AND LEARNING WEBSITES:

- a) <http://nptel.ac.in/courses>. (NPTEL)
- b) https://www.araiindia.com/Draft_AIS_Standards.asp. (ARAI, Pune)
- c) http://www.cirtindia.com/testing_universalTyreTestingMachine.html. (CIRT, Pune)
- d) www.pcraindia.org/pages/view/220. (PCRA, New Delhi)
- e) <https://www.saeindia.org/>. (SAE India)
- f) <https://transport.maharashtra.gov.in/1161/Road-Signs>. (RTO, M. V. Department, M.S.)
- g) <https://msrtc.maharashtra.gov.in/>. (MSRTC, M.S.)
- h) <https://www.howstuffworks.com>.
- i) <https://www.youtube.com/watch?v=Y1zbE21PzI0>. (Automatic Transmission)
- j) https://www.youtube.com/watch?v=u_y1S8C0Hmc. (Automatic Transmission)
- k) <https://www.youtube.com/watch?v=wCu9W9xNwtI>. (Manual Transmission)
- l) <https://www.youtube.com/watch?v=vOo3TLgL0kM>. (Manual Transmission)
- m) <https://www.youtube.com/watch?v=aNGA5Ejq8A4>. (Differential)
- n) <https://www.youtube.com/watch?v=VFu-6tckyc8>. (Rear Axle)
- o) <https://www.youtube.com/watch?v=IrBE8k9rlr8>. (Radial and Tubeless Tyre)
- p) https://www.youtube.com/watch?v=mLCG1_ecC3g. (Tubeless Tyre)
- q) <https://www.youtube.com/watch?v=wKwvObmidh0>. (Repair of Tubeless Tyre)
- r) <https://www.youtube.com/watch?v=LCMs-7K8nLk>. (Alloy Wheels)
- s) https://www.youtube.com/watch?v=hnsvkpOP8_g. (Alloy and Cast Wheel)
- t) https://www.youtube.com/watch?v=F6ZZ_U_F11Y. (Wheel Alignment)
- u) <https://www.youtube.com/watch?v=1k6Yh6FhHvE>. (Wheel and Tyre Animation)
- v) https://www.youtube.com/watch?v=bg92_ytLm0M. (Tyre Protector)
- w) <https://www.youtube.com/watch?v=LffD2xx-7uw>. (Repair of Tubeless Tyre)