

**Maharashtra State Board Of Technical Education, Mumbai**

**Learning and Assessment Scheme for Post S.S.C Diploma Courses**

<b>Programme Name</b>	: Diploma In Automobile Engineering.		
<b>Programme Code</b>	: AE	<b>With Effect From Academic Year</b>	: 2023-24
<b>Duration Of Programme</b>	: 6 Semester	<b>Duration</b>	: 16 WEEKS
<b>Semester</b>	: Fourth	<b>NCrF Entry Level</b>	: 3.5
		<b>Scheme</b>	: K

Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Paper Duration (hrs.)	Assessment Scheme									
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week			Theory			Based on LL & TL				Based on Self Learning		Total Marks
						CL	TL	LL					FA-TH	SA-TH	Total	Practical		SLA				
																FA-PR	SA-PR	Max	Min	Max	Min	

**(All Compulsory)**

1	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	314301	2	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	ADVANCED ENGINE TECHNOLOGIES	AET	DSC	314341	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
3	AUTOMOBILE MANUFACTURING PROCESSES	AMP	AEC	314342	2	4	-	4	-	8	4	3	30	70	100	40	25	10	25@	10	-	-	150
4	AUTOMOBILE SYSTEMS	ASY	DSC	314343	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
5	TWO AND THREE WHEELER TECHNOLOGIES	TTW	DSC	314344	2	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175
6	FUNDAMENTALS OF PYTHON PROGRAMMING	FPP	AEC	313007	-	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50
7	MECHANICAL MEASUREMENT	MME	AEC	314019	2	1	-	2	1	4	2	-	-	-	-	-	25	10	-	-	25	10	50
<b>Total</b>					<b>8</b>	<b>19</b>		<b>14</b>	<b>7</b>		<b>20</b>		<b>150</b>	<b>350</b>	<b>500</b>		<b>150</b>		<b>125</b>		<b>125</b>		<b>900</b>

**Abbreviations :** CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

**Legends :** @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

**Note :**

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**Course Category :** Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

<b>Programme Name/s</b>	<b>: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil &amp; Rural Engineering/ Construction Technology/ Computer Science &amp; Engineering/ Fashion &amp; Clothing Technology/ Dress Designing &amp; Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics &amp; Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics &amp; Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware &amp; Maintenance/ Instrumentation &amp; Control/ Industrial Electronics/ Information Technology/ Computer Science &amp; Information Technology/ Instrumentation/ Interior Design &amp; Decoration/ Interior Design/ Civil &amp; Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics &amp; Computer Engg./ Travel and Tourism/ Textile Manufactures/</b>
<b>Programme Code</b>	<b>: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX</b>
<b>Semester</b>	<b>: Fourth</b>
<b>Course Title</b>	<b>: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY</b>
<b>Course Code</b>	<b>: 314301</b>

**I. RATIONALE**

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

## II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

## III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.
- CO5 - Implement the environmental policies under the relevant legal framework.

## IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TL				Based on SL		Total Marks	
				CL	TL	LL					Total	Practical		SLA							
							FA-TH	SA-TH				FA-PR	SA-PR	Max	Min	Max	Min				
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

**Total IKS Hrs for Sem. : 2 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
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3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

## **V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's)aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
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<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
1	<p>TLO 1.1 Explain the need of studying environment and its components.</p> <p>TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions</p> <p>TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation</p> <p>TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change</p> <p>TLO 1.5 Explain the concept of zero carbon-footprint with carbon credit</p>	<p><b>Unit - I Environment and climate change</b></p> <p>1.1 Environment and its components, Types of Environments, Need of environmental studies</p> <p>1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization</p> <p>1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste</p> <p>1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on Climate Change in Indian perspectives</p> <p>1.5 Zero Carbon footprint for sustainable development, (IKS-Environment conservation in vedic and pre-vedic India)</p>	Lecture Using Chalk-Board Presentations

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
2	<p>TLO 2.1 Justify the importance of natural resources in sustainable development</p> <p>TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability</p> <p>TLO 2.3 Differentiate between renewable and non-renewable sources of energy</p> <p>TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues</p>	<p><b>Unit - II Sustainability and Renewable Resources</b></p> <p>2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS-Concepts of Panchmahabhuta)</p> <p>2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources</p> <p>2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel</p> <p>2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy &amp; Tidal energy</p>	Lecture Using Chalk-Board Presentations
3	<p>TLO 3.1 Explain the characteristics and functions of ecosystem</p> <p>TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability</p> <p>TLO 3.3 Describe biodiversity assessment initiatives in India</p> <p>TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India</p> <p>TLO 3.5 Explain the need of conservation of biodiversity in the given situation</p>	<p><b>Unit - III Ecosystem and Biodiversity</b></p> <p>3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem</p> <p>3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity</p> <p>3.3 Biodiversity Assessment Initiatives in India</p> <p>3.4 SWOT analysis of biodiversity hot spot in India</p> <p>3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity</p>	Lecture Using Chalk-Board Presentations Video Demonstrations

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
4	<p>TLO 4.1 Classify the pollution based on the given criteria</p> <p>TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques</p> <p>TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures</p> <p>TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms</p> <p>TLO 4.5 Compare the noise level from different zones of city with justification</p> <p>TLO 4.6 Describe the roles and responsibilities of central and state pollution control board</p>	<p><b>Unit - IV Environmental Pollution</b></p> <p>4.1 Definition of pollution, types- Natural &amp; Artificial (Man- made)</p> <p>4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation</p> <p>4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation</p> <p>4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential area</p> <p>4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city</p> <p>4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities</p>	Lecture Using Chalk-Board Presentations
5	<p>TLO 5.1 Explain Constitutional provisions related to environmental protection</p> <p>TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws</p> <p>TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental problem</p> <p>TLO 5.4 Explain the role of information technology in environment protection</p>	<p><b>Unit - V Environmental legislation and sustainable practices</b></p> <p>5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts</p> <p>5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs</p> <p>5.3 Green technologies like solar desalination, green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging</p> <p>5.4 Role of information technology in environment protection and human health</p>	Lecture Using Chalk-Board Presentations Video Demonstrations

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.****VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)****Assignment**

- Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution
- Draft an article on India's Strategies to progress across the Sustainable Development Goals
- Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each source
- Conduct the SWOT analysis of biodiversity hotspot in India
- Prepare a mind-mapping for the zero carbon footprint process of your field
- Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions
- Any other assignment on relevant topic related to the course suggested by the facilitator

**UNICEF Certification(s)**

- Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal [www.mahayouthnet.in](http://www.mahayouthnet.in) . The course encompasses five Modules in the form of Units as given below: -

Unit 1: Living with climate change

Unit 2 : Water Management and Climate Action

Unit 3: Energy Management and Climate Action

Unit 4 : Waste Management and Climate Action

Unit 5 : Bio-cultural Diversity and Climate Action

If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

**Micro project**



- Technical analysis of nearby commercial RO plant.  
Comparative study of different filters used in Household water filtration unit  
Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainability and cost-benefit  
IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion  
Visit a local polluted water source and make a report mentioning causes of pollution  
Any other activity / relevant topic related to the course suggested by the facilitator

**Activities**

- Prepare a report on the working and functions of the PUC Center machines and its relevance in pollution control.  
Prepare and analyse a case study on any polluted city of India  
Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local authority  
Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers  
Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool  
Watch a video related to air pollution in India and present the summary  
Any other assignment on relevant topic related to the course suggested by the facilitator
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**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	Nil	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

<b>Sr.No</b>	<b>Unit</b>	<b>Unit Title</b>	<b>Aligned COs</b>	<b>Learning Hours</b>	<b>R-Level</b>	<b>U-Level</b>	<b>A-Level</b>	<b>Total Marks</b>
1	I	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Environmental legislation and sustainable practices	CO5	7	4	4	4	12
<b>Grand Total</b>				<b>45</b>	<b>20</b>	<b>24</b>	<b>26</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Two-unit tests (MCQs) of 30 marks will be conducted and average of two-unit tests considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as UNICEF Certification(s)/Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

**Summative Assessment (Assessment of Learning)**

- Online MCQ type Exam

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	-	1	-	-	3	2	3			
CO2	-	2	2	-	3	2	3			
CO3	-	-	-	-	3	1	2			
CO4	1	-	-	-	3	2	2			

**ENVIRONMENTAL EDUCATION AND SUSTAINABILITY****Course Code : 314301**

CO5	1	-	2	-	3	2	3			
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Legends :- High:03, Medium:02,Low:01, No Mapping: -

\*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Environmental science	APH Publishing New Delhi (ISBN 978-8176485906)

**XIII. LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
1	<a href="https://sdgs.un.org/goals">https://sdgs.un.org/goals</a>	United Nation's website mentioning Sustainability goals
2	<a href="http://www.greenbeltmovement.org/news-and-events/blog">http://www.greenbeltmovement.org/news-and-events/blog</a>	Green Belt Movement Blogs on various climatic changes and other issues
3	<a href="http://www.greenbeltmovement.org/what-we-do/tree-planting-for-watersheds">http://www.greenbeltmovement.org/what-we-do/tree-planting-for-watersheds</a>	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques
4	<a href="https://www.youtube.com/@ierekcompany/videos">https://www.youtube.com/@ierekcompany/videos</a>	International Experts For Research Enrichment and Knowledge Exchange –IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	<a href="http://www.mahayouthnet.in">www.mahayouthnet.in</a>	UNICEF Initiative for youth leadership for climate action

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
6	<a href="https://eepmoefcc.nic.in/index1.aspx?lsid=297&amp;lev=2&amp;lid=1180&amp;langid=1">https://eepmoefcc.nic.in/index1.aspx?lsid=297&amp;lev=2&amp;lid=1180&amp;langid=1</a>	GOI Website for public awareness on environmental issues
7	<a href="https://egyankosh.ac.in/handle/123456789/61136">https://egyankosh.ac.in/handle/123456789/61136</a>	IGNOU's Initiative for online study material on Environmental studies
8	<a href="https://egyankosh.ac.in/handle/123456789/50898">https://egyankosh.ac.in/handle/123456789/50898</a>	IGNOU's Initiative for online study material on sustainability
9	<a href="https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf">https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf</a>	Final list of proposed Sustainable Development Goal indicators
10	<a href="https://sustainabledevelopment.un.org/memberstates/india">https://sustainabledevelopment.un.org/memberstates/india</a>	India's Strategies to progress across the SDGs.
11	<a href="https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html">https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html</a>	Challenges to Sustainable Development
12	<a href="https://nptel.ac.in/courses/109105190">https://nptel.ac.in/courses/109105190</a>	NPTEL course on sustainable development
13	<a href="https://onlinecourses.swayam2.ac.in/cec19_bt03/preview">https://onlinecourses.swayam2.ac.in/cec19_bt03/preview</a>	Swayam Course on Environmental studies (Natural Resources, Biodiversity and other topics)
14	<a href="https://onlinecourses.nptel.ac.in/noc23_hs155/preview">https://onlinecourses.nptel.ac.in/noc23_hs155/preview</a>	NPTEL course on environmental studies which encompasses SDGs, Pollution, Climate issues, Energy, Policies and legal framework
15	<a href="https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf">https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf</a>	SWOT analysis of Biodiversity
16	<a href="https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf">https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf</a>	Central Sanskrit University publication on Vedic and pre-Vedic environmental conservation

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

**MSBTE Approval Dt. 21/11/2024**

**Semester - 4, K Scheme**

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<b>Programme Name/s</b>	<b>: Automobile Engineering.</b>
<b>Programme Code</b>	<b>: AE</b>
<b>Semester</b>	<b>: Fourth</b>
<b>Course Title</b>	<b>: ADVANCED ENGINE TECHNOLOGIES</b>
<b>Course Code</b>	<b>: 314341</b>

### **I. RATIONALE**

This course explores advanced engine technologies that power modern vehicles. Students will gain comprehensive insights into the components of fuel supply systems and combustion process in petrol and diesel engines. Additionally, they acquire insights into digitally controlled engines, alternative energy sources and air pollution and emission control. This course integrates laboratory practice work focusing on component identification, inspection and maintenance of engine and other systems, to ensure optimal engine performance. This course is also prerequisite for the course ‘Vehicle Systems Maintenance’.

### **II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Maintain advanced automotive engines.

### **III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Detect abnormal combustion in I.C. engine.
- CO2 - Use diagnostic equipment for effective engine fuel management.
- CO3 - Apply the fundamental principles of advanced technology for better engine performance
- CO4 - Perform I.C. engine test
- CO5 - Apply basic concepts of emission control to reduce automotive pollution.

### **IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

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Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
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							Max	Min						Max	Min	Max	Min	Max		Min	
314341	ADVANCED ENGINE TECHNOLOGIES	AET	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25@	10	25	10	175

**Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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## V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
1	<p>TLO 1.1 Select fuel for the given application/ engine for better performance.</p> <p>TLO 1.2 Construct fuel supply system layout for gaseous fuel.</p> <p>TLO 1.3 Describe the procedure to locate leakage in gaseous fuel supply system of the given type of engine.</p> <p>TLO 1.4 Identify factors responsible for abnormal combustion in the given engine.</p>	<p><b>Unit - I Engine Combustion and Alternative Fuels</b></p> <p>1.1 Combustion in S.I. and C.I. Engines: Ignition limits, Air Fuel ratio in Petrol and Diesel engines, Stages of combustion in SI engine, I- head combustion chamber, Detonation and its control, Stages of combustion in CI engine, Diesel knock and its control, DI and IDI combustion chambers.</p> <p>1.2 Properties of various fuels used in IC engines- Gasoline, Diesel, LPG, CNG, Hydrogen, Alcohol, Bio diesel.</p> <p>1.3 Alternative Fuels for SI and CI engines- LPG, CNG, Alcohol, Bio- diesel (Merits and demerits with respect to performance and emission), CNG conversion kit block diagram. Leak detection procedure.</p>	<p>Lecture Using Chalk-Board Presentations, Model Demonstration, Video Demonstrations.</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Explain function, location and working of component of given fuel supply system.</p> <p>TLO 2.2 Describe the steps to scan the faults of the given MPFI engine.</p> <p>TLO 2.3 Explain with sketch operation of the given component of CRDI system.</p> <p>TLO 2.4 State manufacturer's diagnostic procedure to diagnose the given fault in CRDI system using scan tools.</p> <p>TLO 2.5 Interpret the given fault codes for the CRDI engine using scanner.</p>	<p><b>Unit - II Engine Fuel Management</b></p> <p>2.1 Fuel Management in S.I. engines: Throttle body injection (TBI) and Port fuel injection (PFI) systems; Methods of fuel Injection: Sequential, Continuous, grouped, simultaneous injection.</p> <p>2.2 Sensors and Actuators of MPFI engine. Pressure regulators, fuel injector, and fuel pump.</p> <p>2.3 Electronic Control Module: Input and output control functions as fuel injection, idle speed control, EGR, canister purge.</p> <p>2.4 Diagnostic procedure of MPFI system: Use of Scan tool and reading fault codes .</p> <p>2.5 Fuel Management in C.I. engines: Common Rail Direct Injection system: Major Components- Solenoid operated Fuel injector, High pressure fuel pump, High pressure accumulator.</p> <p>2.6 CRDI System operation and advantages.</p> <p>2.7 Diagnostic procedure of CRDI system; Use of Scan tool and reading fault codes.</p> <p>2.8 Glow plugs: Construction, Circuit and operation of glow plug and its control unit.</p>	<p>Lecture Using Chalk-Board Presentations, Model Demonstration, Video Demonstrations.</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	<p>TLO 3.1 Describe advanced features of the given turbocharger.</p> <p>TLO 3.2 Select the engine with technology/ features suitable for the given application.</p> <p>TLO 3.3 Compare the salient features of the given turbochargers.</p> <p>TLO 3.4 List the salient features of the given injection system.</p> <p>TLO 3.5 State the merits and demerits of using supercharger in S.I. engine</p>	<p><b>Unit - III Advances in Automobile Engines</b></p> <p>3.1 Turbocharger with wastegate boost control and its limitations .</p> <p>3.2 Variable Geometric Turbocharger (VGT).</p> <p>3.3 Variable Valve Timing mechanism (VVT).</p> <p>3.4 Gasoline Direct Injection (GDI) and Stratified-charge injection.</p> <p>3.5 Supercharger.</p>	<p>Lecture Using Chalk-Board Presentations, Model Demonstration, Video Demonstrations.</p>
4	<p>TLO 4.1 Interpret the given engine performance parameters and their implications.</p> <p>TLO 4.2 Explain with sketches the working principle of the given type of dynamometer.</p> <p>TLO 4.3 Calculate engine Performance parameters for the given situation.</p> <p>TLO 4.4 Prepare heat balance sheet for the given situation.</p>	<p><b>Unit - IV Engine Performance</b></p> <p>4.1 Engine Performance parameters. Definitions: Indicated Power, Brake Power and Frictional Power; Efficiencies - Air standard, Mechanical, Brake Thermal, Indicated Thermal, Volumetric and Relative.</p> <p>4.2 Dynamometers and engine testing: Working Principle and types of Dynamometers: Hydraulic and Eddy current. Engine Testing: Morse Test, Willian's line Method for finding Frictional Power. Heat balance sheet and Method of calculating Volumetric Efficiency and Fuel Consumption.</p>	<p>Lecture Using Chalk-Board Presentations, Model Demonstration, Video Demonstrations.</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	<p>TLO 5.1 State the properties of the exhaust emission for the given engine.</p> <p>TLO 5.2 Explain with sketch method of emission control for the given engine.</p> <p>TLO 5.3 Tabulate prevailing Bharat Stage (BS) norms for given vehicle.</p>	<p><b>Unit - V Fuel Economy and Emission control</b></p> <p>5.1 Fuel economy and methods of improving fuel economy.</p> <p>5.2 Petrol engine emission and its control: Pollutants from petrol engine. Engine design modification, treatment of exhaust gas-Catalytic Converter; fuel modification. Positive crankcase ventilation (PCV) system; Evaporation emission control system.</p> <p>5.3 Diesel Engine emission and its control: Diesel engine pollutants, diesel smoke and control. Exhaust-Gas recirculation (EGR) – EGR valve and control system; Selective Catalytic Reduction.</p> <p>5.4 Emission Norms for two, three and four-wheeler engines.</p>	<p>Lecture Using Chalk-Board Presentations, Model Demonstration, Video Demonstrations.</p>

## VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
<p>LLO 1.1 Identify the type of combustion chamber.</p> <p>LLO 1.2 Sketch combustion chamber showing position of valves, injector/ spark plug.</p>	1	* Condition monitoring of combustion chamber of a multicylinder S.I. / C.I. Engine.	2	CO1
<p>LLO 2.1 Locate LPG system leakage using soap bubble test/ combustible gas leak detector sensor.</p> <p>LLO 2.2 Repair or replace leaking component.</p> <p>LLO 2.3 Recheck for leakage</p>	2	Test the LPG system for leakage.	1	CO1
<p>LLO 3.1 Identify and locate the various sensors on vehicle engine.</p> <p>LLO 3.2 Diagnose any one of the sensors for functionality (standalone diagnosis as per service manual)</p>	3	* Diagnosis of the functionality of various sensors in the MPFI engine.	2	CO2 CO3

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<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 4.1 Check fuel filter for contamination LLO 4.2 Inspect the MPFI engine fuel pump inlet for dirt and debris LLO 4.3 Check all fuel hoses and tubing on the fuel pump assembly for leakage LLO 4.4 Reassemble the fuel feed pump	4	Dismantle and assemble electrical fuel feed pump of the MPFI System	2	CO2 CO3
LLO 5.1 Connect Scan tool to MPFI engine control unit and enter vehicle identification data. LLO 5.2 Interpret the trouble code/s. LLO 5.3 Inspect relevant transducer and wiring. LLO 5.4 Rectify fault and clear diagnostic trouble code	5	Diagnosis of MPFI engine using engine scanner.	2	CO2 CO3
LLO 6.1 Identify and locate the position of CRDI system components LLO 6.2 Sketch relevant components and their connections. LLO 6.3 Check electrical connections and pipelines for leakage	6	* Identification of different components of the Common Rail Direct Injection (CRDI) System.	2	CO2 CO3
LLO 7.1 Detect fault using scanner LLO 7.2 Replace faulty sensor, actuator or ECU as required. LLO 7.3 Perform onboard diagnostics on CRDI engine.	7	Diagnosis of CRDI engine.	2	CO2 CO3
LLO 8.1 Diagnose CRDI ECU using scan tool. LLO 8.2 Replace malfunctioning components LLO 8.3 Check the system for smooth operation.	8	Servicing of the CRDI engine	2	CO2 CO3

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<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 9.1 Locate glow plug/s. LLO 9.2 Test glow plug LLO 9.3 Check glow plug operation	9	Glow Plug Testing	1	CO2
LLO 10.1 Check Engine fuel consumption LLO 10.2 Calculate power output and heat losses for different engine loads LLO 10.3 Draw heat balance sheet	10	* Engine Performance Testing	4	CO4
LLO 11.1 Calculate power output of engine LLO 11.2 Record power output with cylinders cut off LLO 11.3 Find mechanical efficiency of engine	11	* Measurement of mechanical efficiency of an engine using Morse Test	2	CO4
LLO 12.1 Check pollutants from S.I. engine using emission test equipment for S.I. engine. LLO 12.2 Tune engine to contain pollutants as per relevant pollution norms. LLO 12.3 Recheck the pollutants to meet norms	12	* Diagnosis of S.I. engine condition using Exhaust gas Analyzer	2	CO5
LLO 13.1 Check pollutants from C.I. engine using emission tester for diesel engine. LLO 13.2 Check injector for spray pattern. LLO 13.3 Recheck pollutants to meet norms.	13	Diagnosis of C. I. engine condition using Exhaust gas Analyzer	2	CO5
LLO 14.1 Locate EGR valve connecting induction and exhaust system LLO 14.2 Test EGR valve diaphragm LLO 14.3 Test EGR valve stem for operation LLO 14.4 Test EGR valve operation	14	* Functionality testing of EGR system of an engine	2	CO5

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 15.1 Locate PCV Valve on engine LLO 15.2 Carry out rattle test and vacuum test on PCV valve. LLO 15.3 Check PCV valve for operation after cleaning it.	15	* Test the PCV system of an engine	2	CO5
<b>Note : Out of above suggestive LLOs -</b>				
<ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

## **VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

### **Micro project**

- Prepare a report on Turbocharger/ VGT/ VVT/ GDI/ supercharger including components, function, merits, demerits and performance.
- Prepare a report on specifications, standard operating procedure and application of Scan tool for On board diagnosis.
- List tools, steps in diagnosis and precautions taken during MPFI/ CRDI engine system using service manual or an OEM video.
- Prepare a report on power measurement by using a dynamometer.
- Prepare a report on LPG/ CNG Kit including components, function, merits, cost and performance.
- Prepare a comparison chart of alternative and conventional fuels for I.C. engines.
- Identify, sketch and compare combustion chambers of 4 different S.I. and C.I. engines
- Prepare a report on methods to improve fuel economy of an engine
- Prepare a report on methods to control engine emission including EGR system/ PCV system/ Catalytic converter/ Selective Catalytic Reduction.

### **Assignment**

- Compare I.C. engine fuels on the basis of properties, performance and emission.
- List the make and model of car using the following technologies: VVT, VGT, GDI and supercharging. State the merits of the technologies incorporated in particular models
- Describe set up of engine test rig with specification of major components. List the formulae used in heat balance sheet.
- Prepare a chart showing advance technologies used in four cars available in market.
- Compare European and Indian emission norms for various vehicle categories.

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	Special purpose tools (internal and external circlip plier, Valve lifter, feeler gauge Torque wrench)- Torque wrench range- 10 Nm to 200Nm., Vacuum gun with gauge, Mechanical (Diesel) fuel Injector-Tester	1,2,3,4,6,9,14
2	General purpose tools (Spanners, ring spanner and socket- 6mm to 32 mm), screw driver set- flat head and Philips head	1,2,3,7,8,9,12,13,14,15



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<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
3	Four-stroke S.I. and C.I. engines: Make: Maruti/ Greaves Cotton/ Tata and alike, Power: 25 kW to 100 kW, Cubic Capacity: 800 CC to 2500CC	1,9
4	Multicylinder engine test rig with dynamometer; Morse test Arrangement	10,11
5	A car equipped with Liquified Petroleum Gas/ Compressed Natural Gas fuel supply system; Make: Maruti/ Hyundai; Power: up to 40 kW; Cubic Capacity: 800cc; Fuel: LPG/ Petrol; Make: Maruti; Power: up to 65 kW; Cubic capacity: 800 to 1350 cc; Fuel: CNG	2
6	Digital Multimeter: LCD Display, 0 to 50°C Operating Temperature, DC voltage- 200mV to 1000 V DC, 2 to 1000 V Alternating Current, Current: 2mA to 20 A DC, Diode Test, Continuity Test- Audible buzzer, Resistance: 200 ? to 200 M?	3
7	Car having Multiport Fuel Injection engine with sensors, actuators and Electronic Control Module, Exhaust Gas Regulation valve and Positive Crankcase Ventilation valve; Make: Maruti/ Tata/ Ford/ Honda/ Hindustan Motors and alike Power: 25 kW @ 5000 rpm to 55kW@ 5000 rpm, Cubic Capacity: 800 CC to 2000 CC	3,4,5
8	Scan tool: Make: BOSCH and alike; On Board Diagnostics (OBD) Scan Tool compatible with vehicle available in laboratory, Controller area network enabled, Colour Display, Operating Temperature: 0 to 50°C, Internal Storage: 4 AAA batteries, External Power: 7 to 18 volts; Generic tool; Accessories: Extender cable, OBD II Cable; Relevant optional accessories.	5,7,8
9	Vehicle having Common Rail Direct Injection Engine with sensors, actuators and Electronic Control Module: Make: Fiat/ Hyundai/ Tata/ Honda and alike; Cubic Capacity: up to 2200 cc; Power: up to 100 kW @ 4000 rpm.	6,7,8

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

<b>Sr.No</b>	<b>Unit</b>	<b>Unit Title</b>	<b>Aligned COs</b>	<b>Learning Hours</b>	<b>R-Level</b>	<b>U-Level</b>	<b>A-Level</b>	<b>Total Marks</b>
1	I	Engine Combustion and Alternative Fuels	CO1	10	6	6	0	12
2	II	Engine Fuel Management	CO2	22	2	12	8	22
3	III	Advances in Automobile Engines	CO3	8	2	4	6	12
4	IV	Engine Performance	CO4	8	2	4	6	12

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Fuel Economy and Emission control	CO5	12	2	4	6	12
<b>Grand Total</b>				<b>60</b>	<b>14</b>	<b>30</b>	<b>26</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- class tests, term work , self learning

**Summative Assessment (Assessment of Learning)**

- end semester examination ( Theory) , practical performance

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	2	-	3			
CO2	3	3	3	3	3	-	3			
CO3	3	2	2	2	2	-	2			

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CO4	3	2	2	3	2	2	2			
CO5	3	3	2	3	3	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

\*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	V.A.W Hiller	Hiller's Fundamentals of Motor Vehicle Technology -Book 1	Nelson Thrones Ltd UK Sixth Edition 16/10987654321
2	Jack Erjavec	Automotive Technology A systems Approach 5th Edition	Delmar Cengage Learning ISBN-13: 978- 1428311497
3	James D. Halderman	Automotive Technology Principles, Diagnosis and Service 4th Edition	Prentice Hall ISBN-13: 978-0-13-254261-6
4	M.L.Mathur and S.C.Sharma	Internal Combustion Engines	Dhanpat rai Publications ISBN 978- 9383182428
5	V.Ganesan	Internal Combustion Engines	McGraw Hill Education ISBN 978- 1259006197
6	K.K. Jain & R B Asthana	Automobile Engineering	McGraw Hill India ISBN 978-0070445291

**XIII. LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
1	<a href="https://www.youtube.com/watch?v=_lqBLu1zBhU">https://www.youtube.com/watch?v=_lqBLu1zBhU</a>	Delphi Common Rail Diesel pump Autopsy Pt2 -Hyundai Terracan and Kia K2700 pump
2	<a href="https://www.youtube.com/watch?v=wJjVMi1oybM">https://www.youtube.com/watch?v=wJjVMi1oybM</a>	Diesel Engine Maintenance Tip 3: How to Remove Crank Position Sensor Wire
3	<a href="https://www.youtube.com/watch?v=85IP8eY1nXY">https://www.youtube.com/watch?v=85IP8eY1nXY</a>	Diesel Pressure Sensor Testing
4	<a href="https://www.youtube.com/watch?v=jDp6lEA8ETs">https://www.youtube.com/watch?v=jDp6lEA8ETs</a>	Lovato Gas LPG systems for vehicles installation training

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
5	<a href="https://dannysengineportal.com/exhaust-gas-recirculation-egr-valve-types-failure-replacement/">https://dannysengineportal.com/exhaust-gas-recirculation-egr-valve-types-failure-replacement/</a>	Exhaust Gas Recirculation – Types, Failure, Cleaning, Replacement
6	<a href="https://www.aalcar.com/library/pcv.htm">https://www.aalcar.com/library/pcv.htm</a>	The Basics of Positive Crankcase Ventilation (PCV)
7	<a href="https://www.youtube.com/watch?v=_vAtjLil5Y0">https://www.youtube.com/watch?v=_vAtjLil5Y0</a>	MAP Sensor & Wiring Diagram
8	<a href="https://www.youtube.com/watch?v=zOM5o6ltxME">https://www.youtube.com/watch?v=zOM5o6ltxME</a>	Electric Fuel Pump
9	<a href="https://www.youtube.com/watch?v=JtYMRrUpZr0">https://www.youtube.com/watch?v=JtYMRrUpZr0</a>	Toyota Corolla Fuel Pump Removal Sending Unit Testing
10	<a href="https://www.youtube.com/watch?v=fUZVKFT-U9k">https://www.youtube.com/watch?v=fUZVKFT-U9k</a>	Electric Fuel Pump Comparison   GM OE Fuel Pumps

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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**AUTOMOBILE MANUFACTURING PROCESSES****Course Code : 314342**

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<b>Programme Name/s</b>	<b>: Automobile Engineering.</b>
<b>Programme Code</b>	<b>: AE</b>
<b>Semester</b>	<b>: Fourth</b>
<b>Course Title</b>	<b>: AUTOMOBILE MANUFACTURING PROCESSES</b>
<b>Course Code</b>	<b>: 314342</b>

**I. RATIONALE**

The automobile manufacturing industry is constantly upgrading to keep up with new trends and technologies. Therefore, students pursuing diploma engineering must stay abreast of these advancements in manufacturing technologies. This course equips students with the knowledge of various manufacturing processes employed in producing vehicle components. It enables them to select appropriate materials, tools, and practices for working in a plant setting, while also fostering a strong awareness of safety protocols through hands-on experience with CNC machine tools.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Use various manufacturing processes for producing given automobile components.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select suitable material for manufacturing of specific automobile component
- CO2 - Choose an appropriate heat treatment process for the given automobile component.
- CO3 - Prepare raw material for powder metallurgy and plastic processing applications
- CO4 - Use relevant surface processing operation for a given automobile component
- CO5 - Execute CNC part program for the given automobile components.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

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**AUTOMOBILE MANUFACTURING PROCESSES****Course Code : 314342**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL		Based on SL		Total Marks		
				CL	TL	LL					Total	Practical		SLA							
							FA-TH	SA-TH				FA-PR	SA-PR	Max	Min	Max	Min				
314342	AUTOMOBILE MANUFACTURING PROCESSES	AMP	AEC	4	-	4	-	8	4	3	30	70	100	40	25	10	25@	10	-	-	150

**Total IKS Hrs for Sem. : 2 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
1	<p>TLO 1.1 Identify the properties, grades/designation of the given material with justification.</p> <p>TLO 1.2 Identify ferrous metal for the given automobile component with justification.</p> <p>TLO 1.3 Identify non-ferrous metal for the given automobile component with justification.</p> <p>TLO 1.4 Describe applications of the given materials in the given types of automobiles.</p> <p>TLO 1.5 Describe applications of the GRP in the given types of automobiles.</p> <p>TLO 1.6 Describe applications of the titanium and magnesium alloys in the given types of automobiles.</p>	<p><b>Unit - I Engineering Materials</b></p> <p>1.1 Introduction: Need of advanced materials in automobile sector. Classification of engineering materials. Ferrous metals and their alloys: Cast iron: types, composition and applications. Plain carbon steel: types, composition and applications</p> <p>1.2 Alloy Steels: Alloy steels, their composition and Application. Effects of alloying elements on the properties of steel.</p> <p>1.3 Non-ferrous metals and their alloys: Aluminium and its alloys their composition, properties and applications. Copper and its alloys their composition, properties and applications.</p> <p>1.4 Magnesium alloys: Properties and applications Titanium alloys: Properties and applications.</p> <p>1.5 Other materials: Polymeric materials- properties and applications; Thermoplastics- Thermosetting Plastics-Epoxy resins and Polyesters.</p> <p>1.6 Rubber – Natural and synthetic Ceramic materials: Properties and application in automotive industry; Composites: Properties and applications of Glass fiber (GRP/GFRP), Carbon fiber (CRP/CFRP)</p>	<p>Presentations, Case Study, Collaborative learning, Lecture Using Chalk-Board, Cooperative Learning,</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Interpret the given Iron-iron carbide (Fe-Fe<sub>3</sub>C) equilibrium diagram.</p> <p>TLO 2.2 Describe with sketches the given type of heat treatment process and its application.</p> <p>TLO 2.3 Differentiate the features of the given heat treatment processes.</p> <p>TLO 2.4 Select the relevant heat treatment process for the given automobile component with justification.</p>	<p><b>Unit - II Heat Treatment</b></p> <p>2.1 Introduction: Concept of phase and phase transformations, phase Cooling curve for pure iron, Iron-Iron carbide (Fe-Fe<sub>3</sub>C) equilibrium diagram. CCT and TTT diagrams. Need of heat treatment.</p> <p>2.2 Common heat treatment processes and their applications in Automobile sector: Annealing, Normalizing, Hardening, Tempering, Surface hardening processes: Case carburizing, Nitriding, Cyaniding, Induction and Flame hardening.</p>	<p>Lecture Using Chalk-Board Video Demonstrations, Collaborative learning, Presentations.</p>
3	<p>TLO 3.1 Describe various processes used for production of metallic powder.</p> <p>TLO 3.2 Enlist advantages and disadvantages of powder metallurgy.</p> <p>TLO 3.3 Describe extrusion process of plastics.</p> <p>TLO 3.4 Describe with relevant examples of industrial applications of Transfer molding.</p> <p>TLO 3.5 Differentiate between plunger and screw Injection molding machines.</p> <p>TLO 3.6 Compare Blow molding and transfer molding.</p>	<p><b>Unit - III Powder Metallurgy and plastic processing</b></p> <p>3.1 Powder Metallurgy: Introduction.</p> <p>3.2 Production of metallic powder.</p> <p>3.3 Processing methods.</p> <p>3.4 Advantages, Disadvantages and applications.</p> <p>3.5 Secondary operations.</p> <p>3.6 Plastic processing-Extrusion of plastics.</p> <p>3.7 Injection molding – Plunger and screw machines.</p> <p>3.8 Compression molding Transfer and Blow molding – Typical industrial applications.</p>	<p>Video Demonstrations, Lecture Using Chalk-Board, Demonstration, Presentations.</p>



<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
4	<p>TLO 4.1 Select the relevant surface cleaning process for the given material(s).</p> <p>TLO 4.2 Explain with sketches the relevant surface coating process for the given component.</p> <p>TLO 4.3 Describe various types of mechanical and chemical cleaning processes.</p> <p>TLO 4.4 Explain with sketches the relevant surface finishing process for the given component with justification.</p> <p>TLO 4.5 Enlist applications of various surface processing operations.</p>	<p><b>Unit - IV Surface Processing Operations</b></p> <p>4.1 Surface cleaning processes- acid, alkaline, electrolytic cleaning, blasting and tumbling.</p> <p>4.2 Metallic surface coating- Electroplating, Galvanizing, metal spraying, painting process, powder coating.</p> <p>4.3 Surface finishing processes: Lapping, honing, super finishing, polishing, buffing, burnishing and their applications.</p>	<p>Presentations, Lecture Using Chalk-Board, Video Demonstrations, Collaborative learning.</p>

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
5	<p>TLO 5.1 Describe the functions of the various element(s) of the CNC Machine.</p> <p>TLO 5.2 Interpret the given CNC part programming code(s).</p> <p>TLO 5.3 Prepare part programme using G and M codes for the given automobile component.</p> <p>TLO 5.4 Explain the function of ATC and APC.</p>	<p><b>Unit - V CNC Machines and Part Programming</b></p> <p>5.1 CNC machines: Types, classification, working and constructional features, advantages, limitations.</p> <p>5.2 Elements of CNC machines - Types, sketch, working and importance of: Automatic tool changer (ATC), Automatic pallet changer (APC).</p> <p>5.3 Definition and importance of various positions like machine zero, home position, work piece zero and programme zero.</p> <p>5.4 CNC part programming: programming format and structure of part programme.</p> <p>5.5 ISO G and M codes for turning and milling-meaning and applications and important codes.</p> <p>5.6 Simple Part programming as per ISO codes on CNC and VMC for operations like turning, drilling and Milling.</p>	<p>Presentations, Lecture Using Chalk-Board, Video Demonstrations, Collaborative learning.</p>

## **VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
<p>LLO 1.1 Identify the material of given automobile components.</p> <p>LLO 1.2 Distinguish in ferrous and non-ferrous materials as per their characteristic features.</p>	1	*Identification of materials of automobile components	2	CO1
<p>LLO 2.1 Identify at least five automobile polymer material components.</p> <p>LLO 2.2 Distinguish in plastic and rubber materials as per their characteristic features.</p>	2	Collection of different polymers components used in a vehicle.	2	CO1

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<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 3.1 Select suitable equipment for given heat treatment. LLO 3.2 Interpret metallurgical changes in given component.	3	Annealing process of plain carbon steel	4	CO2
LLO 4.1 Select suitable equipment for given heat treatment. LLO 4.2 Measure hardness of given sample before and after process	4	* Hardening (Quenching) process of plain carbon steel	4	CO2
LLO 5.1 Select suitable equipment for given heat treatment. LLO 5.2 Choose suitable process parameters for given process.	5	Tempering process of plain carbon steel	4	CO2
LLO 6.1 Select suitable tools used to produce the metal powder LLO 6.2 Distinguish between different powder production methods.	6	*Production of aluminium metal powder.	4	CO3
LLO 7.1 Interpret the specification of given blow molding machine LLO 7.2 Identify various components. LLO 7.3 Prepare a detail report on blow molding machine including purpose and industrial applications	7	*Demonstration of blow molding machine	2	CO3
LLO 8.1 Select suitable tool/ tools to prepare the surface for painting operation. LLO 8.2 Perform suitable operation for preparation of surface.	8	*Preparation of surface for painting process	4	CO4

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<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 9.1 Select suitable tool for hand lapping operation. LLO 9.2 Apply suitable abrasive material. LLO 9.3 Perform lapping operation.	9	Hand lapping operation	2	CO4
LLO 10.1 Select suitable buffing wheel for given application. LLO 10.2 Perform buffing operation.	10	Buffing operation	2	CO4
LLO 11.1 Identify different elements of CNC machine. LLO 11.2 Observe systems and subsystem	11	Surface polishing operations	4	CO4
LLO 12.1 Identify different elements of CNC machine. LLO 12.2 Observe systems and subsystem LLO 12.3 Prepare a report including specifications, features, control systems, industrial applications etc.	12	*Demonstration of CNC Machines.	2	CO5
LLO 13.1 Select required G codes and M codes LLO 13.2 Set the work and tool offset on CNC as per operations	13	* Work and tool offset setting on CNC machine.	4	CO5
LLO 14.1 Select required G codes and M codes LLO 14.2 Select suitable tools LLO 14.3 Prepare part programme for given operation LLO 14.4 Execute part Programme	14	*CNC part Programming- Turning operation	4	CO5

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<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 15.1 Select required G codes and M codes LLO 15.2 Select suitable tools LLO 15.3 Prepare part programme for given operation LLO 15.4 Execute part Programme	15	*CNC part Programming- Drilling operation	4	CO5
LLO 16.1 Select required G codes and M codes LLO 16.2 Select suitable tools LLO 16.3 Prepare part programme for given operation LLO 16.4 Execute part Programme	16	CNC part Programming- milling operation	4	CO5
LLO 17.1 Select required G codes and M codes LLO 17.2 Select suitable tools LLO 17.3 Prepare part programme for given operation LLO 17.4 Execute part Programme	17	CNC part Programming- milling and drilling operation	4	CO5
LLO 18.1 Enlist various ancient Indian material development process. LLO 18.2 Compare ancient Indian material development process with recent process.	18	*Comparison of ancient Indian material development processes with current processes. (IKS)	2	CO1 CO2 CO3 CO4
<b>Note : Out of above suggestive LLOs -</b> <ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

**Assignment**

- Collect information related to machineries related to powder metallurgy, and prepare report which contains their manufacturers, raw materials, products etc.
- Collect information related to plastic processing machineries, and prepare report which contains their manufacturers, raw materials, products etc.
- Collect information related to machineries related to grinding and superfinishing, and prepare report which contains their manufacturers, raw materials, products etc.
- Collect information on special attachments used in CNC machine like Automatic tool changer etc
- Collect different G codes and M codes used in different operating control systems (Siemens, Fanuc, Mazac, mitsubishi etc.)
- Prepare detailed list of different components of the automobile, classify it, give their manufacturing processes.

**Micro project**

- Case study on preparation on part programme for given production drawing of component.
  - Collect different tools used for CNC operations give their specifications, characteristic features and materials.
  - Prepare survey report on advanced materials used in automobile industries.
  - Collect automobile components on which Lapping, honing, buffing, polishing, Electroplating, Galvanizing, metal spraying and powder coating are performed. For each process collect information about the material, machines and other resources required. Also prepare list of industries in your state doing these processes.
  - Prepare model of blow molding machine and show all its components with specific features.
  - Prepare model of automatic tool changer and show all its components.
  - Prepare model of automatic pallet changer and show all its components.
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**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	CNC lathe (turning centre) Oi-mate TD. 02. Capacity	11
2	VMC Machine. 1200M. Table size, mm, 1200 x 510, 1500 x 630. Traverses X, Y & Z axes, mm, 1000 x 500 x 500), 1200 x 600 x 600. Rapid rate, m/min, 12 (standard), 20/32 (optional),	13
3	Hardness Tester (Rockwell Type)	2
4	Demonstration model of blow molding machine.	2
5	High Temperature Oven (Capable of up to 1000o C)	7
6	Set of common hand and power tools	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

<b>Sr.No</b>	<b>Unit</b>	<b>Unit Title</b>	<b>Aligned COs</b>	<b>Learning Hours</b>	<b>R-Level</b>	<b>U-Level</b>	<b>A-Level</b>	<b>Total Marks</b>
1	I	Engineering Materials	CO1	16	2	8	6	16
2	II	Heat Treatment	CO2	10	4	6	4	14

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
3	III	Powder Metallurgy and plastic processing	CO3	10	2	8	4	14
4	IV	Surface Processing Operations	CO4	8	4	2	4	10
5	V	CNC Machines and Part Programming	CO5	16	2	8	6	16
<b>Grand Total</b>				<b>60</b>	<b>14</b>	<b>32</b>	<b>24</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- term work , class tests

**Summative Assessment (Assessment of Learning)**

- End semester examination theory , End semester examination Lab performance( Internal)

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	2	2	2	3	2			



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CO2	3	2	-	2	2	3	2			
CO3	3	2	-	3	-	3	-			
CO4	3	2	2	3	-	3	2			
CO5	3	3	2	3	-	3	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
 \*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	G.K.Awari, V.S.Kumbhar, R.B.Tirpude, S.W.Rajurkar	Automobile manufacturing Processes: A case study approach	CRC Press First Edition 9781003367321, 978- 1032312385
2	Serope Kalpakjian Steven R. Schmid	Manufacturing Engineering and Technology	Pearson ISBN 978-9353062910
3	M. Adithan (Aut B.S. Pabla	CNC Machines	New age international ISBN 978-8122434262
4	Rajput R. K.	Engineering Materials and Metallurgy	S. Chand Limited, New Delhi. 2013, ISBN 13: 9788121927093
5	Kodgire V. D.	Material Science and Metallurgy	Everest Publishing House , Pune. 1020, ISBN: 9788186314005, 8186314008
6	Rao P.N.	CAD/CAM Principles and applications	McGraw-Hill Publishing Co. Ltd, New Delhi, 2012, ISBN:9780070681934
7	Sharma P.C.	Production technology	S. Chand, Mumbai, 2006,ISBN: 9788121911146
8	Mikell P. Groover	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems	John Willey and Sons , 4th edition ISBN 978- 0470467008

**XIII. LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
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<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
1	<a href="https://www.youtube.com/watch?v=_p7cSr3F1F8&amp;list=PLSGws_74K01g9nnTMBssGURHawYYQfMQ&amp;index=52">https://www.youtube.com/watch?v=_p7cSr3F1F8&amp;list=PLSGws_74K01g9nnTMBssGURHawYYQfMQ&amp;index=52</a>	heat treatment
2	<a href="https://www.youtube.com/watch?v=gQ5x5DpILg8&amp;list=PLSGws_74K01-g9nnTMBssGURHawYYQfMQ&amp;index=55">https://www.youtube.com/watch?v=gQ5x5DpILg8&amp;list=PLSGws_74K01-g9nnTMBssGURHawYYQfMQ&amp;index=55</a>	heat treatment
3	<a href="https://www.youtube.com/watch?v=azGg68B-Glk">https://www.youtube.com/watch?v=azGg68B-Glk</a>	Powder metallurgical processes
4	<a href="https://www.youtube.com/watch?v=qn16JtE_vLc">https://www.youtube.com/watch?v=qn16JtE_vLc</a>	Plastic processing technology
5	<a href="https://www.youtube.com/watch?v=ZfDqTc3vhvE&amp;list=PLSGws_74K01-g9nnTMBssGURHawYYQfMQ&amp;index=58">https://www.youtube.com/watch?v=ZfDqTc3vhvE&amp;list=PLSGws_74K01-g9nnTMBssGURHawYYQfMQ&amp;index=58</a>	Coating process
6	<a href="https://www.youtube.com/watch?v=-Kxz7Nt8C5I">https://www.youtube.com/watch?v=-Kxz7Nt8C5I</a>	Tumbling Process
7	<a href="https://www.youtube.com/watch?v=n2J1Wlfw-Dw">https://www.youtube.com/watch?v=n2J1Wlfw-Dw</a>	CNC tools and tool holders
8	<a href="https://www.youtube.com/watch?v=IEyNWtM6MW4">https://www.youtube.com/watch?v=IEyNWtM6MW4</a>	CNC machine working

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

**MSBTE Approval Dt. 21/11/2024****Semester - 4, K Scheme**

<b>Programme Name/s</b>	<b>: Automobile Engineering.</b>
<b>Programme Code</b>	<b>: AE</b>
<b>Semester</b>	<b>: Fourth</b>
<b>Course Title</b>	<b>: AUTOMOBILE SYSTEMS</b>
<b>Course Code</b>	<b>: 314343</b>

### **I. RATIONALE**

Automobile control systems play an important role in enhancing vehicle performance, fuel efficiency, and reducing emissions. These systems are instrumental in safeguarding the safety of drivers, passengers, and pedestrians alike. Considering the above needs, this course will equip students to acquire relevant knowledge and skills in this area. Additionally, this course will help students analyze the performance of automobiles during inspection, installation, operation, and maintenance. This course will be a prerequisite for studying fifth and sixth-semester courses such as automobile component design and vehicle maintenance.

### **II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Select relevant automobile control system parts and vehicle bodies.

### **III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify different components in the front axle and steering system.
- CO2 - Select a suitable braking system as per the vehicle.
- CO3 - Select relevant suspension systems for vehicles.
- CO4 - Select relevant body materials for better performance.
- CO5 - Use safety and advanced driver assistance systems in vehicles.

### **IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

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Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL		Based on SL		Total Marks		
				CL	TL	LL					Total	Practical		SLA							
							FA-TH	SA-TH				FA-PR	SA-PR	Max	Min	Max	Min				
314343	AUTOMOBILE SYSTEMS	ASY	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

**Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

## V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
1	<p>TLO 1.1 Identify the type of front axle and stub axle in the given vehicle.</p> <p>TLO 1.2 Describe the function of various front axle and stub axle with applications.</p> <p>TLO 1.3 Describe the parts of the steering system in the given vehicle.</p> <p>TLO 1.4 Suggest the suitable steering gearbox for the given application.</p> <p>TLO 1.5 Describe with sketches the working principle of the given type of power steering.</p>	<p><b>Unit - I Front Axle and Steering</b></p> <p>1.1 Types of front axle- Dead axle, Live axle.</p> <p>1.2 Types of stub axle arrangements- Elliot, Reverse Elliot, Lamoine and Reverse Lamoine; Front wheel assembly.</p> <p>1.3 Steering linkages for the vehicle with rigid axle, independent suspension system.</p> <p>1.4 Ackerman steering gear mechanism. (Only Theory, No Derivation).</p> <p>1.5 Steering geometry parameters: Caster, Camber, King- pin inclination, Toe in-Toe out, Understeering and Oversteering.</p> <p>1.6 Construction, working and application of Steering gear box: Rack and pinion type, recirculating ball type and worm and roller type steering gear box.</p> <p>1.7 Power assisted steering and its types (Hydraulic and electrical).</p>	<p>Model Demonstration, Video Demonstrations, Lecture Using Chalk-Board, Presentations.</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Explain with sketches the construction and working of the given brakes.</p> <p>TLO 2.2 Describe the characteristics of the friction material.</p> <p>TLO 2.3 Describe the various properties of the brake fluid.</p> <p>TLO 2.4 Suggest the relevant type of braking system for the given vehicle with justification.</p> <p>TLO 2.5 Describe the significance characteristic and advantages of Antilock Braking System (ABS).</p>	<p><b>Unit - II Automotive Brakes</b></p> <p>2.1 Necessity of brakes.</p> <p>2.2 Classification of brakes.</p> <p>2.3 Disc brake and Drum brake -Construction, working and its Application.</p> <p>2.4 Friction materials and its characteristics: Brake fade, coefficient of friction, dry friction and wet friction.</p> <p>2.5 Construction and working of Braking Systems: Mechanical braking system, Hydraulic Braking system, Air braking system, Vacuum assisted braking system, parking brake, Exhaust brake, Antilock braking system.</p> <p>2.6 Properties of brake fluids.</p>	<p>Lecture Using Chalk-Board, Presentations, Video Demonstrations, Model Demonstration.</p>
3	<p>TLO 3.1 Identify the various components of the given automobile suspension system.</p> <p>TLO 3.2 Explain with sketches the construction and working of given suspension system with application.</p> <p>TLO 3.3 Describe with sketches the working of the given air suspension system.</p> <p>TLO 3.4 Suggest relevant suspension system for the given vehicle with justification.</p>	<p><b>Unit - III Suspension Systems</b></p> <p>3.1 Necessity of suspension system.</p> <p>3.2 Classification of suspension system.</p> <p>3.3 Rigid suspension system.</p> <p>3.4 Independent suspension system- Front Wheel and Rear Wheel.</p> <p>3.5 Damper (Shock absorber) construction and working: Telescopic and Gas filled.</p> <p>3.6 Different types of spring – Leaf spring, Coil spring, Torsion bar, Anti roll bar or stabilizer bar, Air spring, Hydrodynamic spring.</p> <p>3.7 Air Suspension System.</p>	<p>Lecture Using Chalk-Board, Presentations, Video Demonstrations, Model Demonstration.</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	<p>TLO 4.1 List the different types of auto bodies used for the given chassis.</p> <p>TLO 4.2 Describe the different materials used for the given body construction with justification.</p> <p>TLO 4.3 Identify the different body accessories used for a given vehicle.</p> <p>TLO 4.4 Describe painting and denting procedure for the given auto body with sketches.</p> <p>TLO 4.5 Select glass, door and body insulation trims for the given body.</p>	<p><b>Unit - IV Auto Body Engineering</b></p> <p>4.1 Functions of auto body.</p> <p>4.2 Types of Auto bodies.</p> <p>4.3 Different Materials used in body construction.</p> <p>4.4 Body accessories and its functions.</p> <p>4.5 Protective and anticorrosive treatments, painting and denting procedure.</p> <p>4.6 Streamlining of vehicle body and its effect, Resistance faced by the vehicle- Air resistance , rolling resistance, gradient resistance.</p> <p>4.7 Miscellaneous Body services- Interior trim and upholstery, Glass and door service, Body insulation and sealing, Exterior trim.</p>	<p>Lecture Using Chalk-Board, Presentations, Video Demonstrations, Hands-on.</p>
5	<p>TLO 5.1 Describe the necessity safety systems in modern vehicles</p> <p>TLO 5.2 Identify the different Advanced Driver Assistance System used in vehicle</p> <p>TLO 5.3 Describe function of Advanced Driver Assistance System used in vehicle</p>	<p><b>Unit - V Safety and Advanced Driver Assistance System</b></p> <p>5.1 Necessity of safety system</p> <p>5.2 Types of safety-Active and Passive</p> <p>5.3 Safety and Advanced Driver Assistance System – Air Bags, Seat Belt, Central Locking, Collapsible Steering, Keyless Entry, Traction Control, Reverse Parking Sensor and Rear View Camera, Active Suspension, Adaptive Cruise Control, Voice Alert System, Automatic Climate Control, GPRS, Tyre Pressure Warning.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations</p>

## VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

**AUTOMOBILE SYSTEMS****Course Code : 314343**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 1.1 Identify the different components of power steering system. LLO 1.2 Draw layout of given power steering system.	1	*Identification of the components of power steering system.	2	CO1
LLO 2.1 Use relevant tools require to dismantle steering gear box from steering system.linkages LLO 2.2 Follow safety procedure as per standard. LLO 2.3 Inspect condition of components. LLO 2.4 Reassemble the steering gear box assembly.	2	Dismantling the steering gear box and reassemble it.	2	CO1
LLO 3.1 Use relevant tools require to dismantle wheel from the axle. LLO 3.2 Follow safety procedure as per standard. LLO 3.3 Inspect condition of components. LLO 3.4 Reassemble the wheel to the axle.	3	*Dismantle the front wheel from the axle and reassemble it.	2	CO1
LLO 4.1 Operate wheel alignment machine for determining various steering geometry.parameter LLO 4.2 Interpret data display on wheel alignment machine. LLO 4.3 Set various steering geometry parameter in the given vehicle according to data display on the wheel alignment machine.	4	*Measuring steering geometry parameters using wheel alignment machine.	2	CO1
LLO 5.1 Use relevant tools require to dismantle hydraulic braking system components. LLO 5.2 Follow safety procedure as per standard. LLO 5.3 Inspect condition of components. LLO 5.4 Reassemble the hydraulic braking system components.	5	*Dismantle the major components of hydraulic braking system and reassemble it.	2	CO2



**AUTOMOBILE SYSTEMS****Course Code : 314343**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 6.1 Use relevant tools require to dismantle air braking system components. LLO 6.2 Follow safety procedure as per standard. LLO 6.3 Inspect condition of components. LLO 6.4 Reassemble the air braking system components.	6	Dismantle the major components of Air braking system/vacuum assisted braking system and reassemble it.	2	CO2
LLO 7.1 Use relevant tools require to dismantle disc brake system components. LLO 7.2 Follow safety procedure as per standard. LLO 7.3 Inspect condition of components. LLO 7.4 Reassemble the disc brake system components.	7	*Dismantle the components of disc brake system and reassemble it.	2	CO2
LLO 8.1 Use relevant tools require to dismantle Mc-pherson strut type suspension system components. LLO 8.2 Follow safety procedure as per standard. LLO 8.3 Inspect condition of components. LLO 8.4 Reassemble the Mc-pherson strut type suspension system.	8	Dismantle the Mc-pherson strut type suspension system and reassemble it.	2	CO3
LLO 9.1 Use relevant tools require to dismantle semi elliptical type leaf spring. LLO 9.2 Follow safety procedure as per standard. LLO 9.3 Inspect condition of components. LLO 9.4 Reassemble the semi elliptical type leaf spring.	9	*Dismantle the semi elliptical type leaf spring rigid axle suspension system and reassemble it.	2	CO3

**AUTOMOBILE SYSTEMS****Course Code : 314343**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 10.1 Use relevant tools require to dismantle telescopic type hydraulic shock absorber. LLO 10.2 Follow safety procedure as per standard. LLO 10.3 Inspect condition of components. LLO 10.4 Reassemble the telescopic type hydraulic shock absorber.	10	Dismantle the telescopic type hydraulic shock absorber and reassemble it.	2	CO3
LLO 11.1 Identify the different auto body accessories. LLO 11.2 Prepare a comparative report on different body accessories including features and specification.	11	Identification of various auto body accessories.	2	CO4
LLO 12.1 Identify types of material used in auto bodies. LLO 12.2 Identify properties of material. LLO 12.3 Select proper material as per application.	12	Auto body materials selection.	2	CO4
LLO 13.1 Identify tools require for denting and panting of vehicle. LLO 13.2 Use proper tools for step-by-step denting and painting procedure.	13	*Denting and painting of auto body parts.	2	CO4
LLO 14.1 Identify types of safety devices used in vehicle. LLO 14.2 Check the functionality of the components used in safety devices.	14	*Practice on vehicle safety devices.	2	CO5
LLO 15.1 Identify Advanced Driver Assistance Systems. LLO 15.2 Check the functionality of Advanced Driver Assistance Systems used in vehicle.	15	Demonstration of functional features of Advanced Driver Assistance System used in different vehicles.	2	CO5

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
<b>Note : Out of above suggestive LLOs -</b>				
<ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

## **VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

### **Micro project**

- Develop a demonstration working model of leaf springs
- Prepare demonstration model of different auto bodies
- Collect used shock absorbers of different vehicles from the market/garages and prepare model on wooden plywood
- Develop a demonstration working model of hydraulic braking system
- Collect used steering gear boxes of different vehicles from the market/garages and prepare model on wooden plywood
- Collect used brake shoes and brake pads of different vehicles from the market/garages and prepare model on wooden plywood

### **Assignment**

- Draw neat label sketch of given steering system linkages.
- Explain working of electric power steering system components with layout
- Observe and prepare report on construction and working of Anti Lock Braking system
- Observe and explain function of hydraulic braking system components
- Study working principle of hydraulic shock absorber with layout
- Prepare report on different types of suspension spring used in automobiles
- Observe and explain function of various body accessories in automobile
- Describe step by step procedure of painting of new car
- Describe step by step procedure of denting and painting of accident car

- Explain working of air bag system with its advantages and disadvantages.

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	Front axle of LMV, HMV, transaxle of FWD car. Full size original front axles of above mentioned vehicles of Make Mahindra/TATA/ Ashok Leyland/ Maruti or alike in good working condition, mounted on powder coated M.S.Stand.	1
2	Demonstration model of power assisted steering.(Hydraulic/Electric) The complete working model of Hydraulic/Electric power assisted steering system made out of new/used original parts of Car/LMV/HCV and suitably mounted on powder coated M.S. stand and working of the same can be shown.	1

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
3	Demonstration model of automotive steering system. Cut section working model of steering of jeep/car with stub axle. The model should be made out of full size original used parts, suitably sectioned and arranged to demonstrate the internal construction details such as steering gear box, bell assembly, tie rod, linkages, stub axle and working of the same can be shown by steering the steering wheel provided. The entire model is mounted on a sturdy iron frame and be suitably painted.	1,2,3
4	Working model of telescopic type hydraulic shock absorber The working model of original used telescopic type hydraulic shock absorber of mounted on powder coated M.S. Stand.	10
5	Body of car/jeep. Body of used car/ Jeep of Make Maruti/ Mahindra/TATA etc.	11,12
6	Denting and painting tools: Technical Specifications:- Earth cable 70 mm <sup>2</sup> (2m long cable)- Multi function gun (2m, 70 mm <sup>2</sup> cable with connector)- inertia hammer- dent pulling with stars- welding of studs, rivets and rings- contact shrinking, graphite pen.- 4 m long mains supply cable- an accessories box with consumables- AMPS : 3800A- Voltage : 230v AC Product Specification: Phase-1 PH, Power Source-AC, Type Of Vehicle-Cars, Type-Fully Automatic Weight -14 Kg	13
7	Different types of steering gear boxes- Rack and pinion, Recirculating ball and nut type, Worm and roller type; Full size original used above mentioned types of gear boxes of any Car/LMV/HCV in good working condition, mounted on powder coated M.S.Stand.	2
8	Demonstration model of front wheel assembly of car/heavy motor vehicle. Cut section model made out of original used parts of car/heavy motor vehicle, suitably sectioned and arranged to demonstrate the internal construction details showing the minute information with suspension strut with spring and shock absorber, disc brake, calliper, wishbone drive shaft etc. , and working of the same can be shown. The entire model is mounted on a sturdy powder coated M.S.Frame.	3
9	Running model of car/jeep. Original full size used car or Jeep in good working condition of make Maruti/TATA/Mahindra or alike.	4,14,15

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
10	Working model of hydraulic braking system and its components. The model made out of Used TATA Indica brake aggregates which will be suitably sectioned, Left Front disc and Left rear drum will be made working, using necessary hydraulic connection from the Master cylinder, By operating the brake pedal connected to the Master cylinder through booster, the functioning of disc and drum brake can be demonstrated. The aggregates on the other side will be suitably sectioned to show the internal details and will be kept dummy. All the aggregates should be paint finished. The entire setup will be mounted on a sturdy iron frame.	5
11	Working model of air braking and its components. The model made out of original parts such as Air compressor, Unloader valve, foot valve, Booster, Wheel assembly, air tank, control valve etc The Brake system will be fitted with two front wheel assembly complete ( without axle) and the drum will be suitably sectioned to show the working of the brake shoe. Other system will be mounted as it is and will be made to function ( foot brake, hand brake etc will be functional). The entire system will be mounted on a sturdy iron frame. A F.H.P Single phase 220/230 V AC motor will be coupled to the compressor for generation of the air, which is used for the operation of the model.	6
12	Working model of vacuum assisted braking system and its components TATA, LEYLAND, MAHINDRA any other reputed automobile manufacturer.	6
13	Disc Brake Assembly. The Model made out of Original parts such as Two Brake disc, two Caliper assembly (one sectioned), two master cylinder (one sectioned) etc, the model is mounted on a sturdy iron frame and can be demonstrated by operating the lever provided.	7

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
14	Suspension systems - Mac-pherson, leaf spring : Mac-pherson suspension- Cut section model of complete both side macpherson suspension strut with drive shaft, disk brake.This model is made out of original used parts, will be suitably sectioned And Arranged to demonstrate the internal construction details showing the minute information With Suspension Strut with spring and shock absorber, disc brake, calipers, drive shaft etc., and working of the same can be shown, the model will be suitably painted and The entire model is mounted on a sturdy iron frame. Leaf Spring - Cut section model of complete leaf spring suspension system with rear axle. This model is made out of original used parts, will be suitably sectioned And Arranged to demonstrate the internal construction details showing the minute information With leaf spring is arranged along with shock absorber etc., and working of the same can be shown, the model will be suitably painted and the entire model is mounted on a sturdy iron frame.	8,9

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

<b>Sr.No</b>	<b>Unit</b>	<b>Unit Title</b>	<b>Aligned COs</b>	<b>Learning Hours</b>	<b>R-Level</b>	<b>U-Level</b>	<b>A-Level</b>	<b>Total Marks</b>
1	I	Front Axle and Steering	CO1	15	6	4	8	18
2	II	Automotive Brakes	CO2	14	4	6	6	16
3	III	Suspension Systems	CO3	10	2	4	6	12
4	IV	Auto Body Engineering	CO4	12	2	8	4	14
5	V	Safety and Advanced Driver Assistance System	CO5	9	2	4	4	10
<b>Grand Total</b>				<b>60</b>	<b>16</b>	<b>26</b>	<b>28</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Term work, Class Test, Self-Learning

**Summative Assessment (Assessment of Learning)**

- End Semester Examination Theory , End Semester Examination Practical (External)

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	3	-	3	3			
CO2	3	3	3	3	2	3	3			
CO3	3	3	3	3	-	3	3			
CO4	3	2	2	3	-	3	3			
CO5	3	3	3	3	2	2	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	Singh, Kirpal	Automobile Engineering	Standard Publication, New Delhi, 2008 ISBN: 9788180141034
2	Jain K.K. and Asthana .R.B	Automobile Engineering	Tata McGraw Hill Publishers, New Delhi 2002 ISBN: 9780070445291



<b>Sr.No</b>	<b>Author</b>	<b>Title</b>	<b>Publisher with ISBN Number</b>
3	Chikara, Anil	Automobile Engineering	Satya Prakashan New Delhi, 2007, ISBN: 9788176843515
4	Gupta R.B.	Automobile Engineering	Satya Prakashan New Delhi, 2016 ISBN: 9788176848589
5	S. Shrinivasan	Automobile Mechanics	McGraw Hill, New Delhi, 2003 ISBN: 9780070494916
6	Crouse / Anglin	Automobile Mechanics	Tata McGraw Hill, Dallas, TX, U.S.A , 1984, ISBN : 9780070148604
7	Giri N.K.	Automobile Technology	Khanna Publication, New Delhi, 2009 ISBN: 9788174091789
8	G.B.S. Narang	Automobile Engineering	Khanna Publication, New Delhi, 2007 ISBN: 9789387394254
9	G.K.Awari, V S Kumbhar, R B Tirpude	Automotive Systems Principles and Practices	CRC Press London ISBN: 9780367498504

**XIII . LEARNING WEBSITES & PORTALS**

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
1	<a href="https://www.youtube.com/watch?v=VrBeL9pp0lg">https://www.youtube.com/watch?v=VrBeL9pp0lg</a>	Steering System Working
2	<a href="https://www.youtube.com/watch?v=7d2K_mKgsZ0">https://www.youtube.com/watch?v=7d2K_mKgsZ0</a>	How to Fix Car Wheel Alignment Parameter
3	<a href="https://www.youtube.com/watch?v=qD00DIGVhtk">https://www.youtube.com/watch?v=qD00DIGVhtk</a>	Working of recirculating ball type steering gear box
4	<a href="https://www.youtube.com/watch?v=98DXe3uKwfc&amp;t=5s">https://www.youtube.com/watch?v=98DXe3uKwfc&amp;t=5s</a>	Antilock Brake System Working Animation
5	<a href="https://www.youtube.com/watch?v=f9fLf4UUIQE">https://www.youtube.com/watch?v=f9fLf4UUIQE</a>	Air Brake System Working
6	<a href="https://www.youtube.com/watch?v=21L9_ISeVAE">https://www.youtube.com/watch?v=21L9_ISeVAE</a>	Car Brake Service
7	<a href="https://www.youtube.com/watch?v=PDnyfrMy1iA">https://www.youtube.com/watch?v=PDnyfrMy1iA</a>	Car Suspension Working
8	<a href="https://www.youtube.com/watch?v=V_g1-WHD4rw">https://www.youtube.com/watch?v=V_g1-WHD4rw</a>	Installation new suspension in car
9	<a href="https://www.youtube.com/watch?v=YBEYILBN8-k">https://www.youtube.com/watch?v=YBEYILBN8-k</a>	Car body manufacturing
10	<a href="https://www.youtube.com/watch?v=qCIes_xJdGo">https://www.youtube.com/watch?v=qCIes_xJdGo</a>	Air Bag Working

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
11	<a href="https://www.youtube.com/watch?v=uRaU1HMJyCo">https://www.youtube.com/watch?v=uRaU1HMJyCo</a>	Seat Belt Working
12	<a href="https://www.youtube.com/watch?v=EiWl5PAtfYA">https://www.youtube.com/watch?v=EiWl5PAtfYA</a>	Advanced Driver Assistance System

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

<b>Programme Name/s</b>	<b>: Automobile Engineering.</b>
<b>Programme Code</b>	<b>: AE</b>
<b>Semester</b>	<b>: Fourth</b>
<b>Course Title</b>	<b>: TWO AND THREE WHEELER TECHNOLOGIES</b>
<b>Course Code</b>	<b>: 314344</b>

### **I. RATIONALE**

The increasing numbers of two and three-wheeler vehicles on Indian roads, particularly as primary transportation for individuals and small businesses in rural and urban areas, highlight the need to equip students with essential knowledge and skills. Recognizing the growth and job prospects in this sector, it is necessary to inculcate students with fundamental features like frames, engine upgradation, electrical systems, brakes, steering, and suspension systems of these vehicles.

### **II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Maintain two and three-wheeler automobile systems

### **III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify proper frame and chassis types and material for both two and three wheelers vehicles.
- CO2 - Diagnose various problems in two and three-wheeler engine, fuel and lubrication system
- CO3 - Perform repairs on transmission, steering, suspension and braking system
- CO4 - Maintain the electrical systems such as ignition, starting, charging and lightning system of a given vehicle
- CO5 - Identify the significance of aerodynamics, aesthetics, ergonomics and safety aspects on vehicle performance

### **IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

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**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
				CL	TL	LL					Practical				SLA						
							FA-TH	SA-TH			Total		FA-PR		SA-PR		Max	Min			
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min									
314344	TWO AND THREE WHEELER TECHNOLOGIES	TTW	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

**Total IKS Hrs for Sem. : 2 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
1	<p>TLO 1.1 Explain the given vehicle frame with sketch.</p> <p>TLO 1.2 Compare the given two/ three wheeler chassis and frames on the basis of construction and application.</p> <p>TLO 1.3 Describe with suitable sketch the layout of two and three wheeler.</p> <p>TLO 1.4 Select relevant frame material for given vehicle application with justification.</p> <p>TLO 1.5 Select frame/ chassis for given application with justification.</p>	<p><b>Unit - I Frame and Chassis</b></p> <p>1.1 Frames: Single cradle frame, Double cradle frame, Tabular frame and its types, Engine based frame and Twin spar frame.</p> <p>1.2 Chassis: Conventional chassis and monocoque or integral construction.</p> <p>1.3 Layout of Two wheeler and Three wheeler vehicle.</p> <p>1.4 Frame material and its properties: Alloy steel, aluminium alloy, carbon fiber.</p>	<p>Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Describe engine technology upgradation from BS IV to BS VI.</p> <p>TLO 2.2 Select an engine for the given vehicle with justification.</p> <p>TLO 2.3 Describe valve clearance adjustment procedure of 4-stroke engine.</p> <p>TLO 2.4 Select an air filter for given vehicle with justification.</p> <p>TLO 2.5 Select an engine exhaust system components for given vehicle with justification.</p> <p>TLO 2.6 Describe fuel supply system with sketch.</p> <p>TLO 2.7 Explain lubrication system for the given two or three wheeler engine with sketch.</p>	<p><b>Unit - II Engine, Fuel and Lubrication System</b></p> <p>2.1 Basics of two and three wheeler engine, Engine technology upgradation (From BS IV to BS VI), Engine selection criteria, Valve operating mechanism.</p> <p>2.2 Induction System: Air filter/Air cleaner: Function, types, construction and working.</p> <p>2.3 Exhaust System: Function, Construction. Basic Parts- Heat Diffuser, Header pipe, Muffler.</p> <p>2.4 Fuel supply system: Block diagram, Construction &amp; working of Carburetor System, Electronic fuel injection system as per BSVI Norms.</p> <p>2.5 Lubrication system: Lubrication in four stroke engines of two wheeler and three wheeler.</p>	<p>Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	<p>TLO 3.1 Sketch the layouts of Transmission system of the given two-wheeler or three-wheeler.</p> <p>TLO 3.2 Explain multiplate and centrifugal clutch with neat sketch.</p> <p>TLO 3.3 Describe construction and working of Continuous variable transmission with neat sketch.</p> <p>TLO 3.4 Explain constant mesh gearbox with neat sketch.</p> <p>TLO 3.5 Describe effect of steering geometry relevant parameters for the given vehicles with sketch.</p> <p>TLO 3.6 Select the suspension system for the given application with justification.</p> <p>TLO 3.7 Compare the braking system of the given vehicles on basis of the given parameters.</p>	<p><b>Unit - III Transmission, steering, suspension and braking systems</b></p> <p>3.1 Transmission system : Layout of transmission system in two and three wheeler, Construction and working of - Cable actuated wet multi-disc clutch, Centrifugal clutch, Chain drive, Continuous variable transmission (CVT), Gearbox- working of constant mesh gearbox, Gear shifting mechanism- hand and foot operated shifting mechanism.</p> <p>3.2 Steering system: Steering geometry and effects-Caster angle &amp; Trail, Steering fork, Handlebar arrangement.</p> <p>3.3 Suspension System: Two wheeler suspension system- Spring and damper- swing arm and telescopic type. Monoshock suspension. Swing Arm type rear suspension of passenger Auto rickshaw.</p> <p>3.4 Braking system: Drum brake and disc brake - Construction &amp; Working. Brake control system- hand and foot operated brake, Braking system of Auto rickshaw.</p>	<p>Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations</p>

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
4	<p>TLO 4.1 Describe working of the given ignition system with sketch.</p> <p>TLO 4.2 Compare the engine starting systems and their aggregates on the basis of the given parameters.</p> <p>TLO 4.3 Describe working of the given charging system with sketch.</p> <p>TLO 4.4 Describe specification and features of the given Dash board /lighting system aggregates.</p>	<p><b>Unit - IV Electrical systems</b></p> <p>4.1 Ignition system: Ignition system upgradation from BS IV to BS VI Block diagram, construction and working of - Magneto Ignition system, Capacitive discharge Ignition system, Microprocessor controlled Ignition system, Concept of twin spark ignition system.</p> <p>4.2 Starting system: Kick start and button start arrangement with components their functions.</p> <p>4.3 Charging system: Circuit diagram, components and working of charging system.</p> <p>4.4 Lightening system and accessories: Specification and application of- Head lamp, tail and number plate lamp, purpose of using LED lights in tail lamp, turn signal lamp, side stand indicator lamp, speedometer lamp, horn, mobile charger point, head lamp and tail lamp reflectors used in two wheelers. Dash units- Use of speedometer, trip meter. Use of engine speed indicator/ Tachometer.</p>	<p>Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations</p>



<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
5	<p>TLO 5.1 Describe aerodynamic aspects for relevant aggregates of the given vehicle with sketch.</p> <p>TLO 5.2 Describe Ergonomic aspect relevant to the given vehicle handling/ seating arrangement with sketch.</p> <p>TLO 5.3 Explain significance of aesthetic aspect for relevant aggregates of the given vehicle with justification.</p> <p>TLO 5.4 Describe safety aspects of given two wheeler relevant to rider.</p>	<p><b>Unit - V Aerodynamics, Aesthetics, Ergonomics and Safety Aspects of vehicles</b></p> <p>5.1 Aerodynamics Aspects: Head lamp shape (Sealed beam and conventional), Tail lamp and indicator light arrangements- body enclosed and separate, Shape of fuel tank in motorcycles.</p> <p>5.2 Ergonomics Aspects: Seat arrangement for rider and pillion rider, Handle bar position, Floor/Foot rest for driver and pillion rider.</p> <p>5.3 Aesthetics Aspects: Headlamp fairing of motorcycles, Side panels for scooter/scooterate and motorcycle, Ground clearance.</p> <p>5.4 Safety Aspects: Crash bar, saree guard, Driving habits.</p>	<p>Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations</p>

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
<p>LLO 1.1 Identify types of vehicle frame/ chassis.</p> <p>LLO 1.2 Analyze vehicle frame data according to different manufactures.</p> <p>LLO 1.3 Prepare report as per the prescribed format.</p>	1	<p>*Identification of two/ three-wheeler frame/ chassis (Use the two &amp; three-wheeler available in the college premises).</p>	2	CO1

**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 2.1 Identify different components in the given dismantled engine. LLO 2.2 Compare specification of different types of Engines.	2	*Comparative study of different types of two/ three wheeler engine.	2	CO2
LLO 3.1 Inspect Valve Clearance using feeler gauge. LLO 3.2 Adjust valve clearance as per service manual.	3	Valve clearance setting of the given engine two/ three wheeler engine.	2	CO2
LLO 4.1 Select suitable tools for Spark Plug & Air filter opening. LLO 4.2 Dismantle Spark Plug & Air filter of given vehicle. LLO 4.3 Cleaning of air filter. LLO 4.4 Cleaning and adjustment of spark plug.	4	Spark Plug & Air filter Cleaning of available vehicle.	2	CO2
LLO 5.1 Use suitable tools for carburetor dismantling. LLO 5.2 Prepare check list. LLO 5.3 Follow standard servicing procedure as per service manual.	5	*Servicing of carburetor.	2	CO2
LLO 6.1 Check the condition of engine oil. LLO 6.2 Maintain the level of engine oil with correct grade oil. LLO 6.3 Identify the faults in lubricating pump. LLO 6.4 Follow standard servicing procedure as per service manual for repair/replace of the pump.	6	Servicing of lubricating system.	2	CO2

**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 7.1 Use suitable tools for clutch dismantling. LLO 7.2 Check the condition of clutch plates. LLO 7.3 Follow standard servicing procedure as per service manual for repair/replace of the clutch.	7	Servicing of clutch assembly.	2	CO3
LLO 8.1 Use suitable tools for gearbox dismantling. LLO 8.2 Check the condition of gearbox. LLO 8.3 Follow standard servicing procedure as per service manual for repair/replace of the gearbox.	8	Servicing of gearbox.	2	CO3
LLO 9.1 Check chain & brake condition. LLO 9.2 Use suitable tool to adjust the chain and brake. LLO 9.3 Repair the loose/ replace of chain & brake.	9	*Chain and brake adjustment.	2	CO3
LLO 10.1 Use suitable tools for dismantling brake assembly. LLO 10.2 Check the condition of brake shoe. LLO 10.3 Follow standard servicing procedure as per service manual Check the condition of brake assembly.	10	*Servicing of brake assembly.	2	CO3

**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 11.1 Use suitable tools for dismantling suspension system. LLO 11.2 check the condition of oil seals, bushings, spring. LLO 11.3 Follow standard servicing procedure as per service manual.	11	Servicing of suspension system.	2	CO3
LLO 12.1 Check the working of different components of ignition system. LLO 12.2 Repair/replace the faulty components.	12	*Servicing of ignition system the given two/three wheeler.	2	CO4
LLO 13.1 Check self start system. LLO 13.2 Servicing the self start system components.	13	Servicing of self start system of the given two/three wheeler.	2	CO4
LLO 14.1 Check wiring harness of the given two/three wheeler. LLO 14.2 Repair wiring harness of the given two/three wheeler.	14	Troubleshooting of Wiring harness of the given two/three wheeler.	2	CO4
LLO 15.1 Observe aerodynamics, ergonomics, aesthetics and safety aspects of the given two/three wheeler. LLO 15.2 Interpret aerodynamics, ergonomics, aesthetics and safety aspects of the given two/three wheeler.	15	*Observe the aerodynamics, ergonomics, aesthetics and safety aspects of the given two/three wheeler.	2	CO5

**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 16.1 Collect data about technology used in ancient Indian vehicles and modern vehicles. LLO 16.2 Compare technological development. LLO 16.3 Prepare a report on the same.	16	*Comparison of modern two/ three wheeler vehicles with ancient Indian vehicles on the basis of technological development (IKS).	2	CO1 CO2 CO3 CO5

**Note : Out of above suggestive LLOs -**

- '\*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)****Micro project**

- Prepare table mounted model of brake assembly of two or three wheeler.
- Prepare table mounted model of Shock up assembly of two or three wheeler.
- Prepare table mounted model of wiring harness of two or three wheeler.
- Compare old & new two or three wheelers on the basis of Aerodynamics, Aesthetic & Ergonomics aspects.
- Collect data of Indian two or three wheeler manufacturers and their products and prepare a report based on product range, market share, product innovation, emission control technology and economy.
- Explore innovative and latest technology/features provided in two and three wheeler vehicle. Prepare a report containing relevant aspects of the technology /features.
- Apply aerodynamic, ergonomics, aesthetic and safety aspect and draw conceptual sketch of two/three-wheeler.
- Visit to nearest garage/ showroom and collect and compare data for different vehicles of same capacity.

**Assignment**

**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

- Observe & prepare report on different types of frames used in modern two or three-wheeler.
- Collect the data of any two or three wheeler of same category and compare them on the basis of various parameters.
- Collect the data of different engine oil available in market for two or three wheeler engines & prepare report of the same.
- Write step wise procedure for dismantling/assembling two/three wheeler engine along with tools required.
- List different lightening accessories used in two/three wheeler with their specification & functions.

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	Two wheeler vehicle- frames (single and double cradle frame)	1
2	Three wheeler vehicle- frame and body (Auto rickshaw – 4 Stroke)	1
3	Universal clutch holder	7
4	Working model of Two wheeler transmission systems (4-Speed transmission)	7,8
5	Working model of Three wheeler transmission systems (4-forward and 1-Reverse transmission)	7,8
6	Two Wheeler vehicle /Three wheeler vehicle (4-stroke,single cylinder engine)	All
7	General purpose tools (Spanners, ring spanner and socket set,)- 6mm to 32 mm	All
8	Torque wrench range- 10 Nm to 200Nm.	All

**TWO AND THREE WHEELER TECHNOLOGIES****Course Code : 314344**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
9	Allen key Set – star & hex	All
10	Screw driver set, plier set, T headed spanner set	All
11	Feeler gauge set	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

<b>Sr.No</b>	<b>Unit</b>	<b>Unit Title</b>	<b>Aligned COs</b>	<b>Learning Hours</b>	<b>R-Level</b>	<b>U-Level</b>	<b>A-Level</b>	<b>Total Marks</b>
1	I	Frame and Chassis	CO1	6	4	2	4	10
2	II	Engine, Fuel and Lubrication System	CO2	11	2	8	6	16
3	III	Transmission, steering, suspension and braking systems	CO3	12	2	8	6	16
4	IV	Electrical systems	CO4	9	4	6	4	14
5	V	Aerodynamics, Aesthetics, Ergonomics and Safety Aspects of vehicles	CO5	7	2	8	4	14
<b>Grand Total</b>				<b>45</b>	<b>14</b>	<b>32</b>	<b>24</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Class Test, Term work and Self learning

**Summative Assessment (Assessment of Learning)**

- End semester examination theory, End semester examination practical (external)

**XI. SUGGESTED COS - POS MATRIX FORM**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>							<b>Programme Specific Outcomes* (PSOs)</b>		
	<b>PO-1 Basic and Discipline Specific Knowledge</b>	<b>PO-2 Problem Analysis</b>	<b>PO-3 Design/ Development of Solutions</b>	<b>PO-4 Engineering Tools</b>	<b>PO-5 Engineering Practices for Society, Sustainability and Environment</b>	<b>PO-6 Project Management</b>	<b>PO-7 Life Long Learning</b>	<b>PSO-1</b>	<b>PSO-2</b>	<b>PSO-3</b>
CO1	3	-	-	-	-	3	2			
CO2	3	2	2	3	2	3	3			
CO3	3	2	2	3	2	3	3			
CO4	3	-	2	2	2	3	3			
CO5	3	-	-	-	-	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

<b>Sr.No</b>	<b>Author</b>	<b>Title</b>	<b>Publisher with ISBN Number</b>
1	Panchal, Dhruv, U.	Two and Three Wheeler Technology	PHI Learning Private Limited, Delhi, 2015, third edition ISBN-978-81-203-5143-1
2	Ramalingam, K.K.	Two Wheeler and Three Wheeler	SCITECH Publication, Chennai. Second edition. ISBN-978-93-85983-30-6
3	Dr. Kripal, Singh	Automobile Engineering Vol-1	Standard Publishes-Distributors-Delhi; 13th Edition (2012), ISBN-13: 978-8180141966
4	William, Crouse; Donald, Anglin	Automotive Mechanics	McGraw Hill Education; 10 edition (1 July 2017), ISBN-13: 978-0070634350



## XIII . LEARNING WEBSITES &amp; PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.youtube.com/watch?v=Jk6V1Kdeons">https://www.youtube.com/watch?v=Jk6V1Kdeons</a>	Bajaj RE Auto Rickshaw Manufacturing
2	<a href="https://www.youtube.com/watch?v=oAircVPnvSs">https://www.youtube.com/watch?v=oAircVPnvSs</a>	Royal Enfield Factory in India
3	<a href="https://www.youtube.com/watch?v=m3osMG_ppIs">https://www.youtube.com/watch?v=m3osMG_ppIs</a>	Bajaj Motorcycles production - Two wheeler manufacturing in India
4	<a href="https://www.youtube.com/watch?v=8qakw7NaFn4&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=7">https://www.youtube.com/watch?v=8qakw7NaFn4&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=7</a>	Operation of Four Stroke Engines (NPTEL)
5	<a href="https://www.youtube.com/watch?v=AAJyUk4wHfI&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=34">https://www.youtube.com/watch?v=AAJyUk4wHfI&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=34</a>	Transmission System (NPTEL)
6	<a href="https://www.youtube.com/watch?v=NJkU8wbjgjs&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=44">https://www.youtube.com/watch?v=NJkU8wbjgjs&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=44</a>	Components of a Brake System and Drum Brake (NPTEL)
7	<a href="https://www.youtube.com/watch?v=54GyDX_pzvw&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=46">https://www.youtube.com/watch?v=54GyDX_pzvw&amp;list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MIJau4F&amp;index=46</a>	Disc Brake and Introduction to Hydraulic Brake (NPTEL)
8	<a href="https://www.youtube.com/watch?v=9cKbzUgFdS0">https://www.youtube.com/watch?v=9cKbzUgFdS0</a>	Working of scooter transmission works (CVT)
9	<a href="https://www.youtube.com/watch?v=kTuybtMAiN8">https://www.youtube.com/watch?v=kTuybtMAiN8</a>	General Servicing of a Two-Wheeler
10	<a href="https://www.youtube.com/watch?v=DUK6gjbsLpQ">https://www.youtube.com/watch?v=DUK6gjbsLpQ</a>	Bajaj Auto Gearbox
11	<a href="https://www.youtube.com/watch?v=m6AZ7_mACUg">https://www.youtube.com/watch?v=m6AZ7_mACUg</a>	Hero Honda Training Film
12	<a href="https://www.youtube.com/watch?v=QWAhLyL2IBk">https://www.youtube.com/watch?v=QWAhLyL2IBk</a>	Overhauling of a Gear Box of a Two- Wheeler

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

**MSBTE Approval Dt. 21/11/2024**

**Semester - 4, K Scheme**

<b>Programme Name/s</b>	<b>: Architecture Assistantship/ Automobile Engineering./ Architecture/ Interior Design &amp; Decoration/ Interior Design/ Mechanical Engineering/ Mechatronics/ Production Engineering/</b>
<b>Programme Code</b>	<b>: AA/ AE/ AT/ IX/ IZ/ ME/ MK/ PG</b>
<b>Semester</b>	<b>: Third / Fourth / Fifth</b>
<b>Course Title</b>	<b>: FUNDAMENTALS OF PYTHON PROGRAMMING</b>
<b>Course Code</b>	<b>: 313007</b>

## **I. RATIONALE**

Comprehension of programming languages is crucial for diploma engineering graduates, especially as they engage with various software applications in the mechanical engineering domain. Python, being easy to code, potent, and stands out as an ideal language for introducing computing and problem-solving concepts to beginners. This course enables students to write Python programs and utilize various built-in functions/methods of Python modules/libraries to solve specific problems.

## **II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

An ability to prepare python programs for solving simple engineering problems.

## **III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use program designing tools and IDE for python.
- CO2 - Employ python building blocks and data types in the programming.
- CO3 - Implement conditional and looping statements in the python programming.
- CO4 - Implement built in functions and modules in the python programming.
- CO5 - Use NumPy for performing operations on list and array.

## **IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

**FUNDAMENTALS OF PYTHON PROGRAMMING****Course Code : 313007**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme										Total Marks	
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TL		Based on SL					
				CL	TL	LL					Total	Practical		SLA							
							Max	Max				Max	Min	Max	Min	Max	Min	Max	Min		
313007	FUNDAMENTALS OF PYTHON PROGRAMMING	FPP	AEC	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50

**Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Describe the functions of different components of computers and peripherals.</p> <p>TLO 1.2 List the applications of computers in the domain of Mechanical Engineering.</p> <p>TLO 1.3 Create flow chart of given programming problem.</p> <p>TLO 1.4 Describe the given feature of Python programming language.</p>	<p><b>Unit - I Introduction to Python Programming</b></p> <p>1.1 Revision of Computer Components (CPU, I/O devices)</p> <p>1.2 Applications of computer and programming languages in Mechanical engineering domain.</p> <p>1.3 Program Designing Tools: Algorithm, Flow Chart.</p> <p>1.4 Introduction and Features of Python: Open source, Interactive, Interpreted, Object-oriented, Platform independent etc., Installation &amp; working of IDEs.</p>	<p>Presentations Hands-on</p>
2	<p>TLO 2.1 Use different Python building blocks.</p> <p>TLO 2.2 Describe different data types of Python programming.</p> <p>TLO 2.3 Differentiate normal and container data types of Python programming language.</p> <p>TLO 2.4 Write simple Python programs by taking the user's input to solve expressions.</p>	<p><b>Unit - II Python building blocks &amp; data types</b></p> <p>2.1 Python building blocks: Identifiers, Indentation, Comments, Variables, Arithmetic and assignment operators and Expressions.</p> <p>2.2 Data Types: Integers, float, complex, string and their declaration, data type conversion.</p> <p>2.3 Accepting input from user: I/O functions.</p> <p>2.4 Container Types: List, tuple, set and their declaration.</p> <p>2.5 Write simple python program to display "Welcome" message.</p>	<p>Presentations Hands-on</p>
3	<p>TLO 3.1 Use basic relational and logical operators in python programs.</p> <p>TLO 3.2 Employ decision control statements in python programs.</p> <p>TLO 3.3 Employ looping statements in python programs.</p>	<p><b>Unit - III Python operators and Control flow</b></p> <p>3.1 Relational and Logical operators.</p> <p>3.2 Decision making statements: if, if-else, if- elif - else statements.</p> <p>3.3 Looping statements: while loop, for loop, Nested loops.</p> <p>3.4 Loop manipulation using continue, pass, break statements.</p>	<p>Demonstration Hands-on</p>

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
4	TLO 4.1 Use built-in functions in Python programs. TLO 4.2 Use built-in modules in Python programs. TLO 4.3 Develop user-defined functions in Python for the given purpose.	<b>Unit - IV Python functions and modules</b> 4.1 Functions: Use of built-in functions, data conversion functions, abs, pow, min, max, round, ceil, floor etc. 4.2 Modules: Use of built-in modules- math cmath, random and statistics. 4.3 User-defined function: Function definition, function calling, function arguments and parameter passing, Return statement, scope of variables.	Demonstration Hands-on
5	TLO 5.1 Manipulate the given list. TLO 5.2 Perform different operations on list. TLO 5.3 Use NumPy arrays for faster operations.	<b>Unit - V List and arrays in python</b> 5.1 List: define list (one and multi-dimension), accessing, deleting and updating values in list. 5.2 Basic list operations: slicing, repeating, concatenation and iteration. 5.3 NumPy array: Generate NumPy arrays and construct multidimensional arrays.	Demonstration Hands-on

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 1.1 Install python IDE. LLO 1.2 Explore the IDE's settings and preferences.	1	Install Python IDE.	2	CO1
LLO 2.1 Draw flow chart for the given problem. LLO 2.2 Write algorithm for the given problem.	2	*Prepare a flow chart and algorithm for simple problem.	2	CO1
LLO 3.1 Use print function to display the message.	3	Write a simple program to display a simple message. (Ex: "Welcome to Python programming")	2	CO2

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 4.1 Write and execute a python program to solve a given expression.	4	Write a simple Python program by taking user's input to - - find the area of rectangle - find the area or circle.	2	CO2
LLO 5.1 Write and execute a python program.	5	*Write a program to accept value of Celsius and convert it to Fahrenheit.	2	CO2
LLO 6.1 Use the if - else statement in the python program.	6	Write a python program to find whether the given number is even or odd using if - else statement.	2	CO3
LLO 7.1 Implement the if-elif-else statement in the python program.	7	*Write a python program to check whether a input number is positive, negative or zero using if – elif- else statement.	2	CO3
LLO 8.1 Use appropriate decision-making control statement to solve the given problem.	8	Write a program to accept the three sides of a triangle to check whether the triangle is isosceles, equilateral, right angled triangle.	2	CO3
LLO 9.1 Identify suitable loop and conditional statement for the problem. LLO 9.2 Inscribe the loop and conditional statement in the python program.	9	Write a program that allows the user to input numbers until they choose to stop, and then displays the count of positive, negative, and zero numbers entered (Use while loop).	2	CO3
LLO 10.1 Identify suitable looping statement for multiplication table. LLO 10.2 Implement the for loop for the multiplication table.	10	*Write a python program for printing multiplication table of a given number using for loop. (Ex. 12x1=12 12x2=24 .... 12x10=120)	2	CO3

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 11.1 Identify a suitable module for importing a given function. LLO 11.2 Use various mathematical functions available in cmath module.	11	*Write a Python program to demonstrate the use of different mathematical functions (Ex. ceiling, floor etc).	2	CO4
LLO 12.1 Use various functions available in statistics module.	12	*Write a python program to find mean, mode, median and standard deviation using statistics module.	2	CO4
LLO 13.1 Use list data type of Python.	13	Write a python program utilizing a list to display the name of a month based on a given month number.	2	CO5
LLO 14.1 Write programs using Multidimensional list in Python.	14	Write a python program to add or subtract two matrices using multidimensional list.	2	CO5
LLO 15.1 Write programs using Multidimensional list in Python.	15	*Write a python program to multiply two matrices using multidimensional list.	2	CO5
LLO 16.1 Perform metrics operation using NumPy Module	16	*Write a python program to multiply two matrices using NumPy.	2	CO5

**Note : Out of above suggestive LLOs -**

- '\*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)****Micro project**

- Not Applicable



**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	Computer System with all necessary peripherals and internet connectivity.	All
2	Any relevant python IDE like IDLE/PyCharm/VSCode/Jupyter Notebook/Online Python Compiler.	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE****X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Term Work

**Summative Assessment (Assessment of Learning)**

- Practical

## XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	2	3	-	-	2			
CO2	2	2	2	3	-	-	2			
CO3	2	2	2	3	-	-	2			
CO4	2	2	2	3	-	-	2			
CO5	2	2	2	3	-	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kenneth A. Lambert	Fundamentals of Python : First Programs , 2E	Cengage Learning India Private Limited, ISBN: 9789353502898
2	Yashavant Kanetkar, Aditya Kanetkar	Let Us Python - 6th Edition	BPB Publications, ISBN: 9789355515414

**XIII . LEARNING WEBSITES & PORTALS**

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
1	<a href="https://www.w3schools.com/python/">https://www.w3schools.com/python/</a>	Python Programming
2	<a href="https://www.tutorialspoint.com/python/index.htm">https://www.tutorialspoint.com/python/index.htm</a>	Python Programming
3	<a href="https://www.python.org/">https://www.python.org/</a>	Python Programming
4	<a href="https://spoken-tutorial.org/tutorial-search/?search_foss=Pyt">https://spoken-tutorial.org/tutorial-search/?search_foss=Pyt</a>	Python Programming

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

<b>Programme Name/s</b>	<b>: Automobile Engineering.</b>
<b>Programme Code</b>	<b>: AE</b>
<b>Semester</b>	<b>: Fourth</b>
<b>Course Title</b>	<b>: MECHANICAL MEASUREMENT</b>
<b>Course Code</b>	<b>: 314019</b>

**I. RATIONALE**

The Diploma Automobile Engineer should select various instruments and use them for measurement of physical and functional parameters of automotive components used in different Automobile segments. Additionally, practical knowledge with measuring instruments can help them to maintain the quality of auto components.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Use different measuring instrument for ensuring the quality of automotive components.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use relevant linear measuring instrument and gauges for measurement in automobile engineering situations.
- CO2 - Select relevant instrument for measurement of physical parameters of system.
- CO3 - Measure the different geometrical tolerances of automotive components.
- CO4 - Use relevant instrument for measurement of various functional parameters of automotive components.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

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**MECHANICAL MEASUREMENT****Course Code : 314019**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TL		Based on SL		Total Marks			
				CL	TL	LL					Total	Practical		SLA							
							FA-TH	SA-TH				FA-PR	SA-PR	Max	Min	Max	Min				
314019	MECHANICAL MEASUREMENT	MME	AEC	1	-	2	1	4	2	-	-	-	-	-	25	10	-	-	25	10	50

**Total IKS Hrs for Sem. : 2 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
1	<p>TLO 1.1 Describe basis of Measurement.</p> <p>TLO 1.2 Explain characteristics of measuring instruments.</p> <p>TLO 1.3 Describe working principle of given Linear measuring instruments.</p> <p>TLO 1.4 Identify errors in given instrument.</p> <p>TLO 1.5 Describe construction and working of given comparators and gauges.</p>	<p><b>Unit - I Overview of Measurement</b></p> <p>1.1 Definition of metrology, objectives of metrology, types of metrology, Need of inspection.</p> <p>1.2 Characteristics of instruments: Least count, Accuracy, Precision, Reliability, Calibration, Hysteresis, Dead Zone, Drift, Sensitivity, Threshold, Repeatability, Reproducibility.</p> <p>1.3 Linear measuring Instruments: Working principle and calibration of Vernier caliper, micrometer, height gauge and depth gauge.</p> <p>1.4 Types of Errors and its sources in Measurements.</p> <p>1.5 Gauges and Comparators: Definition, Classification, Use of comparators, working principle (Merits and Demerits) of Dial indicator, Sigma Comparator and Pneumatic Comparator, Taylor's principle of Gauge design, Plug, Ring Gauges, Snaps gauges, Wringing of Slip Gauges.</p>	<p>Chalk-Board Presentations</p> <p>Video</p> <p>Demonstrations</p>

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
2	<p>TLO 2.1 Select Angular measuring instrument for given component and calculate unknown angle.</p> <p>TLO 2.2 Calculate screw thread parameters using given method.</p> <p>TLO 2.3 Explain procedure of measuring the given parameters of gear.</p> <p>TLO 2.4 Describe procedure for examining surface finish of the given component.</p> <p>TLO 2.5 Describe the given Geometrical relationships for the given components.</p>	<p><b>Unit - II Angular, Screw Thread, Gear, Surface Measurements and Geometrical Testing</b></p> <p>2.1 Angle measurement: Instruments used in Angular Measurements: Angle Gauges (No Numerical), Bevel Protractor, sine bar.</p> <p>2.2 Screw thread Measurements: Screw thread terminology, measurement of different elements such as major diameter, minor diameter, effective diameter, pitch, thread angle.</p> <p>2.3 Gear Measurement: Measurement of tooth thickness by Gear tooth Vernier and Profile projector.</p> <p>2.4 Surface Roughness Measurement: Meanings of surface texture and definitions, methods of surface measurement - Ra, Rz and RMS values (No Numerical), Taylors Hobsons Talysurf.</p> <p>2.5 Geometrical Tolerance: Parallelism, Straightness, Squareness, roundness, run out, alignment testing of automobile components.</p>	<p>Chalk-Board Presentations</p> <p>Video Demonstrations</p>

<b>Sr.No</b>	<b>Theory Learning Outcomes (TLO's) aligned to CO's.</b>	<b>Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.</b>	<b>Suggested Learning Pedagogies.</b>
3	<p>TLO 3.1 Select displacement measuring instrument in the given system with justification.</p> <p>TLO 3.2 Explain Working of given pressure measurement instrument.</p> <p>TLO 3.3 Choose relevant instrument for measurement of temperature of given system.</p> <p>TLO 3.4 Describe the procedure for measurement of engine shaft power.</p> <p>TLO 3.5 Explain Working of given speed measurement instrument.</p>	<p><b>Unit - III Miscellaneous Measurement</b></p> <p>3.1 Displacement Measurement: working principal of Capacitive transducer, Potentiometer, LVDT.</p> <p>3.2 Pressure Measurement: Working principal of Pressure Gauge- Bourdon tube, Electrical resistance type pressure measurement devices.</p> <p>3.3 Temperature Measurement: Working principal of Bimetallic strip gauge, thermometer and thermocouple.</p> <p>3.4 Shaft power measurement: Eddy Current Dynamometer.</p> <p>3.5 Speed measurement - Working principal of Tachometer and Stroboscope.</p>	<p>Chalk-Board Presentations</p> <p>Video Demonstrations</p>

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 1.1 Interpret ancient measurement system for measurement of length and weight.	1	*Measurement of Length and weight by using ancient measurement system (IKS)	2	CO1
LLO 2.1 Compare the results of linear parameters of a given job by using Vernier caliper, Micrometer and height / depth gauge. LLO 2.2 Operate linear measuring instrument(s) for measurement of given job.	2	*Measurement of dimensions of component using vernier caliper, vernier height gauge, vernier depth gauge, micrometer and inside micrometer.	2	CO1



**MECHANICAL MEASUREMENT****Course Code : 314019**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 3.1 Check the roundness of a component with the help of mechanical comparators. LLO 3.2 Operate dial gauge for checking the roundness of plain shaft used in any automobile.	3	Roundness checking of the given component using dial indicator / dial gauge.	2	CO3
LLO 4.1 Check the parallelism of a component with the help of mechanical comparators LLO 4.2 Operate dial gauge for checking the parallelism of saddle with main axis of lathe machine	4	*Parallelism checking of the given component using dial indicator / dial gauge.	2	CO3
LLO 5.1 Use different optical flats for measurement of surface flatness. LLO 5.2 Identify the types of observed fringe patterns of optical flats.	5	Measurement of flatness of given component by using optical flats.	2	CO3
LLO 6.1 Inspect specified size attribute of the automotive component by using a pneumatic comparator. LLO 6.2 Use pneumatic comparator for given situation efficiently.	6	Inspection of given size attribute by using a pneumatic comparator.	2	CO1 CO2
LLO 7.1 Use Bevel Protractor and Sine bar for measurement of unknown angle LLO 7.2 Operate Bevel Protractor and Sine bar for angle measurement	7	*Measurement of unknown angle of a component using Bevel Protractor and verification by Sine bar.	2	CO2
LLO 8.1 Use floating carriage micrometer for measurement of major, minor and effective diameter of screw threads. LLO 8.2 Operate optical profile projector for checking thread profile.	8	*Measurement of the screw thread elements by using screw thread micrometer and verification by optical profile projector	2	CO2

**MECHANICAL MEASUREMENT****Course Code : 314019**

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 9.1 Measure face width and tooth thickness of a gear by using gear tooth vernier caliper LLO 9.2 Check given gear profile by optical profile projector	9	*Measurement of the gear tooth elements using gear tooth vernier caliper and verification by optical profile projector.	2	CO2
LLO 10.1 Compare given machined surface using Surface Roughness Tester and Surface Roughness Standard Piece.	10	*Measurement of the surface roughness of machined surface by using surface roughness tester.	2	CO2
LLO 11.1 Measure displacement of micrometer by using LVDT. LLO 11.2 Use LVDT for measurement of linear displacement.	11	*Measurement of displacement by using Linear Variable Displacement Transducer (LVDT).	2	CO4
LLO 12.1 Use Thermocouple for measurement of temperature of given system. LLO 12.2 Measure temperature of a system by using thermometer.	12	Measurement of temperature by thermocouple and Verification by thermometer.	2	CO4
LLO 13.1 Measure Pressure of a given system by using Bourdon Pressure gauge.	13	*Measurement of Pressure by using Bourdon Pressure gauge	2	CO4
LLO 14.1 Measure the speed of rotating shaft by Tachometer or Stroboscope LLO 14.2 Use Tachometer or Stroboscope for measurement of speed of rotating shaft	14	Measurement of speed of rotating shaft by Tachometer or Stroboscope	2	CO4
LLO 15.1 Determine engine torque by Eddy current dynamometer. LLO 15.2 Use Eddy current dynamometer for measurement of engine torque.	15	Measurement of engine torque by Eddy current dynamometer.	2	CO4

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
<p><b>Note : Out of above suggestive LLOs -</b></p> <ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

## **VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

### **Micro project**

- Visit to Automobile service station, observe the different sensors used in cars and prepare a report of the same. (Name, Use, Location, Working, Applications)
- Prepare a report on calibration procedure of Vernier Caliper and Micrometer followed by NABL Lab.
- Prepare comparative study of different contact and non-contact type transducers / sensors.
- Comparative study of various linear measuring instruments like steel rule, Inside-outside micrometer, Vernier Caliper and Digital Caliper on the basis of accuracy, precision, repeatability, errors, etc. with proper justification.

### **Assignment**

- Prepare a report to interpret effect of errors on the accuracy of instrument and measurement.
- Visit to any nearby automobile service station or industry and list out different gauges used for inspection along with its purpose.
- Prepare a comparative study of different screw threads measuring instruments on the basis of their least count, accuracy, cost, ease of operation.
- Prepare a set of procedure for Pressure measurement with suitable instrument.

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
1	Surface Plate-Granite (24 x 36 inch)	1,2,3,4,7,8,9,10
2	Surface roughness Tester (Max Sampling length 0.8 mm) having profile printing facility	10
3	Set of surface roughness standard pieces: Ra (micron) - 0.8 to 50.0, Rz (micron) - 2.5 to 250 including turned, end milled, surface grounded and lapped.	10
4	Inductive transducer – measurement range 0 to 100 mm – sensor – inductive (nonlinear) solenoid type onboard with micrometer, micrometer screw gauge assembly for displacement, bridge balance type circuit Display 3.5 digit display	11
5	Sensor – type K (Cr-AI) thermocouple, sensor assembly and water bath with heating arrangement Display 3.5 digit display	12
6	Bourdon tube C type with LVDT Display 3.5 display for Pressure / Displacement	13
7	Multidigital Stroboscope cum Tachometer for speed measurement – up to 5000 rpm	14

**MECHANICAL MEASUREMENT****Course Code : 314019**

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
8	Eddy Current Dynamometer - 250 kW (335 bhp)- Max Power, 1200 Nm (886 lbf.ft) – Max Capacity, 8000 rpm- Max Speed	15
9	Vernier Calipers (0-200 mm)	2
10	Vernier Height Gauge and Depth Gauge. (0-300 mm)	2
11	Outside Micrometer (0-25 mm, 25-50 mm)	2
12	Inside Micrometer (0-25 mm)	2
13	Dial indicator (0-25 mm) with magnetic stand	3,4,7
14	Optical flats set range (0.2 $\mu$ m) Diameter / Thickness 45/12 mm and 60/15 mm	5
15	Pneumatic comparator unit (Range 0 to 10 bar)	6
16	Universal bevel protractor Graduation: 5 min (0-90-0 degrees)	7
17	Sine bar, Sine Center (0-200mm)	7
18	Slip gauge set of M83 (Measuring Range: 1.001 – 1.009, 1.01- 1.49, 0.5 – 9.5, 10-100)	7
19	Screw thread micrometer (Accuracy 0.001-0.006 mm, Dimensions 40 cm x 50 cm x 8 cm)	8
20	Profile projector with gear profile / Thread profile templates Opaque fine grained ground glass screen with 90 deg, 60 deg, 30 deg cross line Location; fitted with graduated ring (0 to 360 deg) L.C. 1 min; Optics Std 10X, 20X, Measuring Range Std 100mm X 100mm; Opt X axis upto 400 mm, Y axis upto 200 mm; Focusing Travel 100 mm; Magnification Accuracy Contour $\pm$ 0.05% Surface $\pm$ 0.05%; Illumination Countor 24V / 150W halogen lamp with illumination control; Resolution 0.005/0.001/0.0005 mm	8,9
21	Gear Tooth Vernier Caliper (0-25 mm)	9

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

<b>Sr.No</b>	<b>Unit</b>	<b>Unit Title</b>	<b>Aligned COs</b>	<b>Learning Hours</b>	<b>R-Level</b>	<b>U-Level</b>	<b>A-Level</b>	<b>Total Marks</b>
1	I	Overview of Measurement	CO1,CO2	4	0	0	0	0
2	II	Angular, Screw Thread, Gear, Surface Measurements and Geometrical Testing	CO2,CO3	6	0	0	0	0

**MECHANICAL MEASUREMENT****Course Code : 314019**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
3	III	Miscellaneous Measurement	CO4	5	0	0	0	0
<b>Grand Total</b>				<b>15</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Continuous Assessment based on Product and Process related performance indicators

**Summative Assessment (Assessment of Learning)****XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	1	3	1	-	2			
CO2	3	-	1	3	1	-	2			
CO3	3	-	-	3	1	-	2			
CO4	3	-	-	3	1	-	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
 \*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

<b>Sr.No</b>	<b>Author</b>	<b>Title</b>	<b>Publisher with ISBN Number</b>
1	N.V. Raghavendra and L. Krishnamurthy	Engineering Metrology and Measurement	Oxford University Press, New Delhi, India ISBN-13: 978-0-19-808549-2. (2013)
2	Anand K Bewoor and Vinay A Kulkarni	Metrology and Measurements	Tata McGraw-Hill Education Private Limited, New Delhi, India ISBN (13): 978-0-07-014000-4 (2017)
3	R K Jain	Engineering Metrology	Khanna Publication, New Delhi, ISBN- 10:817409153X (2022)
4	R. K. Rajput	Engineering Metrology & Instrumentation	S.K. Kataria and Sons ISBN:9788185749822 (2009)
5	R K Jain	Mechanical and Industrial Measurements	Khanna Publication, New Delhi ISBN: 8174091912 (1995)
6	Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard	Mechanical Measurements	Pearson Prentice Hall ISBN:9780136093763 (2013)

**XIII. LEARNING WEBSITES & PORTALS**

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
1	<a href="https://onlinecourses.nptel.ac.in/noc20_me94/preview">https://onlinecourses.nptel.ac.in/noc20_me94/preview</a>	NPTEL MOOCS course on Engineering Metrology
2	<a href="https://onlinecourses.nptel.ac.in/noc23_me09/preview">https://onlinecourses.nptel.ac.in/noc23_me09/preview</a>	NPTEL MOOCS course on Mechanical Measurement Systems
3	<a href="https://www.youtube.com/watch?reload=9&amp;v=Hi7NUJdznc0">https://www.youtube.com/watch?reload=9&amp;v=Hi7NUJdznc0</a>	Video Lecture on Engineering Metrology by IIT Madras
4	<a href="https://www.youtube.com/watch?v=xPGi2e-gOo8&amp;t=196s">https://www.youtube.com/watch?v=xPGi2e-gOo8&amp;t=196s</a>	Measurement of screw thread elements
5	<a href="https://www.youtube.com/watch?v=ShDbYKmOKH8">https://www.youtube.com/watch?v=ShDbYKmOKH8</a>	Potentiometer Working Principle

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
6	<a href="https://www.youtube.com/watch?v=TqPBDFXyQ_k">https://www.youtube.com/watch?v=TqPBDFXyQ_k</a>	Working Principle of Thermocouple, RTD, Thermistors
7	<a href="https://www.youtube.com/watch?v=9VpimWrPTaM">https://www.youtube.com/watch?v=9VpimWrPTaM</a>	Different Pressure measurement instruments
8	<a href="https://www.youtube.com/watch?v=_OnGXJA7oX8&amp;t=1215s">https://www.youtube.com/watch?v=_OnGXJA7oX8&amp;t=1215s</a>	Working Principle of Dynamometers

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students