

## Maharashtra State Board Of Technical Education, Mumbai

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

Maharashtra State Board Of Technical Education, Mumbai																													
Learning and Assessment Scheme for Post S.S.C Diploma Courses																													
Programme Name		: Diploma In Automobile Engineering.																											
Programme Code		: AE										With Effect From Academic Year					: 2023-24												
Duration Of Programme		: 6 Semester										Duration					: 16 WEEKS												
Semester		: Sixth										NCrF Entry Level : 4.0					Scheme					: K							
Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme						Credits	Paper Duration (hrs.)	Assessment Scheme										Total Marks					
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Theory			Based on LL & TL				Based on Self Learning											
						CL	TL	LL			FA-TH			SA-TH	Total	Practical		SLA											
																FA-PR	SA-PR	Max	Min	Max	Min								
<b>(All Compulsory)</b>																													
1	MANAGEMENT	MAN	AEC	315301	1	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125						
2	AUTOMOBILE COMPONENT DESIGN	ACD	DSC	316346	6	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125						
3	AUTOMOBILE HYDRAULIC AND PNEUMATIC CONTROL SYSTEMS	HPC	DSC	316347	-	3	-	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150						
4	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	EDS	AEC	314014	-	1	-	2	1	4	2	-	-	-	-	50	20	25@	10	25	10	100							
5	AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEM	AES	AEC	316009	-	2	-	2	-	4	2	-	-	-	-	25	10	50@	20	-	-	75							
6	SOLID MODELLING AND ADDITIVE MANUFACTURING	SAM	SEC	316010	-	-	-	4	2	6	3	-	-	-	-	25	10	25#	10	25	10	75							
7	CAPSTONE PROJECT	CPE	INP	316004	-	-	-	2	2	4	2	-	-	-	-	50	20	50#	20	50	20	150							
<b>Elective - II (Any - One)</b>																													
8	ALTERNATIVE FUELS FOR AUTOMOBILES	AFL	DSE	316348	-	4	-	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150						
	AUTOMOBILE AIR CONDITIONING	AAC	DSE	316349	-	4	-	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150						
	AUTOTRONICS	ATN	DSE	316350	-	4	-	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150						
<b>Total</b>					<b>7</b>	<b>17</b>	<b>-</b>	<b>16</b>	<b>7</b>		<b>20</b>		<b>120</b>	<b>280</b>	<b>400</b>		<b>225</b>		<b>175</b>		<b>150</b>		<b>950</b>						

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						CL	TL	LL					FA-TH		SA-TH		Total		FA-PR			SA-PR		SLA	
													Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min

**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) , Ability Enhancement Course (AEC) , Skill Enhancement Course (SEC) , Generic Elective (GE)

**Programme Name/s** : Automobile Engineering.  
**Programme Code** : AE  
**Semester** : Sixth  
**Course Title** : AUTOMOBILE COMPONENT DESIGN  
**Course Code** : 316346

### I. RATIONALE

The automotive industry is a dynamic and rapidly evolving sector, driven by technological advancements, increasing performance demands, and stringent safety and environmental regulations. Consequently, the design and development of automotive components require a sophisticated and multidisciplinary approach. This course addresses the critical need for engineers who possess a strong foundation in component design principles, coupled with the ability to apply modern design methodologies and analysis techniques.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of the course is to help the students to attain the following industry identified outcome through various teaching learning experiences:

Students will be able to design automotive components using relevant design principles and methodologies.

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

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

- CO1 - Apply fundamental design principles and methodologies to design automotive components.
- CO2 - Determine stresses in automobile components under various loading conditions
- CO3 - Design automotive chassis components.
- CO4 - Design automotive engine components.
- CO5 - Design simple axles using available data.

### IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH			Theory			Based on LL & TL				Based on SL			
				CL	TL	LL					FA-TH	SA-TH	Total	Practical		SLA					
				Max	Max	Max	Min	Max			Min	Max	Min	Max	Min	Max	Min				
316346	AUTOMOBILE COMPONENT DESIGN	ACD	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125

**Total IKS Hrs for Sem. : 6 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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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.
1	<p>TLO 1.1 List the principles of modern design concepts for designing Auto component.</p> <p>TLO 1.2 Describe the modes of failure with relevant examples.</p> <p>TLO 1.3 Explain component design procedure.</p> <p>TLO 1.4 Describe the standards used in the design of the given automobile component.</p> <p>TLO 1.5 Explain effects of aesthetics and ergonomics on shape and size of an automobile component.</p> <p>TLO 1.6 List environmental consideration in design of automobile components.</p>	<p><b>Unit - I Design Principles and Practices</b></p> <p>1.1 Component design – Concept and modern design considerations (Concurrent engineering, Design for manufacturing, Design for assembly).</p> <p>1.2 Modes of failure of different automotive components.</p> <p>1.3 Basic requirements of automobile components, Basic automobile component design procedure.</p> <p>1.4 Use of IS codes (For material designation, Testing of materials, standard for shapes and dimensions, standards for fits, Tolerances and surface finish) and Standards in automobile component design (Introduction only), Preferred numbers series.</p> <p>1.5 Ergonomic and aesthetic considerations in automobile component design (shape, size and color).</p> <p>1.6 Environmental consideration in component design.</p>	<p>Lecture Using Chalk-Board</p> <p>Case Study</p> <p>Video</p> <p>Demonstrations</p> <p>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 State different types of loads acting on automobile components.</p> <p>TLO 2.2 Describe stresses induced in the given components.</p> <p>TLO 2.3 State torsional equation for solid and hollow shafts.</p> <p>TLO 2.4 Describe SN curve.</p> <p>TLO 2.5 Illustrate suitable remedies to reduce stress concentration for the given component with justification.</p> <p>TLO 2.6 List criteria affecting selection of factor of safety.</p>	<p><b>Unit - II Fundamentals of Design</b></p> <p>2.1 Types of loads-Static, Dynamic, Impact, Shock .</p> <p>2.2 Types of stresses-Normal and Shear stresses, Crushing stress, Bearing pressure, Bending stresses (Simple numerical only).</p> <p>2.3 Torsion of shafts, Modulus of rigidity, Torsional equation, (Simple numerical on solid, hollow shafts only).</p> <p>2.4 Fatigue, Endurance limit, SN Curve.</p> <p>2.5 Stress concentration, causes and remedies.</p> <p>2.6 Working stress, factor of safety, selection of factor of safety.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations</p>
3	<p>TLO 3.1 Describe design procedure for threaded joint in a tie rod.</p> <p>TLO 3.2 Calculate friction lining dimensions of a clutch plate.</p> <p>TLO 3.3 Describe design procedure for a propeller shaft and universal coupling.</p> <p>TLO 3.4 Explain design procedure of parallel and transverse fillet welded joints for axially loaded symmetrical sections.</p>	<p><b>Unit - III Design of chassis components</b></p> <p>3.1 Design of threaded joint in a tie rod.</p> <p>3.2 Torque transmitted by clutch considering Uniform pressure and Uniform wear theory (No derivation), Clutch plate friction lining design for single and multi-plate clutch considering uniform wear condition. (Simple numerical only).</p> <p>3.3 Design of propeller shaft, Universal coupling design (Shaft diameter, pin diameter and empirical relations).</p> <p>3.4 Design of welded joints in automobile manufacturing, Design of parallel and transverse fillet welds, axially loaded symmetrical Section.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom</p>
4	<p>TLO 4.1 Explain valve spring design procedure.</p> <p>TLO 4.2 Explain design procedure for IC engine piston and piston pin.</p> <p>TLO 4.3 Describe design procedure of connecting rod.</p>	<p><b>Unit - IV Design of Engine components</b></p> <p>4.1 Materials for valve spring with justification, IC engine valve spring terminology, Design procedure of valve spring.</p> <p>4.2 Materials for piston and piston pin with justification, IC engine piston design procedure (For strength) , Piston pin design procedure (Simple numerical only).</p> <p>4.3 Materials for connecting rod with justification, Design procedure of connecting rod cross section (Simple numerical only).</p>	<p>Lecture Using Chalk-Board Video Demonstrations 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.
5	<p>TLO 5.1 Describe design procedure a front axle cross section for given load condition</p> <p>TLO 5.2 Describe design procedure of a full floating rear axle cross section for given load condition.</p>	<p><b>Unit - V Design of Axles</b></p> <p>5.1 Material for axle with justification, Design procedure for front axle beam cross section (Simple numerical only).</p> <p>5.2 Material for rear axle with justification, Design procedure for full floating rear axle cross section (solid, hollow)(Simple numerical only).</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Model</p> <p>Demonstration</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
LLO 1.1 Find a feasible solution to resolve manufacturing and assembly issues using 'Concurrent Engineering' .	1	*Concurrent Engineering for designing automobile components.	2	CO1
LLO 2.1 Select suitable material for automobile component based on environmental aspects.	2	Environmental considerations in component design	2	CO1
<p>LLO 3.1 Select an automobile component based on ergonomic and aesthetic considerations as per requirement.</p> <p>LLO 3.2 List the ergonomic and aesthetic aspects identified components under LLO 3.1.</p> <p>LLO 3.3 Analyze shape, size and color of selected component with respect to ergonomics and aesthetics.</p>	3	Aesthetic and Ergonomic design considerations in automobile components.	2	CO1
LLO 4.1 Find a feasible solution to reduce stress concentration in the engine/ chassis components such as crank, connecting rod, chassis frame, leaf spring, axles, etc.	4	*Stress concentration in the automobile components.	2	CO2
<p>LLO 5.1 Identify material used in manufacturing of automobile components such as crank, connecting rod, chassis frame, leaf spring, axles, etc. (Any four) referring design data book.</p> <p>LLO 5.2 Specify material properties for components given in LLO 5.1 with relevant justification.</p>	5	*Automobile component materials.	2	CO1 CO2
<p>LLO 6.1 Measure dimensions of given propeller shaft and Universal coupling.</p> <p>LLO 6.2 Select relevant materials from design data book.</p> <p>LLO 6.3 Select relevant design procedure.</p> <p>LLO 6.4 Calculate dimensions.</p> <p>LLO 6.5 Modify dimensions.</p> <p>LLO 6.6 Prepare CAD drawing.</p>	6	*Propeller shaft and universal coupling design	6	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Measure dimensions of given piston. LLO 7.2 Select relevant materials from design data book. LLO 7.3 Select relevant design procedure. LLO 7.4 Calculate dimensions. LLO 7.5 Modify dimensions. LLO 7.6 Prepare CAD drawing.	7	*Piston design	6	CO4
LLO 8.1 Measure dimensions of given front axle beam. LLO 8.2 Select relevant materials from design data book. LLO 8.3 Select relevant design procedure. LLO 8.4 Calculate dimensions of I section. LLO 8.5 Modify dimensions for preparation of drawing.	8	Front axle design	4	CO5
LLO 9.1 Measure dimensions of given rear axle beam. LLO 9.2 Select relevant materials from design data book. LLO 9.3 Select relevant design procedure. LLO 9.4 Calculate the dimensions of the section. LLO 9.5 Modify the dimensions for preparation of drawing.	9	*Rear axle design.	4	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)**

**Other**

- 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 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**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system (Core i5 or equivalent, RAM- 4GB or more, Monitor 20" or more) with internet connectivity (More than 2 mbps)	1
2	Computer system (Core i5 or equivalent, RAM- 4GB or more, Monitor 20" or more) with internet connectivity (More than 2 mbps)	2
3	Chassis model of old vehicle with major chassis components (Chassis frame, leaf spring, engine mounted on frame, propeller shaft, Axles).	3
4	Chassis model of old vehicle with major chassis components (Chassis frame, leaf spring, engine mounted on frame, propeller shaft, Axles). Crankshaft, piston, connecting rod, valves, etc.	4
5	Design data book and Chassis model of old vehicle with major chassis components (Chassis frame, leaf spring, engine mounted on frame, propeller shaft, Axles). Crankshaft, piston, connecting rod, valves, etc.	5
6	Single piece propeller shaft with hollow cross section and slip joint, universal coupling at ends for any commercially vehicle.	6
7	Petrol/Diesel engine working model, specifications of the engine, Vernier caliper, Design data book and piston connecting rod assembly model.	7
8	Dead type front axle (I cross section) with chassis component mounted on frame, Design data book.	8
9	fully floating rear axle used in light/heavy commercial motor vehicle with vehicle specifications (Engine torque, gear box ratio, differential ratio).	9

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Design Principles and Practices	CO1	12	4	8	4	16
2	II	Fundamentals of Design	CO2	10	2	8	2	12
3	III	Design of chassis components	CO3	14	4	4	8	16
4	IV	Design of Engine components	CO4	16	2	4	8	14
5	V	Design of Axles	CO5	8	2	8	2	12
<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)**

- Continuous assessment based on process and product related performance indicators

**Summative Assessment (Assessment of Learning)**

- End semester examination

**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	2	2	2	-	2			
CO2	3	3	2	2	-	-	2			
CO3	3	3	3	2	-	-	2			
CO4	3	3	3	2	-	-	2			
CO5	3	3	2	2	-	-	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	Bhandari, V.B.	Design of Machine Elements	McGraw Hill Education New Delhi, 3rd Edition 2012 ISBN (13 digit) 9780070681798
2	Khurmi, R.S., Gupta J.K.	A Textbook of Machine Design	S Chand Publishing New Delhi 2010, ISBN (13 Digit) 9788121925372
3	Giri, N.K.	Automobile Technology	Khanna Publisher, Delhi 110006, 2012, ISBN (13 Digit) 9788174091789
4	--	Design Data Book	PSG College of Technology Coimbatore, 2014 ISBN 13-9788192735504
5	Aggarwal K.M.	Auto Design Problems	Satya Prakashan New Delhi 2012 ISBN:8176842079

## XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3283358">https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3283358</a>	Environment consideration in Auto component design
2	<a href="https://www.youtube.com/watch?v=9_R7M49Atz4">https://www.youtube.com/watch?v=9_R7M49Atz4</a>	Aesthetics and Ergonomics in Design
3	<a href="https://www.youtube.com/watch?v=-hLwyhDRcJM">https://www.youtube.com/watch?v=-hLwyhDRcJM</a>	Design of fillet welds
4	<a href="https://www.youtube.com/watch?v=LhUclxBUV_E">https://www.youtube.com/watch?v=LhUclxBUV_E</a>	Fatigue testing procedure
5	<a href="https://www.youtube.com/watch?v=ZwqBia_gRGo&amp;list=PLg9TnucUbzBW3tt1AtCBxcz6Hr1YqQYwQ&amp;index=1">https://www.youtube.com/watch?v=ZwqBia_gRGo&amp;list=PLg9TnucUbzBW3tt1AtCBxcz6Hr1YqQYwQ&amp;index=1</a>	Design of piston in IC engine
6	<a href="https://www.youtube.com/watch?v=PvIm35eiI78">https://www.youtube.com/watch?v=PvIm35eiI78</a>	Use of Design data book
7	<a href="https://www.youtube.com/watch?v=-FG9AVYqF0U">https://www.youtube.com/watch?v=-FG9AVYqF0U</a>	Modes of failure
8	<a href="https://www.youtube.com/watch?v=yQGiwSHQab8">https://www.youtube.com/watch?v=yQGiwSHQab8</a>	Methods of reducing stress concentration

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
<b>Note :</b> <ul style="list-style-type: none"><li>Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students</li></ul>		

**Programme Name/s** : Automobile Engineering.  
**Programme Code** : AE  
**Semester** : Sixth  
**Course Title** : AUTOMOBILE HYDRAULIC AND PNEUMATIC CONTROL SYSTEMS  
**Course Code** : 316347

### I. RATIONALE

Hydraulic and pneumatic control systems are extensively used in both the automotive and manufacturing industries due to their versatility and adaptability in automation. Automobile technocrats must be proficient in maintaining these systems. This course is designed to provide students with the knowledge and skills essential to effectively maintain and manage various hydraulic and pneumatic systems in industrial settings.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Maintain automotive hydraulic and pneumatic systems efficiently.

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

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

- CO1 - Apply principles of fluid mechanics for energy conservation.
- CO2 - Select suitable hydraulic pumps for the given applications.
- CO3 - Maintain hydraulic and pneumatic components used in automobile systems.
- CO4 - Select appropriate accessories for a given fluid-operated systems.
- CO5 - Maintain hydraulic, pneumatic and hydro-pneumatic circuits and systems.

### IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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316347	AUTOMOBILE HYDRAULIC AND PNEUMATIC CONTROL SYSTEMS	HPC	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150

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

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1	TLO 1.1 Define different properties of fluids. TLO 1.2 Classify different fluid flows. TLO 1.3 Classify different pressures. TLO 1.4 List different device for measurement of pressure. TLO 1.5 Determine different parameters by using Bernoulli 's theorem. TLO 1.6 Calculate different Hydraulic Coefficients.	<b>Unit - I Overview of Fluid Mechanics</b> 1.1 Fluid Fundamentals: Classification of fluids, properties of fluids: specific weight, specific gravity, viscosity. Specifications of hydraulic oil, Pascal 's law, Types of fluid flow- steady, unsteady, laminar, turbulent, one, two and three dimensional flow, uniform and non-uniform flow. 1.2 Pressure Measurement: Concept of Intensity of pressure and pressure head. Concept of atmospheric pressure, gauge pressure, vacuum and absolute pressure. Pressure gauges - Piezometer tube, simple and differential manometer. Bourdon's tube pressure gauge 1.3 Hydrodynamics: Basic principles of fluid flow, Law of continuity and its applications. Energy possessed by the liquid in motion. Bernoulli's theorem and its applications such as Venturi meter, orifice-meter and Pitot tube. Hydraulic Coefficients: Coefficient of Contraction, Coefficient of Velocity, Coefficient of Discharge and Coefficient of Resistance. Relation between hydraulic coefficients.	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration

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 construction and working of different pumps.</p> <p>TLO 2.2 State significance of NPSH.</p> <p>TLO 2.3 Select pumps on the basis of pressure, discharge, field of application and economy.</p> <p>TLO 2.4 Differentiate the given Positive Displacement pumps.</p>	<p><b>Unit - II Hydraulic Machinery</b></p> <p>2.1 Centrifugal Pump: Working principle of centrifugal pump and types of casing. Need of priming, Heads, losses and efficiencies of centrifugal pump, Cavitation and Net Positive Suction Head (NPSH), Fault finding and remedies, Pump selection.</p> <p>2.2 Reciprocating Pump: Construction and working of single and double acting reciprocating pump, Coefficient of discharge, positive and negative slip, Air vessels (Functions and Advantages)</p> <p>2.3 Submersible Pump: Construction, working and application</p> <p>2.4 Positive Displacement Pumps: Gear type, vane type, plunger type (axial, radial, swash plate and bent axis), Comparison of above pumps for various characteristics and their applications.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration</p>
3	<p>TLO 3.1 Draw layout of automobile hydraulic and pneumatic system.</p> <p>TLO 3.2 Explain the constructional and working of the given hydraulic and pneumatic actuator with neat sketch.</p> <p>TLO 3.3 Explain hydraulic and pneumatic valves with neat sketch.</p> <p>TLO 3.4 Classify different valves.</p>	<p><b>Unit - III Basic Components of Hydraulic and Pneumatic Systems</b></p> <p>3.1 General layout of oil hydraulics and pneumatics system.</p> <p>3.2 Hydraulic Actuators-hydraulic cylinders (Single, double and telescopic)-Construction and working, hydraulic motors (gear and piston type)-construction and working.</p> <p>3.3 Pneumatic Actuators-Pneumatic cylinders (single and double acting)-construction and working, air motors (vane and piston type)-construction and working.</p> <p>3.4 Classification of Control valves. Pressure control valves- relief, unloading, sequence, counter balance, pressure reducing valves. Direction control valves- Check valve, 2/2, 3/2, 4/2, 4/3, 5/2, 5/3 D.C. Valves used in Hydraulics and Pneumatics. Standard centre positions, Methods of valve actuation. Flow control valves- Non-compensated, Pressure and temperature compensated.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration</p>
4	<p>TLO 4.1 Explain with sketch the functions of the given accessory for hydraulic systems.</p> <p>TLO 4.2 Compare the given accessories of pneumatic/hydraulic systems.</p> <p>TLO 4.3 Select accessories based on Material Compatibility, type of sealing (Static/ dynamic), Shape and Design.</p>	<p><b>Unit - IV Accessories of hydraulic and Pneumatic systems</b></p> <p>4.1 Hydraulic filters and strainers- Full flow and proportional types, function and working, difference between filters and strainers.</p> <p>4.2 Pneumatic Filters-Screen type and mechanical type, function and working, FRL unit.</p> <p>4.3 Hoses and connectors for Hydraulic and Pneumatic systems- Types, construction and application.</p> <p>4.4 Seal and gasket for hydraulic and pneumatic systems- Types, function and construction of commonly use seals and gasket materials.</p> <p>4.5 Concept of Intensifiers and accumulators.</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.
5	<p>TLO 5.1 Draw ISO symbols (ISO 1219-1:2012) used in Pneumatic Hydraulic circuits.</p> <p>TLO 5.2 Draw simple hydraulic and pneumatic circuits.</p> <p>TLO 5.3 Draw specified circuit using the given components for the given application.</p> <p>TLO 5.4 Name different components of Hydro-pneumatic systems.</p> <p>TLO 5.5 Write procedure for Maintenance of Hydraulic, Pneumatic and hydro-pneumatic systems.</p> <p>TLO 5.6 Diagnose different faults in hydraulic and pneumatics systems.</p>	<p><b>Unit - V Hydraulic and Pneumatic Circuits and systems</b></p> <p>5.1 ISO symbols (ISO 1219-1:2012) used in Pneumatic Hydraulic circuits.</p> <p>5.2 Simple Hydraulic circuits: Single and Double Acting Hydraulic cylinders, motors. Speed control circuits: Meter in, Meter out, bleed off, Sequencing circuits Applications of hydraulics circuits-Hydraulic power steering, hydraulic brakes, milling machine, hydraulic press. Electro-hydraulics- concept, principles and applications.</p> <p>5.3 Simple pneumatic circuits: Single and Double Acting Hydraulic cylinders, motors. Speed control circuit, Sequencing circuit and time delay circuit, Application of pneumatic circuits-air brake, low-cost automation in industries, pneumatic power tools (drill, nut runner, hammer and grinder).</p> <p>5.4 Simple hydro-pneumatic circuits and system-Hydro-pneumatic rams, Brake booster of truck/bus, Pin lift of pneumatic mounding machines.</p> <p>5.5 Maintenance of Hydraulic, Pneumatic and hydro-pneumatic systems.</p> <p>5.6 Troubleshooting of hydraulic and pneumatics systems.</p>	<p>Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration</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 various components of available hydraulic brake.</p> <p>LLO 1.2 Check the condition of various components of hydraulic brake.</p> <p>LLO 1.3 Do the necessary remedial action based on condition observed.</p>	1	Hydraulic circuit and components of automobile hydraulic brakes relevant to Pascal's law.	2	CO1
<p>LLO 2.1 Calculate total energy available at different sections of a pipe layout.</p> <p>LLO 2.2 Verify Bernoulli's theorem.</p>	2	*Measurement of total energy available at different sections of a pipe layout to verify Bernoulli's theorem	2	CO1
<p>LLO 3.1 Measure the manometric head (Hm) at different flow rates</p> <p>LLO 3.2 Calculate overall efficiency of centrifugal pump</p> <p>LLO 3.3 Plot performance characteristics based on the results</p>	3	*Determination of overall efficiency of Centrifugal pump using Centrifugal pump test rig	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 Identify various components of centrifugal pump LLO 4.2 Check the condition of various components of centrifugal pump LLO 4.3 Do the necessary remedial action based on condition observed.	4	Assembly and dismantling of the centrifugal pump to prepare a troubleshooting chart.	2	CO2
LLO 5.1 Calculate overall efficiency of reciprocating pump LLO 5.2 Calculate percentage slip of reciprocating pump	5	*Determination of overall efficiency and percentage slip of Reciprocating pump using Reciprocating pump test rig	2	CO2
LLO 6.1 Identify various components of available reciprocating pump. LLO 6.2 Check the condition of various components of reciprocating pump. LLO 6.3 Do the necessary remedial action based on condition observed.	6	Assembly and dismantling of the reciprocating pump to prepare a troubleshooting chart.	2	CO2
LLO 7.1 Identify various components of available lubricating oil pump. LLO 7.2 Check the condition of various components of lubricating oil pump. LLO 7.3 Do the necessary remedial action based on condition observed.	7	Assembly and dismantling of the lubricating oil pump of car.	2	CO2
LLO 8.1 Identify various components of air motor. LLO 8.2 Check the condition of various components of air motor. LLO 8.3 Do the necessary remedial action based on condition observed.	8	Assembly and dismantling of the air motor.	2	CO3
LLO 9.1 Identify various components of used valve. LLO 9.2 Check the condition of various components of used valve. LLO 9.3 Do the necessary remedial action based on condition observed.	9	*Assembly and dismantling of the hydraulic and pneumatic system valves.	2	CO3
LLO 10.1 Inspect hydraulic and pneumatic filters used in the system. LLO 10.2 Clean hydraulic and pneumatic filters used in the system. LLO 10.3 Replace hydraulic and pneumatic filters used in the system if needed.	10	Service and replacement of the hydraulic and pneumatic filters.	2	CO4
LLO 11.1 Identify and select leak detection tests. LLO 11.2 Check the effectiveness of seals and gaskets by identifying leaks. LLO 11.3 Do the necessary remedial action based on condition observed.	11	*Leak detection test to verify the effectiveness of installed seals and gaskets.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 12.1 List ISO symbols used in Pneumatic Hydraulic circuits. LLO 12.2 Draw ISO symbols used in Pneumatic Hydraulic circuits.	12	Drawing of the ISO symbols used in pneumatic hydraulic circuits.	2	CO5
LLO 13.1 Draw Meter-in and Meter-Out Hydraulic circuits. LLO 13.2 Choose different components for Meter-in and Meter-Out Hydraulic circuits. LLO 13.3 Connect and Test the circuit for the correct operation.	13	*Construction and actuation of the Meter-in and Meter-Out hydraulic circuits.	2	CO5
LLO 14.1 Draw Sequencing Hydraulic circuits. LLO 14.2 Choose different components for Sequencing Hydraulic circuits. LLO 14.3 Connect and Test the circuit for the correct operation.	14	*Development of any suitable sequencing hydraulic circuit	2	CO5
LLO 15.1 Draw Sequencing Pilot Control Pneumatic circuits. LLO 15.2 Choose different components for Pilot Control Pneumatic circuit. LLO 15.3 Connect and Test the circuit for the correct operation.	15	Construction and actuation of the pilot control pneumatic circuit.	2	CO5
LLO 16.1 Select a Hydraulic and Pneumatic simulation software. LLO 16.2 Represent the Hydraulic and Pneumatic circuit using the software's graphical interface and connecting the components. LLO 16.3 Execute the simulation to observe the circuit's behavior.	16	*Construction of the Hydraulic and Pneumatic circuit using simulation software.	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)**

**Assignment**

- Visit a hydroelectric power plant and prepare a report on layout of plant, components of plant.
- Power Point Presentation on accessories used in hydraulics and pneumatics by group of two/three students. (Duration: 10 minutes)
- Prepare journal based on practical performance in Industrial fluid power laboratory.
- Power Point Presentation on hydraulic and Pneumatic brakes by group of two/three students. (Duration: 10 minutes)

- Power Point Presentation on accessories used in hydraulics and pneumatics by group of two/three students. (Duration: 10 minutes)
- Power Point Presentation on accessories used in hydraulics and pneumatics by group of two/three students. (Duration: 10 minutes)
- Prepare Seminar/presentation on types of oil filters by group of two/three students.(Duration: 10 minutes)

**Micro project**

- Prepare report of market survey of suppliers for fluid powered Earth moving equipment's like JCB, Mahindra Earth master by group of four students.
- Prepare chart on full imperial drawing sheet for ISO Symbols used in hydraulic and pneumatic system by group of two students.
- Prepare display chart on types of seals and gaskets (actual/ used samples) used in hydraulics.
- Prepare visit report of any automobile service station to observe use of pneumatic hand tools.
- Prepare visit report of construction sites to observe use of earth moving equipment /Other hydraulic /pneumatic equipment's for automation.
- Prepare case study report on maintenance of hydraulic brake, air brake, hydraulic jack, and hydraulic power steering.
- Prepare a detailed report based on the range of products, manufacturer and technical specifications of Centrifugal/ reciprocating/ multistage pumps/ submersible pumps/any other pump from the local market or internet.

**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**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hydraulic trainer kit consisting of power pack (motor, pump, tank, filter, breather, pressure relief valve and pressure gauge), Basic components-valves-direction control valve, flow control valve, sequencing valve, bleed off valve, pressure gauge, actuators, accumulators, rigid pipes, hoses and connectors.	13,14
2	Compressor (Two stage -Two-cylinder air cooled, with intercooler and after cooler, receiver mounted,30 to 40 m <sup>3</sup> /hr,3.5 KW with pressure switch, pressure gauge and safety valve mounted).	15,16
3	Pneumatic trainer kit consisting of compressor, basic components-FRL unit, valves-direction control valve, flow control valve, safety valve, sequence valve, connectors and hoses.	15,16
4	Venturimeter Test-Rig (Venturimeter-Cast iron/Brass/PVC) 25 mm and 50 mm.	2

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Practical; Set-up of Bernoulli's Theorem (apparatus for verification of Bernoulli's theorem complete with tank).	2
6	Measuring Equipments (Pressure gauges, Stopwatch, etc)	2,4,6
7	Centrifugal pump test rig (Constant Speed-Centrifugal pump, with electric motor, vacuum gauge at suction and pressure gauge on discharge pipe, gate valve on discharge). Motor suitable for main and operating characteristics.	3
8	Centrifugal Pump-1/2 HP (370 W),1400 rpm.	4
9	Maintenance kit (Maintenance tool kit for hydraulic and pneumatic system)	4,6,7,8
10	Hydraulics and Pneumatics Maintenance Tool Kit	4,6,7,8,9,10,11
11	Reciprocating pump test rig (Re-circulating type unit with reciprocating pump and vacuum gauge, pressure gauge at discharge) three speed drive arrangement pulley.	5
12	Reciprocating pump-Max.Flow rate: upto 3728 L/Hr Max. Pressure: upto 150	6
13	Gear pump of lubrication system of a vehicle.	7
14	Hydraulic and Pneumatic Valves- Direction control valves: Operating pressure min 10 bar Operating pressure max 50 bar, Nominal flow 80 L/min. Flow control valve: Valve size 1/4" to 2", Pressure 500 bar. Pressure relief valve: flow rate (60 L/min). Material- Brass, Pressure-35 bar.	9

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of Fluid Mechanics	CO1	8	2	4	6	12
2	II	Hydraulic Machinery	CO2	10	4	4	8	16
3	III	Basic Components of Hydraulic and Pneumatic Systems	CO3	12	4	6	8	18
4	IV	Accessories of hydraulic and Pneumatic systems	CO4	6	2	2	4	8
5	V	Hydraulic and Pneumatic Circuits and systems	CO5	9	2	6	8	16
<b>Grand Total</b>				<b>45</b>	<b>14</b>	<b>22</b>	<b>34</b>	<b>70</b>

### X. ASSESSMENT METHODOLOGIES/TOOLS

#### Formative assessment (Assessment for Learning)

- Two-unit tests of 30 marks and average of two-unit tests.
- For laboratory learning 25 Marks
- For Self Learning 25 Marks

#### Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.

### 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	3	3	3	3	-			
CO2	3	3	-	3	2	3	3			
CO3	3	3	-	-	-	3	2			
CO4	3	-	-	-	-	3	2			
CO5	3	3	3	3	2	3	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	Er. R.K. Rajput	A Textbook of Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi, 1 January 2016 ISBN: 9789385401374
2	Dr. R.K. Bansal	Fluid Mechanics and Hydraulic Machines	Laxmi Publications Pvt. Ltd., New Delhi, 1 January 2019 ISBN: 9788131808153
3	Dr. P.N. Modi, Dr. S.M. Seth	Hydraulics and Fluid Mechanics including Hydraulic Machines	Standard Book House, New Delhi, 1 January 2019 ISBN: 13: 9788189401269
4	R.S. Khurmi, N. Khurmi	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi, 15th Edition, ISBN: 9788121901628
5	Modi P.N.; Seth S.M.	Hydraulic and fluid Mechanics	Standard Book House, Delhi, 2017 ISBN-13:978-8189401269
6	Pippenger, Hicks	Industrial Hydraulics	McGraw Hill Int. Mumbai, 3rd Edition ISBN-13:978-0070501409
7	Ilango.S. Soundararajan V	Introduction to Hydraulics and Pneumatics	PHI Learning Private Limited, New Delhi, 11 March 2012 ISBN: 978-8120344068
8	Esposito Anthony	Fluid Power with Applications	PEARSON Education, Noida, Delhi, 1 January 2013, ISBN-13:978-8177585803
9	Sundaram S.K.	Hydraulic and Pneumatic Controls	S. Chand, Pune, 2006. 1 December 2006 ISBN-13:978-8121926355
10	Vickers	Industrial Hydraulics Manuel	Vickers system international Ltd. Pimpri, Pune-411018, 1999. ISBN-13:978-0963416209

## XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.youtube.com/watch?v=_bfcdRhY7Rw">https://www.youtube.com/watch?v=_bfcdRhY7Rw</a>	Working Principle of Venturimeter
2	<a href="https://www.youtube.com/watch?v=iRdJHPFVHwM">https://www.youtube.com/watch?v=iRdJHPFVHwM</a>	Orifice Meter Working Principle
3	<a href="https://www.youtube.com/watch?v=3zEdtkuNYLU">https://www.youtube.com/watch?v=3zEdtkuNYLU</a>	Pitot Tube Working Animation

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
4	<a href="https://www.youtube.com/watch?v=IiE8skW8btE">https://www.youtube.com/watch?v=IiE8skW8btE</a>	Centrifugal Pump
5	<a href="https://www.youtube.com/watch?v=41vb6T42_Tk">https://www.youtube.com/watch?v=41vb6T42_Tk</a>	Reciprocating Pump animation
6	<a href="https://www.youtube.com/watch?v=ri5QydTx3AQ">https://www.youtube.com/watch?v=ri5QydTx3AQ</a>	Reciprocating Pump animation
7	<a href="https://www.youtube.com/watch?v=Dim0fLFIFOg&amp;list=PLIMdd_mE4yZGWJ32cgnK2-bs44Gpj81xi">https://www.youtube.com/watch?v=Dim0fLFIFOg&amp;list=PLIMdd_mE4yZGWJ32cgnK2-bs44Gpj81xi</a>	Introduction to Oil Hydraulics and Pneumatics
8	<a href="https://www.youtube.com/watch?v=9cO78SgZkXc">https://www.youtube.com/watch?v=9cO78SgZkXc</a>	Single Acting Cylinder/Actuator Animation
9	<a href="https://www.youtube.com/watch?v=mDLf7pe_Zug">https://www.youtube.com/watch?v=mDLf7pe_Zug</a>	Telescopic Cylinder/Actuator Animation
10	<a href="https://www.youtube.com/watch?v=sTrEGXXSLSA">https://www.youtube.com/watch?v=sTrEGXXSLSA</a>	Hydraulic Motors Summary of Features
11	<a href="https://www.youtube.com/watch?v=2UoDHqIMGB8">https://www.youtube.com/watch?v=2UoDHqIMGB8</a>	Types Of Pneumatic Actuators
12	<a href="https://www.youtube.com/watch?v=jbOdnEwUYOw">https://www.youtube.com/watch?v=jbOdnEwUYOw</a>	Flow Control Valves in Hydraulics
13	<a href="https://www.youtube.com/watch?v=LfWTyn8UT5M">https://www.youtube.com/watch?v=LfWTyn8UT5M</a>	Pressure Control Valves
14	<a href="https://www.youtube.com/watch?v=JIYbKgsgrxY">https://www.youtube.com/watch?v=JIYbKgsgrxY</a>	Directional Control Valves
15	<a href="https://www.youtube.com/watch?v=VGWua73ArFs">https://www.youtube.com/watch?v=VGWua73ArFs</a>	Types of hydraulic Filters
16	<a href="https://www.youtube.com/watch?v=4BoGenyK45w">https://www.youtube.com/watch?v=4BoGenyK45w</a>	Hydraulic accumulators, Classifications, Applications
17	<a href="https://www.youtube.com/watch?v=_EbJvm2T_OU">https://www.youtube.com/watch?v=_EbJvm2T_OU</a>	Industrial Hydraulic Circuit
18	<a href="https://www.youtube.com/watch?v=kbLyD-ATOZ8">https://www.youtube.com/watch?v=kbLyD-ATOZ8</a>	Oil Hydraulic Circuits
19	<a href="https://www.youtube.com/watch?v=JnFOFa7J-Ms">https://www.youtube.com/watch?v=JnFOFa7J-Ms</a>	Pneumatic Circuits

**Note :**

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

**Programme Name/s** : Automobile Engineering.  
**Programme Code** : AE  
**Semester** : Sixth  
**Course Title** : AUTOMOBILE AIR CONDITIONING  
**Course Code** : 316349

### I. RATIONALE

Automobile air conditioning is essential for modern vehicles, enhancing comfort and safety. This course offers a thorough understanding of air conditioning systems, covering principles, components, and operation. Students will gain diagnostic and problem-solving skills to ensure efficient cooling and passenger comfort. Mastering these aspects prepares students to contribute to the development of more efficient and eco-friendly vehicles.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Maintain air conditioning system for automotive applications using relevant knowledge & skills related to HVAC system.

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

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

- CO1 - Interpret the Heating, Ventilation and Air-conditioning system in various environmental conditions.
- CO2 - Illustrate various components of automobile air conditioning system.
- CO3 - Select relevant duct system for vehicles.
- CO4 - Troubleshoot air conditioning control systems
- CO5 - Maintain air-conditioning system.

### IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme									
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL		Total Marks			
				CL	TL	LL			Practical			FA-PR		SA-PR		SLA					
									Max			Min	Max	Min	Max	Min	Max		Min		
316349	AUTOMOBILE AIR CONDITIONING	AAC	DSE	4	-	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150

**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.
1	<p>TLO 1.1 Explain the vapour compression refrigeration cycle and its key components</p> <p>TLO 1.2 Distinguish between controlled and uncontrolled ventilation systems on the basis of given parameters</p> <p>TLO 1.3 Explain the effects of air movement, wind chill factor, odor problems, and humidity on human comfort.</p> <p>TLO 1.4 Compare the requirements of heating ventilation and air conditioning (HVAC) systems in light motor vehicles, heavy goods vehicles, and heavy passenger vehicles.</p> <p>TLO 1.5 Describe handling and disposal of refrigerant in automobile safely</p>	<p><b>Unit - I Overview of HVAC System</b></p> <p>1.1 Vapour compression refrigeration cycle and Basic components</p> <p>1.2 Uncontrolled and controlled ventilation</p> <p>1.3 Human comfort factors: comfort zone, air movement, wind chill factor, odor problems and effects of humidity.</p> <p>1.4 Requirements of heating, ventilation and air conditioning system in- light Motor Vehicle, driver cabin of heavy goods vehicle,goods compartment of heavy goods vehicle and heavy passenger motor vehicle</p> <p>1.5 Environmental and safety aspects in heating, ventilation and air conditioning systems.</p>	<p>Lecture Using Chalk-Board Presentations 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 the operational flow of air and refrigerant within the system.</p> <p>TLO 2.2 Explain the function and operation of the given component of air conditioning system</p> <p>TLO 2.3 Differentiate between reciprocating, scroll, and rotary vane compressors in terms of design, application, and performance.</p> <p>TLO 2.4 Explain the properties of refrigerants used in automotive AC systems</p> <p>TLO 2.5 List different refrigerants used in AC system</p> <p>TLO 2.6 Explain the operation of the electromagnetic clutch in controlling compressor engagement.</p> <p>TLO 2.7 Explain with sketch the construction and working of the given type of metering device of vehicle air conditioning system.</p> <p>TLO 2.8 Explain the throttling action, modulating action, and controlling action in an automotive air conditioning system.</p> <p>TLO 2.9 Explain the working of automotive heating systems in given situation</p>	<p><b>Unit - II AC System Components</b></p> <p>2.1 General layout of automotive air conditioning system , constructional details.</p> <p>2.2 Types of AC Systems: AC system with thermostatic expansion valve with components evaporator, compressor, condenser, receiver drier, thermostatic expansion valve &amp; its type (internally equalized, externally equalized).</p> <p>2.3 Throttling action, modulating action and controlling action, remote bulb.</p> <p>2.4 AC system with orifice tube with components evaporator, accumulator, compressor, condenser, fixed orifice Tube.</p> <p>2.5 Types of compressor - Scroll compressor, rotary vane compressors.</p> <p>2.6 Construction and working of electromagnetic clutch.</p> <p>2.7 Drive systems for compressor for IC engine &amp; electric vehicle.</p> <p>2.8 Types of automobile refrigerants, properties.</p>	<p>Lecture Using Chalk-Board Model Demonstration Presentations Video Demonstrations Demonstration</p>
3	<p>TLO 3.1 Explain the functions of the air intake section, core section, and distribution section in an automotive air conditioning system.</p> <p>TLO 3.2 Explain the purpose and operation of air filters and air blowers in AC systems.</p> <p>TLO 3.3 Select case and duct system for the given seating capacity of vehicle with justification.</p> <p>TLO 3.4 Explain with sketch the construction and working of the given type of duct.</p> <p>TLO 3.5 Explain the components and operation of a rear cooling system for given Vehicle.</p>	<p><b>Unit - III Case and Duct System</b></p> <p>3.1 Air intake section, core section, and distribution section</p> <p>3.2 Air filter and air blower in A.C. system</p> <p>3.3 Downstream, upstream, split and hybrid case &amp; duct systems, case &amp; duct System in electric vehicle.</p> <p>3.4 Construction and working of rear cooling system</p> <p>3.5 Air Conditioning system in electric vehicle &amp; hybrid Vehicles</p> <p>3.6 Heating system: Construction working and functions of I.C, engine vehicle and electric vehicle</p>	<p>Lecture Using Chalk-Board Video Demonstrations Presentations 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 Explain the components and operation of vacuum control systems and electronic temperature control systems.</p> <p>TLO 4.2 Explain the function and operation of given vacuum operated device.</p> <p>TLO 4.3 Explain the function and operation of given switch used in automotive air conditioning systems.</p> <p>TLO 4.4 State the purpose and location of given sensor used in automotive air conditioning systems.</p> <p>TLO 4.5 Explain the function and operation of given AC control devices used in automotive air conditioning systems.</p> <p>TLO 4.6 Compare manual climate control systems and electronic climate control systems.</p>	<p><b>Unit - IV Vehicle Climate Control Systems</b></p> <p>4.1 System controls – Vacuum control system and electronic temperature control system.</p> <p>4.2 Vacuum operated devices i.e. vacuum reserve tank, vacuum restrictor, vacuum motor, check valve and check relays.</p> <p>4.3 Switches - High-Side temperature switch, low-side temperature switch, high-pressure switch, low- pressure switch, pressure regulator and superheat switch.</p> <p>4.4 Sensors- Sunload sensor, outside temperature sensor and in-car temperature sensor.</p> <p>4.5 A.C. Control devices: aspirator, blower motor speed control, heater control, and time delay relay for heater control.</p> <p>4.6 Manual climate control system and automatic climate control system.</p>	<p>Lecture Using Chalk-Board Model Demonstration Presentations Video Demonstrations</p>
5	<p>TLO 5.1 List potential faults of AC systems using visual and acoustic methods.</p> <p>TLO 5.2 Write the operating procedure of manifold gauge to measure low-side and high-side pressures in an air conditioning system.</p> <p>TLO 5.3 Describe the procedure to perform a temperature test.</p> <p>TLO 5.4 Explain different leak detection tests and their applications.</p> <p>TLO 5.5 Describe the procedure to check hoses and connectors of an air conditioning system.</p> <p>TLO 5.6 Write the procedure of evacuation and charging procedures for refrigerant charging.</p> <p>TLO 5.7 List common symptoms and faults in an air conditioning system, compressor, electromagnetic clutch and heating system.</p>	<p><b>Unit - V HVAC System Diagnostic and Repair Procedures</b></p> <p>5.1 Inspection of A.C. System: Visual and acoustic, sight glass.</p> <p>5.2 Service equipment and tools: Vacuum pump, Manifold and gauge i.e. low side and high side, gauge calibration recovery unit and recycling unit, Halide (Freon) and Fluorescent leak detector, Nitrogen leak tester.</p> <p>5.3 Leak test and Temperature test, Evacuation, Charging of refrigerant and Moisture removal.</p> <p>5.4 Proper use and safety precautions when working with hoses and connectors.</p> <p>5.5 Symptoms, Faults, Causes and Remedies in compressor and electromagnetic clutch.</p> <p>5.6 Maintenance of the heating system in IC engine vehicle and electric vehicle: Fault diagnosis, remedial action.</p>	<p>Lecture Using Chalk-Board Site/Industry Visit Video Demonstrations Presentations</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
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**AUTOMOBILE AIR CONDITIONING****Course Code : 316349**

<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 different processes used in vapour compression cycle Draw the vapour compression cycle P-V and H-S diagram, compressor, condenser, expansion valve, and evaporator.	1	*Basics of vapour compression cycle	2	CO1
LLO 2.1 Identify the different types of environmental effect of automobile heating ventilation and air conditioning (HVAC) system LLO 2.2 Calculate heat transfer by automotive HVAC system	2	Assessment of Environmental Effect of automotive heating ventilation and air conditioning (HVAC) Systems	2	CO1
LLO 3.1 Identify the major components of (HVAC) system used in given type of vehicle LLO 3.2 Draw the layout and arrangement of the HVAC system components in given type of vehicle.	3	* Layout of automobile air conditioning system and sub systems.	2	CO2
LLO 4.1 Identify parts of given at expansion device in an automotive AC system. LLO 4.2 Check the functionality of given expansion valve	4	*Types of expansion devices used in automotive AC system	2	CO2
LLO 5.1 Dismantle a scroll/rotary vane type compressor and identify its components. LLO 5.2 Clean and inspect the compressor components for wear and damage LLO 5.3 Assemble the compressor	5	*Dismantle and assemble Scroll/Rotary vane type Compressor	2	CO2
LLO 6.1 Check case & duct system of IC vehicle /electric vehicle LLO 6.2 Draw various components of the case & duct system in ic vehicle/electric vehicle	6	Types of Case Duct system	2	CO3
LLO 7.1 Identify the different types of air blowers and air filters used in HVAC systems. LLO 7.2 Write procedure of regular maintenance of the air blower and air filter in an HVAC system.	7	*Servicing of air filters and air blowers	2	CO3
LLO 8.1 Check the components and operation of manual and automatic climate control systems LLO 8.2 Differentiate the principles of temperature control and humidity control in manual and automatic climate control systems	8	Comparative Study of Manual & Automatic Climate Control System	2	CO4
LLO 9.1 Identify different types of sensors and switches utilized in AC systems, including their specific functions and applications LLO 9.2 Compare the operational principles and performance characteristics of sensors & switches	9	*Various types of Sensors & Switches used in AC System.	2	CO4
LLO 10.1 Diagnose faults in climate control systems using appropriate diagnostic tools and methodologies. LLO 10.2 Perform corrective action based on service, information and technical resources of given system	10	*Troubleshoot the climate control system of Vehicle	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Prepare the vehicle's AC system for temperature testing by ensuring it is properly charged with the appropriate refrigerant LLO 11.2 Interpret temperature readings to assess the performance and efficiency of the AC system	11	Perform AC System Temperature test of Given Vehicle	2	CO5
LLO 12.1 Identify various leak detection methods, including soap trace solutions, electronic leak detectors, halogen leak detectors, and dye solutions LLO 12.2 Perform leak tests on A.C. systems using different detection methods, accurately locating and diagnosing leaks. .	12	Leak detection test of automotive A.C. System.	2	CO5
LLO 13.1 Identify faults within an Air Conditioning control. LLO 13.2 Diagnose faults within an Air Conditioning control	13	* Evacuation & charging of refrigerant in automotive A.C. system	4	CO5
LLO 14.1 Identify components of automotive heating systems, including their functions and interrelationships. LLO 14.2 Carry out repairing of faulty heating system components, ensuring compliance with manufacturer specifications.	14	Troubleshoot of heating system	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)**

**Not applicable**

- 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 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**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Evaporator of Commonly used car A.C. System (any car AC system of 1 Ton Capacity )	1,3
2	Condenser of commonly used car A.C System (any car AC system of 1 Ton Capacity )	1,3
3	Accumulator of commonly used car A C System(any car AC system of 1 Ton Capacity )	1,3
4	Working model of Automobile HVAC system of any Car model Make: car manufacturer in India Power supply: 220 V AC 50 Hz 110 V AC 60 Hz Compressor Scroll / Rotary Vane type Condenser parallel flow type suitable for car Evaporator serpentine type with a thermostatic expansion valve, blower motor, and grill. Receiver with sight glass and other accessories. All ideal controls and safety controls for car ac. Single phase electric motor 2 HP Suitable 12volt battery to run condenser fan, evaporator fan and to operate magnetic clutch of the compressor. Battery Charger to recharge Battery.	1,3,4
5	Scroll Type, Rotary Vane Type AC Compressor (For Dismantling & Assembly)(any car AC system of 1 Ton Capacity )	1,3,6
6	Digital Temperature Guage (Temp Range -200C to 700C)	12
7	Halide & Fluorescent Refrigerant Leak Detector (HFC Halogen Gas Refrigerant Leak Detector in Automobile Air Conditioning	13
8	Refrigerant tank for R-134a(Capacity 13.6)	13,14
9	Refrigerant Recovery, Recycling, and recharging Machine Power supply: 220 V AC 50 Hz 110 V AC 60 Hz Evacuating air speed of vacuum pump: 4.5 CFM Compressor power: 3/8 HP Accuracy of electronic scale: 5 g Maximum weight of the electronic scale: 50 Kg Drying filter: 500 cc, 3/8 connecting port Capacity of refrigerant tank: 23.5 L 13.6 L Maximum working pressure: 17.5 bar Maximum recovery speed: 0.5 Kg/Min Maximum recharging speed: 2 Kg/Min	14
10	Thermostatic Expansion valve commonly used car A.C System and orifice tube	4,5
11	Electromagnetic Clutch of commonly used car A C System (any car AC system of 1 Ton Capacity )	6
12	Manifold gauge Set, Compressor & Vacuum pump (Single Stage Rotary Vane R134A, 1/3HP Deep Vacuum Pump of Car AC)	6,14
13	Car Heater Blower Assembly	7,8
14	General Purpose Tools ( Spanner, Ring Spanner & Socket)(6mm to 32mm)	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview of HVAC System	CO1	10	2	6	4	12
2	II	AC System Components	CO2	16	4	6	8	18
3	III	Case and Duct System	CO3	10	2	6	4	12
4	IV	Vehicle Climate Control Systems	CO4	12	4	4	6	14
5	V	HVAC System Diagnostic and Repair Procedures	CO5	12	2	4	8	14
<b>Grand Total</b>				<b>60</b>	<b>14</b>	<b>26</b>	<b>30</b>	<b>70</b>

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

- Two-unit tests of 30 marks and average of two-unit tests.
- For laboratory learning 25 Marks

**Summative Assessment (Assessment of Learning)**

- End semester assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks.

**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	--	2			
CO2	3	--	--	2	2	2	2			
CO3	3	--	--	--	2	2	2			
CO4	2	2	--	2	2	2	2			
CO5	2	3	--	3	2	2	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	Dwiggins, Boyce H.	Automobile Air Conditioning	Delmar Cengage Learning; 8th Revised edition edition, ISBN: 978-0827358188
2	Haynes, John H. ; Stubblefield, Mike	Automotive Heating & Air Conditioning Manual	Haynes Manuals N. America, Incorporated, 2011 ISBN 1563929139
3	Ananthanarayanan, P. N.	Basic Refrigeration and Air Conditioning	McGraw Hill Education; Fourth edition (2013) ISBN-10: 9781259062704
4	Halderman , J. D.	Automotive Heating and Air Conditioning	Pearson Prentice Hall; 7 edition (2014) ISBN: 978-0133514995
5	Khurmi, R. S. ; Gupta , J. K.	Textbook of Refrigeration & Air conditioning	S. Chand Limited, New Delhi (2008) ISBN: 8121927811, 9788121927819
6	Arora; Domkundwar	Refrigeration and Air-Conditioning	Dhanpatrai & Son's, New Delhi ISBN: 9780000229663

## XIII . LEARNING WEBSITES &amp; PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.youtube.com/watch?v=nHZE Ae08sE8">https://www.youtube.com/watch?v=nHZE Ae08sE8</a>	Understanding working of HVAC system.
2	<a href="https://www.youtube.com/watch?v=I5rrZSu4PxQ">https://www.youtube.com/watch?v=I5rrZSu4PxQ</a>	Understanding the working of Car AC
3	<a href="https://www.youtube.com/watch?v=Pdq8JA1ct6s">https://www.youtube.com/watch?v=Pdq8JA1ct6s</a>	Procedure to Recharge refrigerant in AC System
4	<a href="https://www.youtube.com/watch?v=F5w31R88fqQ">https://www.youtube.com/watch?v=F5w31R88fqQ</a>	Procedure to evacuate refrigerant from AC System
5	<a href="https://www.2carpros.com/articles/re-charge-an-air-conditioner-system">https://www.2carpros.com/articles/re-charge-an-air-conditioner-system</a>	Evacuation and charging of A.C. System
6	<a href="https://www.youtube.com/watch?v=Yyf30wStUE4">https://www.youtube.com/watch?v=Yyf30wStUE4</a>	Leak Detection in A.C. System
7	<a href="https://www.youtube.com/watch?v=WncHNLdU4EA">https://www.youtube.com/watch?v=WncHNLdU4EA</a>	Trouble diagnosis of A.C. System
8	<a href="https://www.youtube.com/watch?v=FzbM0YoUZgo">https://www.youtube.com/watch?v=FzbM0YoUZgo</a>	Cleaning air conditioner evaporator
9	<a href="https://www.youtube.com/watch?v=rulXlnG2Unk">https://www.youtube.com/watch?v=rulXlnG2Unk</a> for Servicing of Compressor in car	Servicing of Compressor in car
10	<a href="https://www.youtube.com/watch?v=UW1GDioa0kE">https://www.youtube.com/watch?v=UW1GDioa0kE</a>	How To Diagnose Car Air Conditioning Problems

**Note :**

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

**Programme Name/s : Automobile Engineering.****Programme Code : AE****Semester : Sixth****Course Title : SOLID MODELLING AND ADDITIVE MANUFACTURING****Course Code : 316010****I. RATIONALE**

The Solid Modeling and Additive Manufacturing course is designed to equip students of diploma in the automobile and allied Industries with essential skills in solid modeling techniques and additive manufacturing technologies. This course will empower students to apply solid modeling and additive manufacturing concepts and methodologies in the design, development, and production of mechanical parts.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply skills to create, prototype, and manufacture automobile components using solid modeling and additive manufacturing techniques.

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

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

- CO1 - Prepare 2D Drawing using sketch toolbar of given 3D modeling software.
- CO2 - Prepare 3D Solid models from 2D sketch using given 3D modeling software.
- CO3 - Prepare assembly of part models using given 3D modeling software.
- CO4 - Plot a drawing for given part model/assembly.
- CO5 - Print components of assembly using 3D Printer/Rapid prototyping machine.

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

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SL	LH	NLH			Theory			Based on LL & TL				Based on SL			
				CL	TL	LL						Total	Practical		SLA							
				Max	Max	Max	Min	Max	Min				Max	Min	Max	Min						
316010	SOLID MODELLING AND ADDITIVE MANUFACTURING	SAM	SEC	-	-	4	2	6	3	-	-	-	-	25	10	25#	10	25	10	75		

**Total IKS Hrs for Sem. : 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.
1	TLO 1.1 Drawing 2D sketch using sketch tool. TLO 1.2 Draw template for 2D sketch.	<b>Unit - I Working in 2D environment</b> 1.1 Drawing tool: Line, Construction line, Rectangle, Polygon, Circle, Arc, Ellipse, Spline, etc. 1.2 Editing tool: Trim, Delete, Extend, Erase, Mirror, etc. 1.3 Modify tool: Chamfer, Fillet, Copy, Move, pattern etc. 1.4 Linear, angular dimensions. Dimensioning constraint and Geometrical constraint. 1.5 Drawing template: prepare drawing template consisting of Name plate boundary lines and projection symbol.	Presentations Video Demonstrations Hands-on
2	TLO 2.1 Draw 3D models of given components. TLO 2.2 Modify 3D models of given components TLO 2.3 Draw Auxiliary planes	<b>Unit - II Development of solid models</b> 2.1 Working in 3D environment: planes, Creating 3D Solid Models of simple machine parts. 2.2 Part tool: Extrude, Hole, Revolve, Rib, Sweep, swept blend, Pattern, etc. 2.3 Part Modify tool: Chamfer, Round, Copy, Move, Draft, etc. 2.4 Creating parts using auxiliary plane.	Presentations Video Demonstrations Hands-on
3	TLO 3.1 Assemble given 3D components. TLO 3.2 Produce exploded view of given assembly drawing.	<b>Unit - III Computer Aided Assembly</b> 3.1 Assembly drawing: preparation of assembly drawing by using assembly tool. 3.2 Relative degrees of freedom and constraints of assembly. 3.3 Rotational and translational motions of assembly. Constraining motions. 3.4 Exploded view: Explode the assembly.	Presentations Video Demonstrations Hands-on Site/Industry Visit

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	TLO 4.1 Generate production drawing from given assembly. TLO 4.2 Prepare part list. TLO 4.3 Setup printing parameters. TLO 4.4 Plot Production Drawing.	<b>Unit - IV Plotting and Drafting 3D Assembly</b> 4.1 Generate orthographic projection of assembly Projections – Generate various views- Sectional, Auxiliary and Isometric Views. 4.2 Bill of Materials – Prepare part lists, Name plate on sheet. 4.3 Printer selection, paper size, orientation. 4.4 Page set up and plotting drawing.	Presentations Video Demonstrations Hands-on
5	TLO 5.1 Select suitable material for printing part using 3D printer. TLO 5.2 Create slices in Slicer software. TLO 5.3 Print given component using 3D printer.	<b>Unit - V Additive Manufacturing</b> 5.1 3D printing file formats 5.2 Selection of material 5.3 Printing parameter setting: temperature, wall thickness, infill percentage. Orientation etc 5.4 Need of Supports, types of support 5.5 Slicing layers using software 5.6 Exporting and printing	Presentations Video Demonstrations Hands-on Site/Industry Visit

## 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
LLO 1.1 Use of sketch toolbar for drawing 2D entities.	1	*Setting drawing template consisting of Name plate boundary lines and projection symbol.	4	CO1
LLO 2.1 Draw given simple 2D components. LLO 2.2 Plot given components.	2	*Drawing and plotting two given simple 2D geometries using sketcher commands.	4	CO1 CO4
LLO 3.1 Draw given simple 3D components. LLO 3.2 Plot given components.	3	Drawing and plotting the given two simple 3-D drawings using 3D modeling commands.	4	CO1 CO2 CO4
LLO 4.1 Draw given complex 3D components. LLO 4.2 Plot given components.	4	Drawing and plotting the given two Complex 3-D drawings using 3D modeling commands.	4	CO1 CO2 CO4
LLO 5.1 Develop 3D model of given components. LLO 5.2 Plot given components	5	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I)	4	CO1 CO2 CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Develop 3D model of given components. LLO 6.2 Plot given components.	6	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified part)	4	CO1 CO2 CO4
LLO 7.1 Develop 3D model of given components. LLO 7.2 Plot given components	7	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified part)	4	CO1 CO2 CO4
LLO 8.1 Develop 3D model of given components. LLO 8.2 Plot given components.	8	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified part)	4	CO1 CO2 CO4
LLO 9.1 Assemble given 3D components. LLO 9.2 Plot given components.	9	*Assembly of the parts of identified assembly. Creating the orthographic views and bill of materials for the given assembly. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified assembly)	4	CO1 CO2 CO3 CO4
LLO 10.1 Develop 3D model of given components. LLO 10.2 Plot given components.	10	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II)	4	CO1 CO2 CO4
LLO 11.1 Develop 3D model of given components. LLO 11.2 Plot given components.	11	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified part)	4	CO1 CO2 CO4
LLO 12.1 Develop 3D model of given components. LLO 12.2 Plot given components.	12	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified part)	4	CO1 CO2 CO4
LLO 13.1 Develop 3D model of given components. LLO 13.2 Plot given components.	13	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified part)	4	CO1 CO2 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>
LLO 14.1 Assemble given 3D components. LLO 14.2 Plot given components.	14	Assembly of the of the parts of identified assembly. Creating the orthographic views and bill of materials for the given assembly. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified assembly)	4	CO1 CO2 CO3 CO4
LLO 15.1 Print the given component using 3D printer.	15	*Printing of any one component from above assembly using 3D printer/ Rapid prototyping machine.	4	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**

- A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:
- 3D model: Each student will identify a small assembly from the institute workshop/laboratory. Measure the dimensions of each part and prepare sketches. Using sketches prepared 3D model of parts and assembly. Plot the assembly and detail drawings. (e.g. Piston-cylinder-connecting rod assembly, Cam-shaft assembly, Gear-train, Brake assembly, Bench vice, Machine vice, Tool post, Couplings, Joints, Bearings etc.)
- 3D printing/RPT: Each student will visits a nearby institute/industry. Collect information regarding troubleshooting of 3D printer/Rapid prototyping machine and prepare a report

**Assignment**

- Write a Brief Introduction to 3D Modelling with key features, advantages, and typical applications.
- Draw and plot simple 2D geometries using sketcher commands.
- Draw and plot the simple 3-D drawings using 3D modeling commands.
- Write a Brief Introduction to additives manufacturing with main characteristics, advantages over conventional methods, and specific applications.

**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**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	3 D printer (FDM)- size- 200x200x250 mm, layer resolution 0.08 mm to 0.4 mm, print speed 40-120 mm/sec, Nozzle size 0.4mm,Filament-ABS/PLA/Composite	15
2	Software: 3D printing software (slicing software).	15
3	Filament PLA, PETG, Nylon, ABS	15
4	Plotter: Multifunction Wide format plotter size A0-A4, resolution 1200X1200 / Printer with latest versions (A3/A4 size) Laserjet	2,1,3,4,5,6,7,8,9,10,11,12,13,14
5	Workstation with latest configurations for each student. Microsoft Windows 10 or above, with minimum i5 Processor (2.5 GHz), 8 GB RAM, 512 SDD	All
6	Any free version of 3D modeling software / Academic version of 3-D modelling commercial software. (CATIA, Solid Works, Creo, NX4, Solid Edge, Delcam, Autocad etc.)	All
7	LCD projector with at least 4500 lumens and aspect ratio 16:10. OR Screen/ Interactive board.	All

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

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering 1) 60% weightage is to process 2) 40% weightage to product

**Summative Assessment (Assessment of Learning)**

- Practical Exam of 25 Marks

**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	2	3	1	2	1			
CO2	3	1	2	3	1	2	1			
CO3	3	1	2	3	1	2	1			
CO4	3	1	2	3	1	2	1			
CO5	3	1	2	3	2	2	1			

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	Sham Tickoo	CATIA V5R17 for Designers	Softcover, Cadcim Technologies
2	Sham Tickoo	Pro/ENGINEER Wildfire for Designers	Softcover, Cadcim Technologies
3	Sham Tickoo	Solid Works For Designers Release 2006	Softcover, Cadcim Technologies
4	Sham Tickoo	Autodesk Inventor for Designers: Release 10	Softcover, Cadcim Technologies
5	Sham Tickoo, Deepak Maini	NX 4 for Designers	Softcover, Cadcim Technologies
6	Sham Tickoo, Deepak Maini	Solid Edge V19 for Designers	Softcover, Cadcim Technologies
7	R.B. Patil, G. J. PAGAR, SATISH MANIAR	Solid Modeling and Drafting	TechKnowledge Publications, Pune

## XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://archive.nptel.ac.in/courses/112/102/112102304/">https://archive.nptel.ac.in/courses/112/102/112102304/</a>	NPTEL: Engineering graphics and design
2	<a href="https://www.3ds.com/store/cad/solid-modeling">https://www.3ds.com/store/cad/solid-modeling</a>	Dassault systems: What is solid modeling and why is it so essential to design?
3	<a href="https://youtu.be/5DxUK-n16sg?si=BU9HGgRC3jcfaChY">https://youtu.be/5DxUK-n16sg?si=BU9HGgRC3jcfaChY</a>	Screw Jack Assembly Design
4	<a href="https://www.youtube.com/watch?v=vjX4PDJcFOI">https://www.youtube.com/watch?v=vjX4PDJcFOI</a>	Solid modeling
5	<a href="https://www.youtube.com/watch?v=JjKs-lePIPY">https://www.youtube.com/watch?v=JjKs-lePIPY</a>	How to Read & Create 3d Models from 2d Drawings
6	<a href="https://archive.nptel.ac.in/courses/112/103/112103306/">https://archive.nptel.ac.in/courses/112/103/112103306/</a>	NPTEL: Fundamentals of additive manufacturing Technologies

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
7	<a href="https://youtu.be/iM2qhc-cmV4?si=57xSDJX_yfROg4rb">https://youtu.be/iM2qhc-cmV4?si=57xSDJX_yfROg4rb</a>	Assembly Introduction Types Catia V5.
8	<a href="https://youtu.be/f94CnlQ0eq4?si=EuDF4ehMaphCH88M">https://youtu.be/f94CnlQ0eq4?si=EuDF4ehMaphCH88M</a>	How does a 3D Printer work?
<b>Note :</b> <ul style="list-style-type: none"><li>Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students</li></ul>		

**Programme Name/s** : Automobile Engineering.  
**Programme Code** : AE  
**Semester** : Sixth  
**Course Title** : AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEM  
**Course Code** : 316009

### I. RATIONALE

Modern vehicles are equipped with a variety of electrical, electronic, and computer-controlled systems that play a crucial role in enhancing performance, drivability, and safety. These systems are managed by multiple control units to ensure optimal efficiency and functionality. Diploma holders in automobile engineering are expected to identify electrical, electronic and computer controlled system components and demonstrate diagnosis thereof. This course is designed to provide students with the essential skills needed to maintain and troubleshoot these advanced systems, preparing them for the demands of automobile industry.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Maintain automotive electrical and electronic systems efficiently and safely.

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

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

- CO1 - Test components of automotive electrical and electronic circuits.
- CO2 - Test automotive batteries and charging system.
- CO3 - Test cranking system and ignition system.
- CO4 - Troubleshoot automotive transducers and OBD-II systems.

### IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SL	LH		NLH	Paper Duration	Theory			Based on LL & TL				Based on SL		Total Marks
				CL	TL	LL						Practical			SLA						
				Max	Max	Max	Min	Max		Min		Max	Min	Max	Min						
316009	AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEM	AES	AEC	2	-	2	-	4	2	-	-	-	-	-	25	10	50@	20	-	-	75

**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.
1	<p>TLO 1.1 State the function of electrical components in the given circuit.</p> <p>TLO 1.2 Describe the operation of the given circuit protection device.</p> <p>TLO 1.3 Describe the test procedure of the given circuit.</p> <p>TLO 1.4 Describe the impact of integrating a smart wiring harness with Flexible Data-rate Controller Area Network (CAN-FD) on modern vehicles.</p>	<p><b>Unit - I Electrical Components, Circuit Protection Devices, and Smart Wiring Systems</b></p> <p>1.1 Purpose and operation of electrical components and circuit protection devices. a)Switches: Single Pole Single Throw (SPST), Single Pole Double Throw (SPDT), Ganged switch. b)Relays, Solenoids, Buzzers, Resistors. c)Fuses, Maxi fuses, Fusible links, Smart fuses and circuit breakers with self-resetting capabilities.</p> <p>1.2 Testing of circuit defects: Open circuit, short circuit, short to ground, voltage drop.</p> <p>1.3 Smart Wiring Harness &amp; Flexible Data-rate Controller Area Network (CAN-FD) – Evolution from traditional wiring harness to high-speed communication networks.</p> <p>1.4 Wiring diagrams: Headlight, turn indicators, Horn, Windshield wiper, Stop light.</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Model</p> <p>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.
2	<p>TLO 2.1 Describe working of the given type of battery.</p> <p>TLO 2.2 List the causes of battery failure based on given symptoms.</p> <p>TLO 2.3 Explain working of Computer/ ECM -controlled alternator.</p> <p>TLO 2.4 Explain working of the computer controlled charging system.</p>	<p><b>Unit - II Automotive Batteries and Charging System</b></p> <p>2.1 Battery: Types of Battery, Construction and Working of following types: Lead acid battery, Maintenance free battery, Hybrid Battery, Lithium-ion battery, Battery rating and specifications.</p> <p>2.2 Standard procedure of battery charging.</p> <p>2.3 Battery failure: Types and causes</p> <p>2.4 Charging system: Charging system circuit, Alternator – Principle of working, Construction and working, Computer/ Electronic Control Module (ECM) controlled alternator.</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Model</p> <p>Demonstration</p>
3	<p>TLO 3.1 Describe working of the given cranking system aggregates.</p> <p>TLO 3.2 State remedial measures for starting system trouble with justification.</p> <p>TLO 3.3 Explain working of the computer-controlled ignition system.</p>	<p><b>Unit - III Cranking and Ignition System</b></p> <p>3.1 Cranking system: solenoid-operated starter circuit, components and their functions.</p> <p>3.2 Types of starter drive: overrunning clutch and Integrated Starter Generator (ISG) system. Stop-Start System: components and working.</p> <p>3.3 Computer-controlled cranking system.</p> <p>3.4 Starter motor components, working principle.</p> <p>3.5 Cranking system: Symptoms and troubleshooting.</p> <p>3.6 Computer controlled ignition system: operation with block diagram.</p>	<p>Lecture Using Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Model</p> <p>Demonstration</p>
4	<p>TLO 4.1 Describe working of the given transducer on engine.</p> <p>TLO 4.2 Describe testing procedure of the given transducer.</p> <p>TLO 4.3 Describe diagnosis procedure of the given sensors using scan tool.</p>	<p><b>Unit - IV Automotive Transducers and On Board Diagnostics (OBD) -II System</b></p> <p>4.1 Transducers - construction, working: Camshaft position sensor, Coolant temperature sensor, Throttle position sensor, Oxygen sensor, Manifold absolute pressure sensor, Mass air flow sensor, electronic fuel injector, idle air control valve.</p> <p>4.2 OBD II procedure for body computer and relevant transducers: Function, diagnosis and procedure to erase fault code.</p>	<p>Video</p> <p>Demonstrations</p> <p>Demonstration</p> <p>Site/Industry Visit</p> <p>Flipped Classroom</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 Inspect given electrical/ electronic component using multi meter.</p> <p>LLO 1.2 Inspect given circuit protection device.</p>	1	*Electrical components and circuit protection devices.	2	CO1
<p>LLO 2.1 Diagnose given parallel/ series circuit fault using service manual standard procedure.</p> <p>LLO 2.2 Troubleshoot fault in wiring harness.</p>	2	Troubleshooting of the faults in automobile circuit/ wiring harness.	2	CO1

<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 Perform battery specific gravity test. LLO 3.2 Perform battery terminal test.	3	*Battery specific gravity test and battery terminal test.	2	CO2
LLO 4.1 Perform battery load test. LLO 4.2 Perform battery drain test.	4	Battery load test and battery drain test.	2	CO2
LLO 5.1 Inspect the battery visually. LLO 5.2 Test the battery terminals and clamps. LLO 5.3 Test the battery voltage. LLO 5.4 Perform battery charging.	5	*Regular maintenance of battery.	2	CO2
LLO 6.1 Dismantle the given alternator. LLO 6.2 Examine the internal components of alternator. LLO 6.3 Assemble the given alternator. LLO 6.4 Measure alternator drive belt tension.	6	*Dismantle and assemble the alternator.	2	CO2
LLO 7.1 Test the Continuity of the stator windings. LLO 7.2 Test the Continuity of rotor winding. LLO 7.3 Inspect the diode rectifier.	7	Continuity test of alternator stator and rotor windings.	2	CO2
LLO 8.1 Perform the Current Output Test. LLO 8.2 Perform the Field Current Draw Test.	8	Current Output Test and Field Current Draw Test on alternator.	2	CO2
LLO 9.1 Perform the Regulator Output Test. LLO 9.2 Perform the Charging Circuit Resistance Test.	9	*Regulator Output Test and Charging Circuit Resistance Test on alternator.	2	CO2
LLO 10.1 Dismantle the given starter motor. LLO 10.2 Identify the components of starter motor. LLO 10.3 Assemble the starter motor.	10	*Dismantle and assemble the starter motor.	2	CO3
LLO 11.1 Perform the Current Draw Test. LLO 11.2 Perform the Insulated Circuit Resistance Test.	11	Current Draw Test, Insulated Circuit Resistance Test on starter motor.	2	CO3
LLO 12.1 Perform the Ground Circuit Test. LLO 12.2 Perform the No-Crank Test. LLO 12.3 Perform the Free Speed Test.	12	*Ground Circuit Test, No Crank Test and Free Speed Test on starter motor.	2	CO3
LLO 13.1 Interpret timing marks on the crankshaft pulley or flywheel. LLO 13.2 Make use of a stroboscope for measuring ignition timing. LLO 13.3 Modify ignition timing or Electronic Control Unit (ECU) settings.	13	Ignition timing inspection of a multi-cylinder engine with Stroboscope.	2	CO3
LLO 14.1 Test the given transducer.	14	Test the sensor and fuel injector.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Make use of a diagnostic scan tool. LLO 15.2 Diagnose faults in body control functions. LLO 15.3 Interpret Diagnostic Trouble Codes (DTCs) related to the Body Control Unit (BCU).	15	*Fault diagnosis of the body control unit using a scan tool.	2	CO4

**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

**Assignment**

- 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 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**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Wiring harness of two and four wheeled vehicle.	1,2
2	Digital Multimeter: LCD Display, 0 to 50°C Operating Temperature, DCvoltage-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 ohm to 200 mega ohm; Accessories: Test leads, Current Clamp 300 A, Current Clamp Adapter.	1,2,3,4,5,6,7,8,9,11,12,14
3	Trainer electrical circuits of two and four wheeled vehicle.	1,2,3,9,11,12
4	Starter Motor – 12V, 0.7KW. Over running clutch type.	10,11,12

<b>Sr.No</b>	<b>Equipment Name with Broad Specifications</b>	<b>Relevant LLO Number</b>
5	Stroboscope/ Timing gun: Ignition Advance: 0 to 45°, 12V DC system, Reverse polarity protection, Bright flash for daylight use.	13
6	Multiport Fuel Injection engine with sensors, actuators and Electronic Control Module, Exhaust Gas Regulation valve and Positive Crankcase Ventilation valve; Power: 25 KW @ 5000 rpm to 55KW@ 5000 rpm, Cubic Capacity: 800 CC to 2000 CC.	13,14,15
7	Scan tool: On Board Diagnostics (OBD) II Generation Scan Tool, 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.	15
8	Battery – 12V,100Amp or above.	3,4,5,9,11,12
9	Hydrometer bulb type or digital 1.100-1.300 Sp. gravity at 27 degree Celsius.	3,5
10	Battery Charger. 2A-10A, 12V-24V	5
11	Alternator – 12V, 40A	6,7,8,9
12	Direct Current Clamp meter: Current measurement – 400 Amperes DC / AC.	8,11,12
13	Auto electrical Test bench –3 phase, 5 HP	8,9,11,12
14	Hand tools: spanner set: Open ended spanner set, Ring spanner set, Box spanner set; Screw driver set, Pliers: Nose plier, Circlip plier, Grip plier ; Engine Belt Tension Gauge, Allen key set, wire brush: internal and external brushes for battery terminal and battery clamp.	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	Electrical Components, Circuit Protection Devices, and Smart Wiring Systems	CO1	8	0	0	0	0
2	II	Automotive Batteries and Charging System	CO2	8	0	0	0	0
3	III	Cranking and Ignition System	CO3	8	0	0	0	0
4	IV	Automotive Transducers and On Board Diagnostics (OBD) -II System	CO4	6	0	0	0	0
<b>Grand Total</b>				<b>30</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### **X. ASSESSMENT METHODOLOGIES/TOOLS**

#### **Formative assessment (Assessment for Learning)**

- For laboratory learning, 25 marks. For FA PR ,Formative (Continuous ) assessment shall be based on process and product related performance indicators. Course teacher may assign 60%, weightage for process and 40% weightage for product related LL work .

#### **Summative Assessment (Assessment of Learning)**

- For SA PR At the end of semester PR examination will be conducted by course teacher and based on PR exam performance marks out of 50 will be allocated.

## 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	-	-	3			
CO2	3	1	-	3	-	-	3			
CO3	3	1	-	2	-	-	3			
CO4	3	1	-	3	-	-	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	James D. Halderman	Automotive Electricity and Electronics	5th Edition Year: 2016, PEARSON ISBN-13: 978-0-13-576442-8
2	James D. Halderman	Diagnosis and Troubleshooting of Automotive Electrical, Electronic, and Computer Systems	5th Edition, Year: 2009, Pearson College Div., ISBN-13: 978-0135066966
3	Tom Denton	Automobile Electrical and Electronic Systems	5th Edition, Routledge, ISBN-13: 978-0415725774
4	A.K. Babu	Automotive Electrical and Electronics	2nd Edition, Year: 2024, Khanna Publishing House ISBN 13 978-93-82609-69-8
5	Dr. P. Thangavel, Dr. M. Vijay Anand, Mr. M. Makesh Kumar	Automotive Electrical & Electronics Concepts	Year: 2025, Notion Press, ISBN-13: 979-8896991731

## XIII. LEARNING WEBSITES &amp; PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.youtube.com/watch?v=mEJEHxIbn9o">https://www.youtube.com/watch?v=mEJEHxIbn9o</a>	How to Use Wiring Diagrams for Car Electrical Diagnosis and Repair
2	<a href="https://www.youtube.com/watch?v=0ihkfUbdsk">https://www.youtube.com/watch?v=0ihkfUbdsk</a>	Circuit Breakers and Fuses Explanation
3	<a href="https://www.youtube.com/watch?v=wWGyUpUsZkU">https://www.youtube.com/watch?v=wWGyUpUsZkU</a>	What is Can bus cable, construction, application Automotive ECU to MCU wiring connection
4	<a href="https://www.youtube.com/watch?v=hObLxIXJPPM">https://www.youtube.com/watch?v=hObLxIXJPPM</a>	Working Principle of Lead Acid Battery

Sr.No	Link / Portal	Description
5	<a href="https://www.youtube.com/watch?v=nrxmQhbZUTc&amp;t=780s">https://www.youtube.com/watch?v=nrxmQhbZUTc&amp;t=780s</a>	The Battery Basics: Understanding Lithium-Ion, Lead-Acid Battery
6	<a href="https://www.youtube.com/watch?v=cxkVxi9P0EA">https://www.youtube.com/watch?v=cxkVxi9P0EA</a>	Battery Rating
7	<a href="https://www.youtube.com/watch?v=v4JGYu4aaEc">https://www.youtube.com/watch?v=v4JGYu4aaEc</a>	Causes and Types of Battery Failure
8	<a href="https://www.youtube.com/watch?v=V7EFAvFPOhw&amp;t=25s">https://www.youtube.com/watch?v=V7EFAvFPOhw&amp;t=25s</a>	Battery Maintenance
9	<a href="https://www.youtube.com/watch?v=Gc1hWC3XQI0">https://www.youtube.com/watch?v=Gc1hWC3XQI0</a>	Hydrometer Test of Lead Acid Battery
10	<a href="https://www.youtube.com/watch?v=YrNRaPP7EKU">https://www.youtube.com/watch?v=YrNRaPP7EKU</a>	Battery Terminal Test
11	<a href="https://www.youtube.com/watch?v=jdSKlg80DjU">https://www.youtube.com/watch?v=jdSKlg80DjU</a>	Alternator Working Principle
12	<a href="https://www.youtube.com/watch?v=EVPoI5wgZ4o">https://www.youtube.com/watch?v=EVPoI5wgZ4o</a>	Alternator Testing
13	<a href="https://www.youtube.com/watch?v=INUikOnGlAE">https://www.youtube.com/watch?v=INUikOnGlAE</a>	PCM (Computer) Controlled Alternators
14	<a href="https://www.youtube.com/watch?v=1bK0De9XOP0">https://www.youtube.com/watch?v=1bK0De9XOP0</a>	Alternator Testing
15	<a href="https://www.youtube.com/watch?v=9UKg71wa0e4">https://www.youtube.com/watch?v=9UKg71wa0e4</a>	Alternator Belt Tension
16	<a href="https://www.youtube.com/watch?v=Lfvig36a3og&amp;t=20s">https://www.youtube.com/watch?v=Lfvig36a3og&amp;t=20s</a>	SHVS mild hybrid + DUALJET
17	<a href="https://www.youtube.com/watch?v=arWoIjk6seA&amp;t=17s">https://www.youtube.com/watch?v=arWoIjk6seA&amp;t=17s</a>	How electrical and ignition systems work
18	<a href="https://www.youtube.com/watch?v=4dPXUzYiGmQ">https://www.youtube.com/watch?v=4dPXUzYiGmQ</a>	Camshaft Position Sensor Explained with Animation
19	<a href="https://www.youtube.com/watch?v=CpmOv83HYhQ">https://www.youtube.com/watch?v=CpmOv83HYhQ</a>	Throttle Position Sensor Explained with Animation
20	<a href="https://www.youtube.com/watch?v=OhShoU_E-0g&amp;t=394s">https://www.youtube.com/watch?v=OhShoU_E-0g&amp;t=394s</a>	OBD2 Explained - A Simple Intro
21	<a href="https://www.youtube.com/watch?v=YGG9VLzeMk8&amp;t=11s">https://www.youtube.com/watch?v=YGG9VLzeMk8&amp;t=11s</a>	How to Use an OBD2 Scan Tool

**Note :**

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

	: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/
Programme Name/s	Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Manufacturing Technology/ Metallurgical Engineering/ Production Engineering/ Computer Science/ Electronics & Computer Engg.
Programme Code	: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ MRT/ MY/ PG/ SE/ TE
Semester	: Sixth
Course Title	: CAPSTONE PROJECT
Course Code	: 316004

### I. RATIONALE

Capstone projects in engineering study are considered important as it allow students to integrate and apply the knowledge and skills acquired throughout their academic program and effectively demonstrating their learning of programme by tackling a real-world problem, ultimately keeping them well prepared for the job market. The capstone project is usually the final assignment and plays a vital role in preparing students for the world of work to its practical applications and ability to help hone students' professional knowledge and skills. Normally, capstone projects are developed in collaboration with industries or businesses, providing students with valuable insights. Capstone projects has been considered as an integral part of diploma curriculum. It helps learners to perform and demonstrate skills gained due to early courses of Diploma study independent. Therefore, this is considered as a course of final year/semester study.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

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

- Apply professional skills for solving , executing and demonstrating solutions to real-world problems

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

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

- CO1 - Elaborate the identified field problem from the perspective of project work at institute.
- CO2 - Conduct feasibility & viability analysis (using data collection, experiments, Simulation , Coding) to validate required resources, cost, support of the project work.
- CO3 - Apply the acquired knowledge and skills in providing solutions to the real field/industrial problems.

- CO4 - Present Project and its output/ findings / achievements alongwith its exhibits.

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

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SL	H			NL	Theory			Based on LL & TL				Based on SL		
				CL	TL	LL						FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA	
							Max	Min			Max			Min	Max	Min	Max	Min	Max	Min	
316004	CAPSTONE PROJECT	CPE	INP	-	-	2	2	4	2	-	-	-	-	50	20	50#	20	50	20	150	

#### V. General guidelines for PROJECT WORK

- The Project- problems must be related to the programme or may be interdisciplinary, based on the industry expected outcomes.
- The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
- Project titles are to be finalized in co-ordination/consultation with the Faculty mentor. However, faculty may form a team of students as per specific roles- Literature survey/data collection, data Analysts, model/prototype developers, testers, Project managers using IoTs ITES and software /application development. Study type project is NOT advisable.
- Project must be assigned to a group of 3-4 students under the guidance of identified faculty mentor.
- Students are required to prepare a prototype/working model/software of the Project and simultaneously prepare a report.
- Students shall Submit One Hard copy and one Soft copy each of Project Report and soft-copy of the project code or the working model.
- Students must maintain a project execution diary having the progress steps and details. The concerned faculty should check the diary on a weekly basis and accordingly interact with students based on the progress shown and keep proper record with feedback if any.
- Project shall address National Thrust area such as Environment, Digitization, Automation, sustainability and similar domains.
- Student shall try to use the national and international standards wherever possible ( processes / materials / equipments etc .. )

#### VI. Project facilitation guidelines:

Once the Project statement has been finalized and allotted to the students, the Faculty Mentor role is very important as guide, motivator, catalyser to promote learning and sustain the interest of the students. At the same time the Faculty Mentor is not expected to guide the students on each step, otherwise it will curb the creativity of the students-group. The Faculty Mentor has to work as a mentor. Following should be kept in mind while facilitating the project at the institute:

**1. Project orientation cum -briefing:** the project should be relevant to the curriculum of the programme. The project shall be cost effective taking safety aspects, ethical issues, environmental issues and confidentiality as per expectation of industry(if any) into consideration, The work may be industry Sponsored.

**2. Information search and data collection:** the information and data should be realistic and relevant to the problem /project. Hypothetical data is not to be taken into consideration.

**3. Implementation and Monitoring:** The project must have important steps /milestones to achieve as per the time frame/action plan prepared by students and faculty. The monitoring mechanism such as daily/weekly dairy (**Format given below**) must be clearly explained and delineated for the students.

## VII. Criteria of Assessment /Evaluation of Project work

### A. Formative Assessment (FA) criteria

The Formative Assessment (FA) of the students for 50 marks is to be done based on following criteria.

**Appropriate RUBRICS may be used for assessment**

#### Rubrics for Assessment of the team

Sr.No.	Criteria	Marks
1	Project Selection & Problem definition	05
2	Literature survey and data collection/ Gathering	05
3	Design / concept of project/ Working - Execution of Project	10
4	Stage wise progress as per Action plan/milestone	05
5	Quality Report Writing	05

#### Rubrics for Individual Assessment

Sr.No.	Criteria	Marks
1	Contribution as a team member	05
2	Depth of Knowledge	10
3	Presentation	05

### B. Summative Assessment Criteria

- The summative assessment for 50 marks is to be done and based on following criteria. This assessment shall be done by the faculty mentor and External examiner.

Sr.No.	Criteria	Marks
1	Capstone Project Completion as per plan	10
2	Project related Requirement Analysis & Designing	10
3	Developing a Solution with proper justifications, Teamwork	10
4	Project Report Writing	10
5	Project Presentation	10

( NOTE : Team based and Individual performance based summative assessment may include Innovativeness , Technology used , user friendliness , cost effectiveness , society benefits etc..)

**SUGGESTED RUBRIC FOR SUMMATIVE ASSESSMENT OF CAPSTONE PROJECT**

<b>PROJECT ASSESSMENT</b>				
Project Title:				
<b>Project Assessment Rubric</b>				
<b>Performance</b>	<b>Excellent</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>
<b>Criteria</b>	<b>9-10 marks.</b>	<b>6-8 marks.</b>	<b>4-5 marks.</b>	<b>0-3 marks</b>
<b>Capstone Project Completion</b>	Excellent	Good	Fair	Poor
	The project is completed as per tasks described in synopsis.	The project is completed but require minor modifications.	The project is completed but require several modifications.	The project is not completed as per tasks described in synopsis.
<b>Project related Requirement Analysis &amp; Designing</b>	9-10 marks.	6-8 marks.	4-5 marks.	0-3 marks
	Effectively contributed in requirement analysis and designing.	Partially Contributed in requirement analysis and designing.	Attempted to contribute in requirement analysis and designing	No contribution in requirement analysis and designing.
<b>Developing a Solution with proper justifications , Teamwork</b>	9-10 marks.	6-8 marks.	4-5 marks.	0-3 marks
	Developed the critical solution modules with Innovation, optimized design and worked very well with the team.	Developed some solutions with higher complexity and worked well with the team.	Attempted to develop few solutions and worked with the team.	No contribution in developing a solution and in the team.
<b>Project Report Writing</b>	9-10 marks.	6-8 marks.	4-5 marks.	0-3 marks
	Worked very well to submit an excellent project report .	Worked well to submit the project report with covering all the aspects of a standard report.	Tried to submit the project report but standard of report was not satisfactory.	No contribution in project report writing.
<b>Project Presentation</b>	9-10 marks.	6-8 marks.	4-5 marks.	0-3 marks
	Presented the project work flawlessly.	Presented the project work very nice.	Presented the project work not so well.	Presentation skill is not up to the mark.
<b>Project Group Members</b>				
<b>ROLL NUMBER/Enrollment Number</b>				
<b>NAME</b>				

<b>Comments (if any)</b>				

**NOTE :** “ These are suggestive rubrics Faculty mentor and external examiner may frame different rubrics as per Programme need and assigned Project work “

### C. Self Learning Assessment

#### Self Learning Assessment

**Max Marks -50**

Sr.No.	Criteria	Max Marks	Marks Obtained
1	Project Selection & Problem definition	10	
2	Literature survey and data collection/ Gathering	05	
3	Design / concept of project/ Working - Execution of Project	15	
4	Stage wise progress as per Action plan/milestone/ psychomotor motor skills acquired	10	
5	Quality Report Writing	10	

### VIII. CO-PO Mapping

CO-PO mapping will vary project wise and shall be prepared by concerned faculty for the given project

### IX. Typographical instructions/guidelines for Project report writing

Following is the suggestive format for preparing the Project report. Actual report may differ slightly depending upon the nature of industry. The training report may contain the following.

- The PROJECT report shall be computer typed (English- British) and printed on A4 size paper.
- Text Font -Times New Roman (TNR), Size-12 point
- Subsection heading TNR- 12 point bold normal
- Section heading TNR- 12 capital bold
- Chapter Name/ Topic Name – TNR- 14 Capital
- All text should be justified. (Settings in the Paragraph)
- The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
- The training report must be hardbound/ Spiralbound with cover page in black colour. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover [Refer sample sheet (outer cover)]
- The training report, the title page [Refer sample sheet (inner cover)] should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

### X. Project Report

On completion of the project work, every student will submit a project report which should contain the following:

1. Cover Page (as per annexure 1)
2. Title page (as per annexure 2)
3. Certificate by the Guide (as per annexure 3)
4. Acknowledgment (The candidate may thank all those who helped in the execution of the project.)
5. Abstract (It should be in one page and include the purpose of the study; the methodology used.)
6. Table of Contents (as per general guidelines): Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality).

Chapter–1 Introduction (background of the Industry or User based Problem/Task)

Chapter–2 Literature Survey (to finalize and define the Problem Statement)

Chapter–3 Scope of the project

Chapter–4 Methodology/Approach, if any

Chapter-5 Details of designs, working and processes

Chapter-6 Results and Applications

7. Conclusion

8. References (The listing of references should be typed 2 spaces below the heading “REFERENCES” in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [ ] brackets, throughout the text and should be collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details). Typical examples of the references are given below:

#### NOTE:

1. Project report must contain only a relevant and short mention – technology or platform or tools used. It must be more focussed on project work and its implementation
2. Students can add/remove/edit chapter names as per the discussion with their guide

#### Formats

### Project Report

“Project Title-----”

as a partial fulfilment of requirement of the

**THIRD YEAR DIPLOMA IN**

Submitted by

- |                   |                   |
|-------------------|-------------------|
| 1)Name Of Student | Enrollment Number |
| 2)Name Of Student | Enrollment Number |
| 3)Name Of Student | Enrollment Number |
| 4)Name Of Student | Enrollment Number |

Are the bonafide on  
FOR THE ACADEMIC YEAR

20-----20---

(H.O.D)

(Principal)

(Internal Guide)

(External Examiner)

Department Name

(If NBA Accredited mention that )

Institute Name

(An Affiliated Institute of Maharashtra State Board of Technical Education)

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INDEX		
Sr.No.	Chapter	Page No.

1.	Chapter-1 Introduction (background of the Project Problem)	1
2.	Chapter-2 Literature Survey (to finalize and define the Problem Statement)	5
3.	Chapter-3 Scope of the project	
4.	Chapter-4 Methodology/Approach, if any	
5.	Chapter-5 Details of designs, working and processes	
6.	Chapter-6 Results and Applications	
7.	REFERENCES	

**Note:**

**\*Students can add/remove/edit chapter names as per the discussion with their guide**

**Annexure****PROJECT DIARY (Weekly/Daily)**

Name of the Student : \_\_\_\_\_

Name of Guide (Faculty ) : \_\_\_\_\_

Enrollment Number : \_\_\_\_\_ Semester: \_\_\_\_\_ Project batch Number : \_\_\_\_\_

WEEK : \_\_\_\_\_

Date	Activity carried out (Details)	Achievement of mile stone/step as per plan	Remark of Faculty
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			

Dated Signature of Faculty

Dated Signature of HOD

MSBTE LOGO INST LOGO

**Certificate**

*This is to certify that*

*Mr./Ms.*

*bearing examination seat No.*

*has*

*Satisfactorily completed his/her **PROJECT** entitled*

*Along with his/her batchmates in partial fulfillment for the*

***Diploma Course in***

*< **PROGRAMME NAME** >*

*Of the Maharashtra State Board of Technical Education at our Polytechnic during the Academic Year 20 -20 .*

*The Project is completed by a group consisting of \_\_\_\_\_ Persons under the guidance of the Faculty Guide*

<b>Faculty Name and Signature (Internal)</b>	<b>Faculty Name and Signature (External if applicable)</b>	<b>HOD Name and Signature with Department Stamp</b>
<b>Date and Time</b>		

<b>Programme Name/s</b>	<b>: Architecture Assistantship/ Architecture and Interior Design/ 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 Software Technology/ Computer Science &amp; Engineering/ Fashion &amp; Clothing Technology/ 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/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics &amp; Computer Engg.</b>
<b>Programme Code</b>	<b>: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DC/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SC/ SE/ TC/ TE</b>
<b>Semester</b>	<b>: Fifth / Sixth</b>
<b>Course Title</b>	<b>: MANAGEMENT</b>
<b>Course Code</b>	<b>: 315301</b>

### I. RATIONALE

Effective management is the cornerstone of success for both organizations and individuals. It empowers diploma engineers/ professionals to accomplish their tasks with finesse and efficiency through strategic planning and thoughtful execution, projects can optimize finances, enhance safety measures, facilitate sound decision-making, foster team collaboration and cultivate a harmonious work environment. The diploma engineers require leadership and management skills with technical knowledge of the core field to carry out various tasks smoothly. This course aims to instill fundamental management techniques, empowering diploma engineers/ professionals to enhance their effectiveness in the workplace.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply the relevant managerial skills for achieving optimal results at workplace.

### 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 management skills to handle work situation
- CO2 - Apply appropriate techniques of product, operations and project management
- CO3 - Use comprehensive tools of recent management practices
- CO4 - Plan suitable marketing strategy for a product / service
- CO5 - Utilize supply chain and human resource management techniques for effective management

#### 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					Practical			FA-PR		SA-PR		SLA			
							FA-TH	SA-TH			Total	Max	Min	Max	Min	Max	Min	Max	Min		
315301	MANAGEMENT	MAN	AEC	3	-	-	1	4		2	1.5	30	70*#	100	40	-	-	-	-		25

**Total IKS Hrs for Sem. : 1 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.

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 Justify the importance of management thoughts in Indian knowledge system.</p> <p>TLO 1.2 Describe the importance of management in day to day life.</p> <p>TLO 1.3 Explain Henry Fayol's principles of management.</p> <p>TLO 1.4 Describe the role of each level of management in its management hierarchy.</p> <p>TLO 1.5 Practice the self management skills for a given situation</p> <p>TLO 1.6 Apply the required managerial skills for a given situation</p>	<p><b>Unit - I Introduction to Management</b></p> <p>1.1 Evolution of management thoughts from ancient/medieval to modern times in India (IKS)</p> <p>1.2 Management: meaning, importance, characteristics, functions &amp; challenges.</p> <p>1.3 Introduction to scientific management- Taylor's &amp; Fayol's principles of management</p> <p>1.4 Levels &amp; functions of management at supervisory level.</p> <p>1.5 Self management skills: Self awareness, self discipline, self motivation, goal setting, time management, decision making, stress management, work life balance and multitasking</p> <p>1.6 Overview of Managerial Skills: negotiation skills, team management, conflict resolution, feedback, leadership</p>	<p>Presentations</p> <p>Case Study</p> <p>Interactive session</p> <p>Quiz competition</p> <p>Mixed Picture</p> <p>Puzzle</p>
2	<p>TLO 2.1 Identify the appropriate creativity technique for new product development</p> <p>TLO 2.2 Describe the new product development process for a product / service</p> <p>TLO 2.3 Comprehend the importance of various strategic steps Product Management</p> <p>TLO 2.4 Elaborate Agile product management</p> <p>TLO 2.5 Explain the significance of the Project Management</p> <p>TLO 2.6 Describe the various tools of project management</p>	<p><b>Unit - II Product, Operations and Project Management</b></p> <p>2.1 Creativity and innovation management: creativity techniques - brainstorming, checklist, reverse brainstorming, morphological analysis, six thinking hats.</p> <p>2.2 New product development, change management</p> <p>2.3 Product Management -meaning, strategic steps for sustainable design of a product</p> <p>2.4 Agile product management- concept, benefits, principles and manifesto</p> <p>2.5 Project Management: importance, areas within project management, 4Ps and phases</p> <p>2.6 Tools of Project Management: PERT and CPM, GANTT &amp; Chart Overview of Estimate and Budget</p>	<p>Presentations</p> <p>Case Study</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Role Play</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 Understand the importance of quality management tools</p> <p>TLO 3.2 Explain the importance of various techniques for optimization and waste minimization</p> <p>TLO 3.3 State the importance of ISO quality standards</p> <p>TLO 3.4 Describe ERP</p> <p>TLO 3.5 State the importance of ISO</p> <p>TLO 3.6 Recognize the importance of customer satisfaction as a competitive advantage</p>	<p><b>Unit - III Management Practices</b></p> <p>3.1 Quality circle, kaizen, Six Sigma, TQM</p> <p>3.2 5S, Kanban card system, TPM, Lean Manufacturing: Meaning, Steps and Importance</p> <p>3.3 Quality Standards and ISO: Meaning, ISO 9001:2016, ISO 14000, OSHA 2020</p> <p>3.4 The overview of ERP along with example</p> <p>3.5 Service quality and customer/client satisfaction, servicescape</p>	<p>Presentation</p> <p>Case study</p> <p>Interactive session</p> <p>Quiz</p> <p>Video</p> <p>Demonstration</p> <p>Lecture Using Chalk-Board</p>
4	<p>TLO 4.1 Explain the importance of marketing techniques</p> <p>TLO 4.2 Explain the importance of needs, wants and desires in marketing</p> <p>TLO 4.3 Interpret the traditional and digital marketing techniques</p> <p>TLO 4.4 Plan different aspects of an event management</p>	<p><b>Unit - IV Marketing Management</b></p> <p>4.1 Marketing management: meaning, significance, Seven P's of Marketing</p> <p>4.2 Needs, wants and demands in marketing. Customer relationship management</p> <p>4.3 Types of marketing: traditional and digital marketing</p> <p>4.4 Event management: types, different aspects of event management, crisis management</p>	<p>Case Study</p> <p>Interactive session based video</p> <p>Role Play</p> <p>Flipped Classroom</p> <p>Presentations</p>
5	<p>TLO 5.1 State the importance of supply chain and logistics management</p> <p>TLO 5.2 Explain the components of supply chain and logistics Management</p> <p>TLO 5.3 Describe the role of information technology in supply chain &amp; logistics management</p> <p>TLO 5.4 State the significance of Human Resource Management</p> <p>TLO 5.5 Analyze the various methods of recruitment, selection and training for an organization</p> <p>TLO 5.6 List the qualities of a successful supervisor</p>	<p><b>Unit - V Supply Chain &amp; Human Resource Management</b></p> <p>5.1 The overview of Supply Chain and logistics Management</p> <p>5.2 Components of Supply Chain and logistics Management</p> <p>5.3 Role of information technology in supply chain &amp; logistics management</p> <p>5.4 Overview of Human Resource Management-Meaning,significance,scope and principles</p> <p>5.5 Recruitment, selection and training of human resources. Chalk Circle</p> <p>5.6 Qualities of a successful supervisor /team leader and types of leadership</p>	<p>Presentations</p> <p>Video</p> <p>Demonstrations</p> <p>Case Study</p> <p>Collaborative learning</p> <p>Video</p> <p>Demonstrations</p> <p>Chalk-Board</p>

## 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 / Article

- Make a one page note based on a book of management you read.
- Write a short article on inventory management exploring online learning resources.
- Prepare a report on ISO standards applicable to your field. a. IATF 16949-2016 / SLA-TS 16949-2016, - Automotive Industry b. ISO 22000 — Food safety management c. ISO 50001 — Energy management d. ISO/IEC 27001 - Cyber Security e. ISO/DIS 4931-1 - Buildings and civil engineering works
- Prepare a 4 quadrant matrix of time management for managing the tasks.
- Prepare a report on any one software used for Supply Chain and Logistics Management.
- Prepare a GANTT Chart for project management related to your field.

### Note Taking

- Watch a Tedx Talk Video on managerial skills and take notes in the form of keywords.

### Case Study

- Prepare a case study and discuss the same on following topics a. Self Management Skills b. Six Thinking Hats c. Kaizen d. Quality Circle e. Safety Measures in different organizations related to your field
- Study the recruitment and selection process of any organization related to your field.
- Prepare a case study on management lessons based on life of Chhatrapati Shivaji Maharaj
- Conduct outbound training on managerial skills. Make a video and upload on social media.

### Quizzes

- Participate in online quizzes related to areas of management .

### Assignment

- Workshops to be conducted for students on following topics a. creativity techniques b. time management c. stress management d. negotiation and conflict e. goal setting f. meditation new product development

### 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 : NOT APPLICABLE****IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Management	CO1	13	8	6	4	18
2	II	Product, Operations and Project Management	CO2	8	2	4	6	12
3	III	Management Practices	CO3	8	4	4	6	14
4	IV	Marketing Management	CO4	8	2	4	6	12
5	V	Supply Chain & Human Resource Management	CO5	8	4	4	6	14
<b>Grand Total</b>				<b>45</b>	<b>20</b>	<b>22</b>	<b>28</b>	<b>70</b>

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

- MCQ Based Class Test, Self Learning Activities / Assignment

**Summative Assessment (Assessment of Learning)**

- Summative Assessment (Assessment of Learning) MCQ based

**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	1	1	-	-	2	3			
CO2	1	3	3	-	1	3	3			
CO3	1	3	1	-	1	1	3			
CO4	1	2	2	-	1	2	3			
CO5	1	1	2	-	1	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	A. K. Gupta	Engineering Management	S. Chand, ISBN: 81-219-2812-5, 2007, 2nd Edition
2	O. P. Khanna	Industrial Engineering & management	Dhanpat Rai Publication, ISBN: 978-8189928353, 2018
3	Harold Koontz and Heinz Weinrich	Essentials of Management	Tata McGraw Hill Education ISBN: 9789353168148, 2020, 12th edition
4	E. H. McGrath	Basic Managerial Skills for All	PHI ISBN: 978-8120343146, 2011, 9th Edition
5	Andrew DuBrin	Management Concepts and Cases	Cengage Learning, ISBN: 978-8131510537, 2009, 9th edition
6	K. Dennis Chambers	How Toyota Changed the World	Jaico Books ISBN: 978-81-8495-052-6, 2009
7	Jason D. O'Grandy	How Apple changed the Wolrd	Jaico Publishing House ISBN: 978-81-8495-052-0, 2009
8	Subhash Sharma	Indian Management	New Age International Private Limited ; ISBN-978-9389802412, 2020, 1st edition
9	Chitale, Dubey	Organizational Behaviour Text and Cases	PHI LEARNING PVT. LTD., ISBN: 978-9389347067, 2019, 2nd Edition

**XIII . LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
1	<a href="https://www.debonogroup.com/services/core-programs/six-thinking-hats/">https://www.debonogroup.com/services/core-programs/six-thinking-hats/</a>	Six Thinking Hats
2	<a href="https://hbr.org/1981/09/managing-human-resources">https://hbr.org/1981/09/managing-human-resources</a>	HR Management
3	<a href="https://theproductmanager.com/topics/agile-product-management/">https://theproductmanager.com/topics/agile-product-management/</a>	Agile Product Management
4	<a href="https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management">https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management</a>	Supply Chain Management
5	<a href="https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm">https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm</a>	PERT, CPM, GANTT Chart
6	<a href="https://www.simplilearn.com/best-management-tools-article">https://www.simplilearn.com/best-management-tools-article</a>	Management Tools
7	<a href="https://www.psychometrica.in/free-online-psychometric-tests.html">https://www.psychometrica.in/free-online-psychometric-tests.html</a>	Psychometric Tests
8	<a href="https://www.investopedia.com/terms/e/erp.asp">https://www.investopedia.com/terms/e/erp.asp</a>	ERP
9	<a href="https://asq.org/quality-resources/quality-management-system">https://asq.org/quality-resources/quality-management-system</a>	QMS
10	<a href="https://testlify.com/test-library/creative-thinking/">https://testlify.com/test-library/creative-thinking/</a>	Psychometric Tests
11	<a href="https://www.mindtools.com/">https://www.mindtools.com/</a>	Management Skills
12	<a href="https://www.investopedia.com/terms/d/digital-marketing.asp">https://www.investopedia.com/terms/d/digital-marketing.asp</a>	Digital Marketing

**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>: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Agricultural Engineering/ Architecture/ Fashion &amp; Clothing Technology/ Dress Designing &amp; Garment Manufacturing/ Food Technology/ Instrumentation &amp; Control/ Instrumentation/ Interior Design &amp; Decoration/ Interior Design/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Surface Coating Technology/ Textile Technology/ Travel and Tourism/ Textile Manufactures/</b>
<b>Programme Code</b>	<b>: AA/ AD/ AE/ AL/ AT/ DC/ DD/ FC/ IC/ IS/ IX/ IZ/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ SC/ TC/ TR/ TX</b>
<b>Semester</b>	<b>: Fourth / Fifth / Sixth</b>
<b>Course Title</b>	<b>: ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS</b>
<b>Course Code</b>	<b>: 314014</b>

### I. RATIONALE

Entrepreneurship and Startup is introduced in this curriculum to develop the entrepreneurship traits among the students before they enter into the professional life. By exposing and interacting with entrepreneurship and startup eco-system, student will develop the entrepreneurial mind set. The innovative thinking with risk taking ability along with other traits are to be inculcated in the students through micro projects and training. This exposure will be instrumental in orienting the students in transforming them to be job generators after completion of Diploma in Engineering.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

- Develop project proposals for launching small scale enterprises and starts up.

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

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

- CO1 - Identify one's entrepreneurial traits.
- CO2 - Use information collected from stakeholder for establishing/setting up/founding starts up
- CO3 - Use support systems available for Starts up
- CO4 - Prepare project plans to manage the enterprise effectively

### IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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	Min				Max	Min	Max	Min	Max	Min				
314014	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	EDS	AEC	1	-	2	1	4	2	-	-	-	-	-	50	20	25@	10	25	10	100

**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.
1	TLO 1.1 Compare advantages and disadvantages of Entrepreneurship TLO 1.2 Identify entrepreneurial traits through self-analysis TLO 1.3 Compare risk associated with different type of enterprise	<b>Unit - I Introduction to Entrepreneurship Development</b> 1.1 Entrepreneurship as a career – charms, advantages, disadvantages , scope- local and global 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking, learning from failure 1.3 Types of enterprises and their features : manufacturing, service and trading	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Explain Important factors essential for selection of product/service and selection of process TLO 2.2 Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. TLO 2.3 Suggest steps for the selection process of an enterprise for the specified product or service with justification. TLO 2.4 Plan a market study /survey for the specified enterprise	<b>Unit - II Startup Selection Process</b> 2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Instries Commission[KVIC]	Presentations Lecture Using Chalk-Board

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 Explain categorization of MSME on the basis of turnover and investment</p> <p>TLO 3.2 Describe support system provided by central and state government agencies</p> <p>TLO 3.3 State various schemes of government agencies for promotion of entrepreneurship</p> <p>TLO 3.4 Describe help provided by the non-governmental agencies for the specified product/service</p> <p>TLO 3.5 Compute breakeven point, ROI and ROS for the specified business enterprise, stating the assumptions made</p>	<p><b>Unit - III Support System for Startup</b></p> <p>3.1 Categorization of MSME, ancillary industries</p> <p>3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP, DI, KVIC</p> <p>3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance.</p> <p>3.4 Breakeven point, return on investment (ROI) and return on sales (ROS).</p>	<p>Presentations</p> <p>Lecture Using Chalk-Board</p>
4	<p>TLO 4.1 Explain key elements for the given business plan with respect to their purpose/size</p> <p>TLO 4.2 Justify USP of the given product/ service from marketing point of view.</p> <p>TLO 4.3 Formulate business policy for the given product/service.</p> <p>TLO 4.4 Choose relevant negotiation techniques for the given product/ service with justification</p> <p>TLO 4.5 Identify risks that you may encounter for the given type of business/enterprise with justification.</p> <p>TLO 4.6 Describe role of the incubation centre and accelerators for the given product/service.</p>	<p><b>Unit - IV Managing Enterprise</b></p> <p>4.1 Techno commercial Feasibility study, feasibility report preparation and evaluation criteria</p> <p>4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project</p> <p>4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan.</p> <p>4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques</p> <p>4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, definition of startup cycle, ecosystem, angel investors, venture capitalist</p> <p>4.6 Incubation centers and accelerators : Role and procedure</p>	<p>Presentations</p> <p>Lecture Using Chalk-Board</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
LLO 1.1 Collect information of successful entrepreneurial traits	1	*Preparation of report on entrepreneurship as a career	2	CO1
LLO 2.1 Identify different traits as an entrepreneur from various field LLO 2.2 Suggest different traits from identified problem	2	Case study on 'Traits of Entrepreneur'	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Explore probable risks for identified enterprise.	3	*Case study on 'Risks associated with enterprise	2	CO1
LLO 4.1 Identify new product for development LLO 4.2 Prepare a newly developed product	4	*Preparation of report on 'Development of new Product'	2	CO1 CO2
LLO 5.1 Identify Process for development of product for new startup	5	Preparation of Report on ' Process selection ' for new startup	2	CO1 CO2 CO3
LLO 6.1 Develop questioner for market survey	6	*Market survey for setting up new Start up	2	CO2 CO3
LLO 7.1 Interpret the use of Technology Life Cycle	7	A Case study on ' Technology life cycle' of any successful entrepreneur.	2	CO3
LLO 8.1 Use information related to support of startups from Government and non-government agencies' LLO 8.2 Prepare report for setting up startup	8	*Preparation of report on 'Information for setting up new startup' from MCED/MSME/KVIC etc	2	CO3 CO4
LLO 9.1 Compute ROI of successful enterprise.	9	Case study on 'Return on Investment (ROI)' of any successful startup	2	CO3
LLO 10.1 Calculate of ROS of any successful enterprise	10	Case study on 'Return on sales (ROS)' of any successful startup	2	CO3
LLO 11.1 Calculate Brake even point of any enterprise	11	Preparation of report on 'Brake even point calculation' of any enterprise.	2	CO3 CO4
LLO 12.1 Prepare feasibility report of given business	12	*Preparation of report on 'feasibility of any Techno-commercial business"	2	CO4
LLO 13.1 Plan a USP of any enterprise.	13	*A case study based on 'Unique selling Proposition (USP) of any successful enterprise	2	CO4
LLO 14.1 Prepare a project report using facilities of Atal Incubation center.	14	*Prepare project report for starting new startup using 'Atal incubation center (AIC)	2	CO1 CO2 CO3 CO4

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

- '\*1' 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 a ' Women entrepreneurship business plan ' Choose relevant government scheme for the product/service
- Prepare a 'Pitch- desk' for your start up
- Prepare a business plan for a. Market research b. Advertisement agency c. Placement Agency d. Repair and Maintenance agency e. Tour and Travel agency

- Prepare a 'Social entrepreneurship business plan, plan for CSR funding.
- Prepare a business plan for identified projects by using entrepreneurial eco system for the same (Schemes, incentives, incubators etc.)

**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**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computers with internet and printer facility	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Entrepreneurship Development	CO1	5	0	0	0	0
2	II	Startup Selection Process	CO2	4	0	0	0	0
3	III	Support System for Startup	CO3	3	0	0	0	0
4	IV	Managing Enterprise	CO4	3	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)**

**Summative Assessment (Assessment of Learning)**

- End of Term Examination - Viva-voce

**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	2	-	3	2			
CO3	2	2	2	2	-	3	2			
CO4	2	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	Dr. Nishith Dubey, Aditya Vyas , Annu Soman , Anupam Singh	Un- boxing Entrepreneurship your self help guide to setup a successful business	Indira Publishing House ISBN-2023,978-93-93577-70-2
2	Gujral, Raman	Reading Material of Entrepreneurship Awareness Camp	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad
3	Chitale, A K	Product Design and Manufacturing	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
4	Charantimath, Poornima	Entrepreneurship Development Small Business Entrepreneurship	Pearson Education India, New Delhi; ISBN: 9788131762264
5	Khanka, S.S.	Entrepreneurship and Small Business Management	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

## XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="http://www.mced.nic.in/allproduct.aspx">http://www.mced.nic.in/allproduct.aspx</a>	MCED Product and Plan Details
2	<a href="http://niesbud.nic.in/Publication.html">http://niesbud.nic.in/Publication.html</a>	The National Institute for Entrepreneurship and Small Business Development Publications
3	<a href="http://niesbud.nic.in/docs/1standardized.pdf">http://niesbud.nic.in/docs/1standardized.pdf</a>	Courses : The National Institute for Entrepreneurship and Small Business Development
4	<a href="https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530">https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530</a>	Government Schemes
5	<a href="https://www.nabard.org/Tenders.aspx?cid=501andid=24">https://www.nabard.org/Tenders.aspx?cid=501andid=24</a>	NABARD - Information Centre
6	<a href="http://www.startupindia.gov.in/pdf/file.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdf&amp;content_type=Actionandsubmenupoint=action">http://www.startupindia.gov.in/pdf/file.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdf&amp;content_type=Actionandsubmenupoint=action</a>	Start Up India

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
7	<a href="http://www.ediindia.org/institute.html">http://www.ediindia.org/institute.html</a>	About - Entrepreneurship Development Institute of India (EDII)
8	<a href="http://www.nstedb.com/training/training.htm">http://www.nstedb.com/training/training.htm</a>	NSTEDB - Training
<b>Note :</b> <ul style="list-style-type: none"><li>Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students</li></ul>		