

MAINTENANCE OF AUTOMOBILE SYSTEMS**Course Code : 315011**

Programme Name/s : Automobile Engineering.
Programme Code : AE
Semester : Fifth
Course Title : MAINTENANCE OF AUTOMOBILE SYSTEMS
Course Code : 315011

I. RATIONALE

This course enables the students to acquire hands on skill related to maintenance of motor vehicle which will be helpful to get employment in automotive service sector and entrepreneurship development. It includes various automobile workshop practices like inspection, checking, troubleshooting, servicing and repair related to engine, transmission, brake, steering and suspension system etc. for keeping the vehicle in good running condition and reduce emissions.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Maintain automobile engine, transmission, control and comfort systems of the vehicles.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select relevant tools and equipment required for maintenance of vehicle.
- CO2 - Service different types of engine systems.
- CO3 - Troubleshoot major assemblies of transmission system.
- CO4 - Maintain automobile Control and Comfort systems (HVAC) components.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks	
				Actual Contact Hrs./Week	SLHNLH			Paper Duration		Theory				Based on LL & TL				Based on SL					
														Practical									
										CL	TL	LL	FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
																	Max	Min	Max	Min	Max		Min
315011	MAINTENANCE OF AUTOMOBILE SYSTEMS	MAS	SEC	2	-	4	-	6	2	-	-	-	-	-	25	10	25#	10	-	-	50		

Total IKS Hrs for Sem. : 0 Hrs

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

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

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 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 Explain the safety precautions to be taken while using the given tool / equipment with justification. TLO 1.2 Select relevant tools and equipment required for the given application. TLO 1.3 Explain the use of the given tool/equipment with justification. TLO 1.4 Select relevant maintenance procedure for the given automobile component. TLO 1.5 Explain the given type of workshop record with its significance.	Unit - I Automobile Workshop tools, Equipment and Maintenance Management 1.1 General safety precautions and procedures in automobile workshop. 1.2 Functions of major automobile workshop tools and equipment with safety precautions - Wheel aligner, Wheel balancer, Engine analyzer, Hydraulic lift, Compressor, Injector tester, Compression tester, Cylinder bore gauge, Battery tester, Pneumatic gun, Timing gun. 1.3 Safety procedure for using power tools and equipment (electrically, hydraulically and pneumatically operated). 1.4 Necessity and Types of maintenance – Preventive maintenance, Scheduled maintenance, Breakdown maintenance. 1.5 Record keeping: Necessity and types of workshop records – History sheet, Work orders /Job cards, Activity file, Service manual, Spare part register, Spares procurement register.	Lecture Using Chalk-Board Hands-on Video Demonstrations Presentations

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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Identify possible causes for the given fault in the engine systems and their remedies. TLO 2.2 Explain with sketch the procedure of engine compression test. TLO 2.3 Describe servicing of the given engine system with relevant tools/equipment. TLO 2.4 Describe the procedure for Phasing and calibration of fuel injection pump. TLO 2.5 Describe with schematic diagram engine tune up procedure for the given engine.	Unit - II Engine Maintenance 2.1 Engine troubleshooting : a) Engine smoke, Engine Knocking, Engine misfire, b) Compression test, vacuum test, cylinder leakage test. 2.2 Lubrication system service: Change oil filter, check oil pump, diagnose causes for excessive oil consumption, external oil leakage and low oil pressure in an engine. 2.3 Fuel feed system service: Injector cleaning and testing of MPFI and CRDI system, FIP Phasing and calibration. 2.4 Cooling system servicing: Refilling of radiator, pressure testing, thermostat checking, leakage testing, radiator fan testing. 2.5 Engine servicing: Checking and servicing of engine components – Cylinder head, Cylinder block, Cylinder liners, Piston, Piston rings, Crank shaft, Connecting rod, Valves, Tuning of engine.	Lecture Using Chalk-Board Presentations Video Demonstrations Hands-on
3	TLO 3.1 State the causes and relevant remedies for the given fault in the transmission system components. TLO 3.2 Explain the servicing procedure for the given transmission system components. TLO 3.3 Explain with sketch backlash adjustment in the given pair of final drive and differential assembly. TLO 3.4 Describe with sketch lubrication of transmission system.	Unit - III Transmission System Maintenance 3.1 Maintenance of Clutch: a) Checking clutch plate (for thickness, run out, rivet depth, torsion spring weakness, hub splines), b) Pressure plate (for wear, scratches, scoring and warpage, free and seated height of pressure springs), c) Clutch shaft (for bent and distorted splines), d) Clutch adjustments - types and procedure, e) Troubleshooting for clutch slip, clutch noise, clutch grab and chatter. 3.2 Maintenance of Gearbox: a) Checking gearbox for run out of main shaft and lay shaft, oil seals, bearings, worn out gears and synchromesh unit. b) Gearbox troubleshooting – Causes and remedies for Gear box noise, Hard gear shifting. 3.3 Maintenance of propeller shaft and universal joint assembly: Checking for Straightness of shaft, wear of slip joint, wear and lubrication of universal joint. 3.4 Maintenance of rear axle: Checking and adjusting final drive for ring gear run-out, backlash in ring gear and bevel pinion, tooth contact between ring gear and pinion, backlash in differential gears, bearing preload –necessity and procedure. 3.5 Troubles, causes and remedies of propeller shaft, differential and rear axle. 3.6 Lubrication of transmission system.	Lecture Using Chalk-Board Presentations Video Demonstrations Hands-on

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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Identify possible causes for the given fault in vehicle control system and their remedies. TLO 4.2 Explain servicing procedure for braking system of the given vehicle with relevant tools/equipment. TLO 4.3 Describe the routine maintenance procedure of the given automotive system. TLO 4.4 Identify causes for the given fault in car air conditioning system and their remedies. TLO 4.5 Describe with sketch procedure for refrigerant leakage testing in HVAC system.	Unit - IV Maintenance of vehicle control and HVAC system 4.1 Maintenance of brakes: a) Inspection of master cylinder, wheel cylinder, brake drum, brake lining, brake disc and brake pads, b) Adjustment of hydraulic brakes – shoe clearance, brake pedal free travel, pedal to floor clearance, parking brake adjustment, c) Types of brake bleeding, procedure for bleeding of hydraulic brakes, d) Troubles, causes and remedies of hydraulic and Air brake system. 4.2 Troubleshooting of suspension and steering system 4.3 Maintenance of wheels and tyres: Care of wheels and tyres, procedure of wheel balancing and wheel alignment by wheel alignment gauges. 4.4 Maintenance of HVAC system: a) Troubleshooting of the air conditioning compressor, blower, evaporator, condenser, receiver and dryer, expansion valve, b) Refrigerant leakage testing procedure.	Lecture Using Chalk-Board Video Demonstrations Hands-on Presentations

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 Identify the special tools and equipment with specifications available in the laboratory. LLO 1.2 Select appropriate tools and equipment in given situation. LLO 1.3 Follow relevant safety procedures for various tools and equipment.	1	* Automobile workshop tools and Equipment.	2	CO1
LLO 2.1 Identify different record keeping formats used in automobile workshop. LLO 2.2 Interpretation of different record keeping formats. LLO 2.3 Fill and maintain different record keeping formats used in automobile workshop.	2	Automobile workshop records for two/four-wheeler.	2	CO1
LLO 3.1 Diagnose common faults in fuel feed system in petrol / diesel engine. LLO 3.2 Replace faulty/worn out parts of the fuel feed system. LLO 3.3 Check fuel flow rate and DTC on OBD II after replacement of faulty/worn out parts.	3	Servicing the engine fuel feed system.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Check and replace faulty/ worn out components of the engine lubrication system. LLO 4.2 Check oil level, external leakages on the given engine.	4	Servicing of the engine lubrication system.	2	CO2
LLO 5.1 Identify possible causes for the given fault in engine cooling system and their remedies. LLO 5.2 Check and replace of various components of the engine cooling system. LLO 5.3 Perform coolant flushing for the given vehicle. LLO 5.4 Perform leak detection in cooling system with relevant tools/equipment.	5	* Servicing of engine cooling system.	2	CO2
LLO 6.1 Choose the relevant equipment and tools required for the compression test. LLO 6.2 Perform compression testing on the Petrol/Diesel engines. LLO 6.3 State the causes of low/high compression pressure during test.	6	* Compression test on petrol/diesel engine.	2	CO2
LLO 7.1 Dismantle cylinder head of the engine using appropriate tools. LLO 7.2 Inspect conditions of components of cylinder head. LLO 7.3 Replace worn out components of cylinder head.	7	* Servicing cylinder head of multicylinder petrol /diesel engine.	2	CO2
LLO 8.1 Dismantle cylinder block of the given engine. LLO 8.2 Check wear of cylinder block with appropriate tools. LLO 8.3 Suggest possible causes for excessive bore wear.	8	Servicing of cylinder block of multicylinder petrol /diesel engine.	2	CO2
LLO 9.1 Identify tools and equipment required for servicing of pistons and connecting rod. LLO 9.2 Service piston and connecting rod assembly. LLO 9.3 Measure various parameter as per manufacturer manual.	9	Servicing of piston and connecting rod assembly of multicylinder Petrol/Diesel engine.	2	CO2
LLO 10.1 Identify tools/equipment essential to perform engine tune up procedure. LLO 10.2 Perform tune up procedure on petrol/diesel engine.	10	* Petrol/diesel engine tune-up.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Dismantle the given Single plate dry clutch assembly. LLO 11.2 Measure various parameters of given single plate clutch assembly. LLO 11.3 Assemble the dismantled Single plate dry clutch. LLO 11.4 Suggest probable causes and their remedies for common clutch troubles.	11	* Servicing of single plate dry coil spring/diaphragm type clutch assembly.	2	CO3
LLO 12.1 Dismantle the given synchromesh gearbox. LLO 12.2 Check and replace worn out components of gearbox if required. LLO 12.3 Assemble the dismantled synchromesh gearbox. LLO 12.4 Check for smooth operation of gearbox after assembly.	12	Servicing of synchromesh gearbox.	2	CO3
LLO 13.1 Service differential assembly of the given vehicle. LLO 13.2 Observe conditions of differential components. LLO 13.3 Adjust backlash in differential assembly.	13	* Servicing of final drive and differential assembly.	2	CO3
LLO 14.1 Service propeller shaft and universal joint of the given vehicle. LLO 14.2 Check and replace various parts as per requirement.	14	Servicing of propeller shaft and universal joint assembly.	2	CO3
LLO 15.1 Check and replace components of hydraulic brake system for efficient working. LLO 15.2 Adjust of brake pedal free play and check for brake fluid leakage.	15	* Servicing of hydraulic brake system.	2	CO4
LLO 16.1 Identify the need of brake bleeding in hydraulic braking system. LLO 16.2 Perform brake bleeding of hydraulic braking system. LLO 16.3 Check for the proper working of hydraulic braking system.	16	Bleeding of hydraulic braking system.	2	CO4
LLO 17.1 Identify faults in suspension system of the given vehicle. LLO 17.2 Replace damage parts of the suspension system as per requirement. LLO 17.3 Check performance of suspension by taking test drive.	17	Troubleshooting of car/LMV suspension system.	2	CO4
LLO 18.1 Identify the faults in steering system of the given vehicle. LLO 18.2 Check and replace the worn out components if required. LLO 18.3 Adjust the clearance in steering gearbox as per requirement.	18	Troubleshooting of car/LMV steering system.	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 19.1 Perform wheel balancing and wheel alignment on vehicle. LLO 19.2 Explain parameters measured in this process.	19	* Wheel balancing and wheel alignment of vehicle.	2	CO4
LLO 20.1 Identify fault in HVAC system of vehicle. LLO 20.2 Perform Leak test on the HVAC system. LLO 20.3 Replace worn out components of HVAC system. LLO 20.4 Check proper working of HVAC system.	20	* Troubleshooting of HVAC system.	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) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Single plate dry coil spring/ diaphragm type clutch assembly of LMV/HMV.	11
2	Sliding mesh/Constant mesh/ Synchromesh gearbox of LMV/HMV in good running condition.	12
3	Final drive and differential assembly of LMV/HMV in good running condition.	13
4	Propeller shaft and universal joint assembly of LMV/HMV in good running condition.	14
5	Actual steering gear boxes of LMV/HMV in good working condition. (Rack pinion type, Recirculating ball and Nut type, Worm and roller type).	18
6	a) Wheel Balancer- max power consumption: 1.1 KW, Balancing Speed <100 rpm, Balancing Accuracy: 10 gm for truck, Cycle time for wheel: 20sec, Diameter Setting range: 10"-30", Max Wheel Diameter 1300mm, Max Wheel weight: 250Kg. b) Wheel Aligner- Equipped with variable height camera support, Vehicle orientation directional indicator, located on camera beam, advanced customer database, Advanced alignment measurement, custom vehicle specification, front/rear/ all/zoom reading, Individual Camber, Caster and Toe, Initial/Final printout in graphical and text. Parameter, Range, Accuracy: Camber $\pm 10^\circ$, $\pm 2'$, Caster $\pm 20^\circ$, $\pm 6'$; Kingpin Inclination: $\pm 20^\circ$, $\pm 6'$, Toe-in and Toe-out $\pm 20^\circ$, $\pm 2'$.	19
7	a) Refrigerant Recovery Machine- 0.75Hp, 230V 50Hz, Recovery tank capacity-1L. b) Refrigerant Leak detector kit (UV dye kit)	20
8	Injector tester- pressure range: 0-60 MPa, fuel tank of 1L	3
9	a) Pressure tester for cooling system- 0-4 bar, b) Antifreeze refractometer, 3-in-1 antifreeze coolant tester for checking freezing point.	5
10	Compression tester for petrol and diesel engine.	6
11	Cylinder bore gauge- resolution 0.01mm, range- 50-160 mm, depth 250mm.	8

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
12	a) Hydraulic lift- capacity 3 Ton. b) Air compressor- 1.5 HP, 23Lit, 1300W c) Battery charger- Input 220-240V AC 50Hz, Output-12V, 8A, starting current 70A. d) Pneumatic nut runner- 10-60 Nm e) Engine analyzer- Generic OM123 OBD II.	All
13	Actual working engine (Multicylinder 4 stroke SI and CI engine above 1000CC) setup with all accessories.	All
14	Light Motor Vehicle: A modern car /jeep of any make and model along with all relevant accessories and systems.	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	Automobile Workshop tools, Equipment and Maintenance Management	CO1	3	0	0	0	0
2	II	Engine Maintenance	CO2	6	0	0	0	0
3	III	Transmission System Maintenance	CO3	5	0	0	0	0
4	IV	Maintenance of vehicle control and HVAC system	CO4	6	0	0	0	0
Grand Total				20	0	0	0	0

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

- For laboratory learning 25 Marks.

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

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

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CO4	3	3	2	2	2	2	3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R. B. Gupta	Automobile Engineering	Satya Prakashan, New Delhi, 2016 ISBN-13. 978-9351921912
2	Jigar Doshi, Dhruv Panchal, Jayesh Maniar	Vehicle Maintenance and Garage Practice	PHI Learning Pvt. Ltd. Delhi, 2014 ISBN-9788120349827
3	Schwaller, Anthony	Motor Automotive Technology	Delmar Publishers 1998 ISBN-13-978-08227351004
4	Jack Erjavec	Automotive Technology	Delmar Cengage Learning, 2020 ISBN-13-978-1337794213
5	Crouse, Anglin	Automotive Mechanics	Tata McGraw-Hill Education, New Delhi, 2017 ISBN-13-978-0070634350

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=luoLh0WBtTw	Engine diagnosis.
2	https://www.youtube.com/watch?v=sn2XkeEDLKg	Cylinder head crack.
3	https://www.youtube.com/watch?v=8KAszximKhw	Engine overheating.
4	https://www.youtube.com/watch?v=k0ovUHEOtyE	Engine cooling system servicing.
5	https://www.youtube.com/watch?v=1vejKSxzGC8	Cylinder bore inspection
6	https://www.youtube.com/watch?v=_tN4G8e3Qao	Inspection of piston and connecting rod.
7	https://www.youtube.com/watch?v=QfW1E3Dvt1U	Inspection of clutch
8	https://www.youtube.com/watch?v=HzfNatzyz68&t=15s	Clutch pedal adjustment
9	https://www.youtube.com/watch?v=PWtpfvUZoYA	Differential Service - Bevel Gear Runout Inspection
10	https://www.youtube.com/watch?v=qmnnEw5_n7c	Inspection of differential

Note :

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