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AUTOMOTIVE MECHATRONICS **Course Code : 316351**

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Sixth**
Course Title : **AUTOMOTIVE MECHATRONICS**
Course Code : **316351**

I. RATIONALE

The modern automotive industry is driven by the integration of sophisticated electronics and control systems. The modern vehicles are no longer purely mechanical entities; they are complex, interconnected systems relying on sophisticated electronics, sensors, actuators, and control algorithms. This course in Automotive Mechatronics is meticulously designed to address this paradigm shift, providing diploma engineers with the essential knowledge and practical skills required to navigate and excel in this dynamic field.

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: Diagnose fault in automotive mechatronic system

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify various automobile systems with their functions and location.
- CO2 - Diagnose performance of given automotive sensors and actuators
- CO3 - Create block diagram of given automotive control system explaining its working and functioning of different components
- CO4 - Perform onboard diagnostics on MPFI and CRDI engine using scan tool and measuring instruments.
- CO5 - Check functionality of vehicle safety device components and advanced driver assistance systems

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
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316351	AUTOMOTIVE MECHATRONICS	AMK	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

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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 Classify Automobiles on basis of various criteria TLO 1.2 Draw block diagram of general vehicle layout TLO 1.3 List major components of automobile with their location and function TLO 1.4 Sketch block diagram of SI & CI Engine TLO 1.5 Explain working of given power train control system with block diagram TLO 1.6 State necessity, functions and location of given automobile system	**Unit - I Automotive Fundamentals** 1.1 Automobile: Definition, Need of Automobile, Classification of Automobiles. 1.2 Block diagram of general vehicle layout 1.3 Major components of Automobile with their function and location 1.4 Block diagram of Spark Ignition (SI) and Compression Ignition (CI) Engine 1.5 Power train control system: Electronic control system used in Multi-Point Fuel Injection (MPFI) and Common Rail Direct Injection (CRDI) system 1.6 Necessity, functions and locations of following automobile systems. a.Transmission system b.steering system. c.Suspension system. d.Cooling and lubrication system e.Fuel injection and Ignition system. f.Starting and charging system.	Video Demonstrations Presentations Model Demonstration Lecture Using Chalk-Board

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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 List variables sensed in engine control TLO 2.2 Describe functions of automobile sensors and actuators TLO 2.3 Explain with sketches working and output signals of given automotive sensors TLO 2.4 Explain construction & working of given automotive actuators TLO 2.5 Describe procedure for maintaining given automotive sensors and actuators	**Unit - II Automotive Sensors and Actuators** 2.1 Concepts of an Electronic Engine control system: Inputs to controller, Outputs from controller 2.2 Variable quantity sensed in automotive engine : Air flow rate, speed , pressure, temperature, vibration, concentration of oxygen. 2.3 Sensors in Automotive: Air flow rate sensor, Engine speed sensor, Engine crankshaft angular position sensor, Throttle Position sensor, Manifold Absolute Pressure sensor, Intake Air Temperature sensor, Coolant Temperature sensor, Exhaust gas oxygen sensor, Knock sensor 2.4 Automobile Engine control Actuators:- Fuel injector, Exhaust gas recirculation actuator, Brushless Direct Current (BLDC) Motor	Video Demonstrations Presentations Model Demonstration Lecture Using Chalk-Board Site/Industry Visit
3	TLO 3.1 Explain construction and working of given motion control system TLO 3.2 State advantages and disadvantages of Antilock Braking system (ABS) TLO 3.3 State function of given motion control system TLO 3.4 List types of cruise control system TLO 3.5 Draw the block diagram of given automotive motion control system	**Unit - III Automotive Motion Control System** 3.1 Cruise control system : Location, Types, Construction & working of cruise control system. 3.2 Antilock Braking system (ABS): Function, Construction & working , Advantages & Disadvantages. 3.3 Electronic power steering (EPS) system: Location, function, Construction & working. 3.4 Traction control system (TCS): Function, Construction & working 3.5 Electronic Stability control (ESC): Function, Construction & working 3.6 Integrated Engine control (IEC): Function, Construction & working	Video Demonstrations Presentations Model Demonstration Lecture Using Chalk-Board

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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 Explain diagnostics procedure to given component and system TLO 4.2 List types of On-Board Diagnostics (OBD) Scanner available in market TLO 4.3 Explain OBD II procedure TLO 4.4 State procedure for standalone diagnosis of given component TLO 4.5 Describe six step approach in testing of given automotive component with flow chart TLO 4.6 List diagnostics fault codes with meaning TLO 4.7 State function of given measuring instrument for testing	**Unit - IV Diagnostics and Testing** 4.1 Electronic control system diagnostics 4.2 On-Board Diagnostics (OBD) scanner types 4.3 On-Board Diagnostics (OBD II) Procedure of MPFI/CRDI system 4.4 Standalone diagnosis: Sensors and actuators 4.5 Six step approach for component testing 4.6 Diagnostic Fault codes : Types with their meaning 4.7 Measuring Instruments: Digital multi-meters, Oscilloscope, scan tool, Frequency meters	Video Demonstrations Presentations Model Demonstration Lecture Using Chalk-Board Site/Industry Visit
5	TLO 5.1 Describe the necessity of safety systems in modern vehicles TLO 5.2 Identify the different Advanced Driver Assistance System used in vehicle TLO 5.3 Describe working of given Advanced Driver Assistance System used in vehicle	**Unit - V Safety and Advanced Driver Assistance System** 5.1 Necessity of safety system 5.2 Types of safety-Active and Passive 5.3 Safety and Advanced Driver Assistance System :– Air Bags, Seat Belt, Central Locking, Collapsible Steering, Keyless Entry, Reverse Parking Sensor and Rear View Camera, Active Suspension, Adaptive Cruise Control, Voice Alert System, Automatic Climate Control, General Packet Radio Service (GPRS), Tyre Pressure Warning.	Video Demonstrations Presentations Lecture Using Chalk-Board Model Demonstration 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 Identify automobile systems like (Transmission ,Control ,Suspension ,Electrical and Electronics) LLO 1.2 Draw block diagram of general vehicle layout LLO 1.3 Label the diagram and list major components of automobile	1	*Trace general vehicle layout of given vehicle	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Select various tools available in laboratory LLO 2.2 Categorize tools available in laboratory LLO 2.3 Use different hand tools and measuring devices for different application	2	Use of different hand tools and measuring devices	2	CO1 CO4
LLO 3.1 Use relevant tools require to dismantle petrol/diesel engine LLO 3.2 Follow safety procedure as per standard LLO 3.3 Inspect condition of components	3	*Dismantling of 4-stroke engine (Petrol/Diesel)	2	CO1
LLO 4.1 Use relevant tools require to assemble petrol/diesel engine LLO 4.2 Follow safety procedure as per standard LLO 4.3 Inspect condition of components LLO 4.4 Reassemble the petrol/diesel engine	4	*Assembling of 4-stroke engine (Petrol/Diesel)	2	CO1
LLO 5.1 Dismantle given clutch LLO 5.2 Identify components of clutch LLO 5.3 Draw any components of the clutch LLO 5.4 Identify fault in clutch. (if any) LLO 5.5 Assemble clutch	5	Dismantling and Assembling of Clutch	2	CO1
LLO 6.1 Identify and locate the various sensors on vehicle engine LLO 6.2 Write function of each	6	*Identification of sensors and actuators in the given MPFI/CRDI engine	2	CO2
LLO 7.1 Connect the oscilloscope to the oxygen sensor signal wire LLO 7.2 Observe the waveform at idle and while the engine is revved LLO 7.3 Check resistance and voltage output LLO 7.4 Observe sensor performance and relate with engine efficiency and performance	7	*Diagnosis of (waveform, resistance and voltage output) oxygen sensor and throttle position sensor using oscilloscope	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 8.1 Make connection of oscilloscope to the given sensor signal wire LLO 8.2 Observe the waveform at idle and while the engine is revved LLO 8.3 Check resistance and voltage output LLO 8.4 Observe sensor performance and relate with engine efficiency and performance	8	Diagnosis of (waveform, resistance and voltage output) Engine Temperature sensor and manifold absolute pressure sensor using oscilloscope	2	CO2
LLO 9.1 Identify Antilock braking system components LLO 9.2 Identify Electronic stability control system components LLO 9.3 List features of ABS and ESC	9	*Identification of various components of ABS and ESC system	2	CO3
LLO 10.1 Identify various components of given motion control system LLO 10.2 List features of motion control system like cruise control system, EPS, TCS, IEC etc. in vehicle	10	Identification of various components of motion control system like cruise control system, EPS, TCS, IEC etc. in vehicle	2	CO3
LLO 11.1 Search information on digital platform/ by market survey LLO 11.2 Report features of various types of OBD scanner	11	*Preparation of report on OBD Scanner types available in market with manufacturer specifications	2	CO4
LLO 12.1 Connect Scan tool to MPFI engine control unit and enter vehicle identification data LLO 12.2 Interpret the trouble code/s LLO 12.3 Inspect relevant transducer and wiring LLO 12.4 Rectify fault and clear diagnostic trouble code	12	On-Board Diagnosis (OBD-II) of MPFI engine using Scan tool	2	CO4
LLO 13.1 Detect fault using scanner LLO 13.2 Replace faulty sensor, actuator or ECU as required LLO 13.3 Perform onboard diagnostics on CRDI engine	13	On-Board Diagnosis (OBD-II) of CRDI engine using Scan tool	2	CO4
LLO 14.1 Identify types of safety devices used in vehicle LLO 14.2 Check the functionality of the components used in safety devices	14	*Functioning of vehicle Saftey devices components	2	CO5
LLO 15.1 Identify Advanced Driver Assistance Systems LLO 15.2 Check the functionality of Advanced Driver Assistance Systems used in vehicle	15	Demonstration of functional features of Advanced Driver Assistance System used in different vehicles	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

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

- Collect specifications and features of control system of vehicle, such as: Traction control system, Stability control, Integrated Engine control and prepare report for the same
- Visit modern service station for observing automobile electronics and computer-controlled systems and prepare a report on the same
- Prepare power point presentation or animation for understanding different automotive components and systems
- Observe videos relevant to practical task. Prepare a list of appropriate tool/ equipment Considering its range/ application. For following applications, tools should be listed: i.Diagnostic tools for MPFI engine ii.Diagnostic tools for CRDI engine
- Observe videos to operate various testing equipment's. Prepare a list of appropriate equipment considering its range/applications
- Collect videos relevant to MPFI, CRDI system
- Collect specifications and features of control system of vehicle, such as: ABS, Electronic suspension systems, Electronic power steering system and prepare report for the same

Micro project

- Choose a modern engine and search information on any one system from website. Prepare a report for the same.
- Case study based on Visit to automobile garage to study a faulty system of engine
- Identify a modern technology used in an engine. Collect relevant information on the technology and its features. Compare the same with older/ modern technologies adopted in other vehicles. Refer internet/ reference books/ manufacturer published literature for the same. Prepare a report
- Prepare a detail report on diagnosis of MPFI engine: following steps to be followed: i.Student should visit the shops/ garage for survey. ii.List out steps of diagnosis. iii.Diagnose a system of an engine using scan tool/multimeter/oscilloscope. iv. Prepare a report

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.

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VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	General purpose tools (spanner, ring spanner and socket)-6mm to 32mm	1,2,3,4,5
2	Scan tool: Make reputed manufacturers: On Board Diagnosis (OBD), II Generation scan tool, controlled Network area enabled, color display, operating temperature:0 to 50 degree Celsius, Internal storage: 4AAA Batteries, External Power :7 to 18 Volts; generic tools; accessories: extended cable, OBD II cable; relevant optional accessories.	11,12,13
3	Special purpose tools (piston ring expander, piston ring compressor, valve lifter, spark plug remover, torque wrench), torque wrench range -10 Nm to 200 Nm	2
4	Multiport fuel injection system with sensors, actuators and electronic control module, exhaust gas circulation valve and Positive crankcase ventilation valve make reputed manufacturers power 25 KW@ 5000 RPM to 50 KW @ 5000 RPM: Cubic capacity 1000 CC to 2000 CC	6,7,8
5	Automotive Diagnostic Oscilloscope; Type PC Based or hand-held analog channel: 8; Bandwidth :1000 KHz; Input impedance resistance: 1 M?; Input sensitivity :10mV/div to 5 V/div	7,8
6	Digital Multimeter: Make: Reputed manufacturers -Measure Voltage and Current AC and DC, Resistance, Capacitance, diodes, continuity, frequency, Min-Max functions: LCD Display,0 to 500C operation, Temperature, DC voltage-2mV to 1000V alternating current, current: 2 Ma TO 20 A DC, Diode Test, Continuity Test-Audible buzzer, resistance: 200 ohm to 200 Mega ohm	7,8,11,12,13
7	Four-wheeler vehicle make of TATA, Mahindra or alike in good running condition. OR Cut section working model of four-wheeler transmission system showing all the parts	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	Automotive Fundamentals	CO1	12	4	4	6	14
2	II	Automotive Sensors and Actuators	CO2	14	4	4	8	16
3	III	Automotive Motion Control System	CO3	12	2	6	4	12
4	IV	Diagnostics and Testing	CO4	12	2	4	10	16
5	V	Safety and Advanced Driver Assistance System	CO5	10	2	4	6	12
Grand Total				**60**	**14**	**22**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Class Test, Term work, Self-Learning

Summative Assessment (Assessment of Learning)

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

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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	1	1	1			
CO2	3	2	1	2	1	-	2			
CO3	2	-	-	1	-	-	1			
CO4	3	2	2	3	1	2	3			
CO5	3	-	-	-	2	1	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. Kirpal Singh	Automobile Engineering Vol-I & II	Standard Publishers Distributors, New Delhi, 2011, ISBN:978-81-8014-171-3
2	William B. Ribben	Understanding Automotive Electronics	Butterworth-Heinemann, UK, 2017, ISBN 13:978-0128104347
3	A K BABU	Automotive Electrical and Electronics	Khanna Book Publishing Co. Ltd, New Delhi, 2016,ISBN:978-93-82609-69-8
4	Ronald K. Jurgen	Automotive Electronics Handbook	McGraw-Hill Inc.
5	Bosch, Robert	Automotive Handbook	Bentley Publishes, UK, 2014, ISBN:13:978978-1119975564
6	Denton, Tom	Advanced Automotive Fault Diagnosis	Routledge, New York, 2012, ISBN:978-0415725767

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=jAqC0qxIiL8 for MPFI system	MPFI system working
2	https://www.youtube.com/watch?v=KzF8ieiJ9UY for CRDI system	CRDI system working
3	https://www.youtube.com/watch?v=M9dZUOr6n4g for camshaft and crankshaft sensor testing	How to test camshaft and crankshaft sensor
4	https://www.youtube.com/watch?v= 8q6qZQJQEIU for automotive sensors and actuators	Describe different Automotive sensor and actuators

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Sr.No	Link / Portal	Description
5	https://www.youtube.com/watch?v=RR8LsMBwL2I for Scan tool video	Scan tool video
6	https://www.youtube.com/watch?v=NUvWnOd5lFw for Common Rail Diesel Injector Working and Common Failure Points	Working of Common Rail Diesel Injector
7	https://www.youtube.com/watch?v=jKtBSFoAYlg- for cruise control system	What is cruise control system
8	https://www.youtube.com/watch?v=oMDqgcm4ZjU - Park assist system	Working of Park assist system
9	https://www.youtube.com/watch?v=lnK00rtWf68 for Throttle Position sensor cleaning	Cleaning process of Throttle position sensor
10	https://www.youtube.com/watch?v=98DXe3uKwfc - Antilock Braking system	How ABS work
11	https://www.youtube.com/watch?v=CYufBm5Bek8 - working of Air bag	Working of Air bag
12	https://www.youtube.com/watch?v=JIa0nsrQXI0 to read car fault codes and to clear them	How to read car fault codes and to clear fault code
13	www.araiindia.com	Website of The Automotive Research Association of India

Note :

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

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**