



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

<b>Programme</b>	Automobile Engineering	<b>Semester</b>	IV
<b>Course Code</b>	20AT41P	<b>Type of Course</b>	Programme Core
<b>Course Name</b>	Advanced Automotive Systems	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 3:1:4	<b>Credits</b>	6
<b>CIE Marks</b>	60	<b>SEE Marks</b>	40

**1. Rationale:** The automotive industry has observed a drastic evolution since 2010 with many advancements in technology. The traditional 4-wheeled cars, which were earlier equipped with basic features have transformed into connected cars with advanced features such as cloud computing, big data, and the Internet of Things (IoT), among others. There is increasing number of electronic embedded systems in 2-wheelers as well as passenger and commercial vehicles such as Antilock Braking System (ABS), Electronic Control Units (ECUs) for engine management, park assist, Electronic Stability Programme (ESP), glow plug timers, Capacitive Discharge Ignition (CDI), etc., that are nowadays being installed not only in luxury cars but also in mid-segment cars by manufacturers. This course focusses on developing skill on these advanced automotive systems.

**2. Course Outcomes/Skill Sets:** At the end of the course the student will be able to:

CO-01	Test, Service and troubleshoot advanced automotive and electronic components of the given vehicle.
CO-02	Select an appropriate sensor and/or actuator for a given automated application, demonstrate collection of measurement data and explain process variables using sensors and transducers.

### 3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	2	2,3,4	1. Computer operation (ECU) - Block diagram of computer (ECU) with its microprocessor-functions working principle. 2. Microprocessors-design-program-information storage-information retrieval. 3. Typical multipoint fuel injection system input/output pin configuration	Refer Table 1	1. Identification of pin configuration of ECU of different engines. 2. a) Identification of pin configuration of ECU of other systems of vehicle. b) Study different error codes of different makes of ECU.
2	2	2,3,4	1. Open loop and closed loop control systems 2. Multiplexing-concept. Computer networking-concept need-Controlled Area Network (CAN)-concept-merits-types. 3. Sensors- Definition, construction and working- throttle position sensor-crankshaft position sensor-types-	Refer Table 1	1. Demonstration of computer area network and Identify TPS and crankshaft position sensor and their locations used in vehicle. 2. Diagnose and troubleshoot TPS and crank position sensor with

					engine scanner (and multi-meter).
3	2	2,3,4	1. Construction and working of magnetic pickup coil type, Hall effect. 2. Construction and working- Piezoelectric combustion, Knock sensor, temperature sensor. 3. Strain gauge type manifold absolute sensor-exhaust gas oxygen sensor.	Refer Table 1	1 Identify piezoelectric knock sensor and temperature sensor and their locations used in vehicle. 2. Diagnose and troubleshoot piezoelectric knock sensor and temperature sensor with engine scanner (and multi-meter).
4	2	2,3,4	1. Mass air flow Sensor-types 2. construction and working of hot film and hot wire type sensors. 3. Potentiometer type -need-working. principle.	Refer Table 1	1. Diagnose and troubleshoot Potentiometer with engine scanner (and multi-meter). 2. Build circuit to demonstrate the testing and working of Potentiometer, LVDT type ride height sensors, rain sensor.
5	1,2	2,3,4	1. LVDT type ride height sensors, rain sensor-need-working. principle. 2. Actuator-Definition, pulse width modulation of input voltage-duty cycle-need. 3. On/off solenoid proportionate solenoid-stepper motor-servo motor-relays-construction and working - applications.	Refer Table 1	1. Diagnose and troubleshoot LVDT type ride height sensors, rain sensor with engine scanner (and multi-meter). 2. Build circuit of On/off and proportionate solenoid stepper motor.
6	1	2,3,4	1. <b>Power steering</b> - types, construction and working- HPS. 2. Construction & working -linkage power steering, Integral power steering. 3. electronic rack and pinion power steering-electronic power steering.	Refer Table 1	1. Servicing and troubleshooting of hydraulic power steering. 2. Service and troubleshoot electronic rack and pinion power steering.
7	1	2,3,4	1. Continuously variable transmission-construction and working. 2. Hydraulic automatic transmission-gear shifting process. 3. Automated manual transmissions-modes-working principle.		1. Service and troubleshoot of CVT. 2. Service and troubleshoot of Hydraulic automatic transmission.
8	1	2,3,4	1. Torque converter- construction and working, torque converter. 2. Limited slip differential-need-types. 3. Working principle of clutch type LSD.	Refer Table 1	1. Servicing of torque converter 2. Service and troubleshoot clutch type LSD.

9	1	2,3,4	1. Anti-lock brakes-Need and types, construction and working. 2. Anti-lock brake modulator. 3. Servo brakes -types, vacuum servo brakes-layout- working,	Refer Table 1	1. Test and troubleshoot wheel speed sensor of anti-lock braking system. 2. Servicing of servo brakes.
10	1,2	2,3,4	1. Electronic stability control-working principle. 2. Hill assistance and traction control system – working principle. 3. Air bag system-need-types-layout of accelerometer-based air bag system.	Refer Table 1	1. Virtual Demonstration of Electronic stability control. 2. Virtual demonstration of air bag systems.
11	1,2	2,3,4,7	1. Collision avoidance warning system-tyre pressure warning system- need-working. 2. Computer based instrumentation-working principle. 3. Trip information computer working principle, working principle-vehicle speed measurement.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Test and troubleshoot of tyre pressure warning system. 2. Demonstration of computer-based instrumentation.
12	1,2	2,3,4,7	1. Navigation- types- GPS navigation system. 2. Four-wheel drive system & all-wheel drive -types. 3. construction and working of permanent 4-wheel drive with viscous coupling.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Demonstration of GPS navigation system. 2. Service and troubleshoot 4-wheel drive system.
13	1	2,3,4,7	1. Air spring-types. construction and working- Bellows' air spring, piston air spring. 2. Hydro-elastic spring construction and working.	Refer Table 1, Study the latest technological changes in	1. Servicing and troubleshooting of air springs 2. Servicing and troubleshooting of hydro-elastic spring.



			3. Working principle-electronically controlled shock absorber.	this course in this course and present the impact of these changes on industry.	
<b>Total in hours</b>			<b>39</b>	<b>13</b>	<b>52</b>

**\* PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)**

**Table 1:** Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Open an ECU from a vehicle and reconnect as per the pin configuration.
2	2	Study and give a Presentation on diagnosis of CAN.
3	3	Make a list of various sensors used in a vehicle with their position and submit it as an assignment.
4	4	Make a list of various actuators used in a vehicle with their position and submit it as an assignment.
5	5	Study and present on the topic evolution of fuel injection and benefits of electronic fuel injection.
6	6	Check modern vehicles which comes with CRDI and Inline systems and present the comparison of their efficiency, speed and other performance of the vehicle.
7	7	Submit as an assignment with proper justification on air bags for 2-wheeler vehicle system.
8	8	Study and Present on reverse parking collision-avoidance assist system.
9	9	Submit a report on various navigation systems used in India.
10	10	Make a group of 5 and visit nearest showroom discuss on the topic battery life, cost of replacement, recycling of batteries in EV and write a report on the observed data.
11	11	List and present the merits and demerits of modern vehicles using clutch-less manual transmission and automatic transmission.
12	12	Study and present on electronically controlled air springs.
13	13	Study and Present on construction and working of electrical power steering.

#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3.	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5.	CIE-5 Skill Test-Practice	12	180	100	
6.	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40

<b>Total Marks</b>	<b>100</b>
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### 5. a) Format for CIE written Test

Course Name	<b>Advanced Automotive Systems</b>	Test	I/II/III	Sem	III/IV
Course Code	<b>20AT41P</b>	Duration	80 Min	Marks	30

**Note:** Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

### 5. b) CIE Skill Test-I Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1	One question on "Service and troubleshoot different power steering". a) Analysis of defects. -05 m b) Service/ Troubleshooting. -25 m	30
2	2	One question on "Sensors and sensor monitoring mechanisms aligned to automotive systems/different signal conditioning techniques/ interfacing techniques/ actuator mechanisms." <b>From week (1-3)</b> a) Identification or Circuit building - 10 m b) Dragonize or troubleshooting - 20m	30
3	2	One question on "Sensors and sensor monitoring mechanisms aligned to automotive systems/different signal conditioning techniques/ interfacing techniques/ actuator mechanisms." <b>From week (5&amp;6)</b> a) Identification or Circuit building -10 m b) Dragonize or troubleshooting - 20m	30
4	1,2	Portfolio evaluation of practical sessions (1-6 week)	10
<b>Total Marks</b>			<b>100</b>

### 5. c) CIE Skill Test-II Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1,2	One question on "Service and troubleshoot different advanced automotive components".	45

		a) Identification of defects –15 m b) Question on Troubleshooting. –30 m	
2	1,2	One question on “Service and troubleshoot advanced electronic systems”  a) Identification of defects –10 m b) Question on Servicing/ Troubleshooting. –35m	45
3	1,2	Portfolio evaluation of practical sessions (7-12) week	10
<b>Total Marks</b>			<b>100</b>

## 6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							<b>5</b>

**Note:** Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

## 7. Reference:

Sl. No.	Description
1	Understanding Automotive electronics, William Ribben, Butterworth-Heinemann Publications.
2	Automotive Computer Controlled Systems (Diagnostic tools and techniques), Allan. W. M Bonnick, Butterworth-Heinemann Publications.
3	Automobile electrical and electronic systems, Tom Denton, Butterworth-Heinemann Publications.
4	Electronic Engine Controls, Steve. V. Hatch, Cengage Learning.
5	Truck engines Fuel & computerized management systems, Sean Bennett, Cengage Learning.
6	Automobile engineering Vol I by Anil Chikara (Satya Prakashan)
7	Advanced vehicle technology by Heinz Heisler (Butterworth-Heinemann)
8	A Systems Approach to Automotive technology by Jack Erjavec (Cengage Learning)
9	Mechatronics by Prof C R Venkataramana
10	Mechatronics by W Bolten (Longman Pearson publications)

## 8. SEE Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1	One question on “Service and troubleshoot different advanced automotive components/ advanced electronic systems”.  a) Identification of defects. –20 m b) Servicing/Troubleshooting. –30 m	50



2	2	One question on "Sensors and sensor monitoring mechanisms aligned to automotive systems/different signal conditioning techniques/ interfacing techniques/ actuator mechanisms."  c) Identification or Circuit building - 10 m d) Debugging or troubleshooting - 10 m	20
3	1,2	Portfolio evaluation of practical sessions (1-13) week	10
4	1,2	Viva-voce	20
<b>Total Marks</b>			<b>100</b>

### 9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Multi-cylinder Engine with Electronic control unit and different engine sensors.		2 sets
2	ECU's of other vehicle systems (ABS, Transmission)		2 sets
3	Throttle position sensors / kit, crank shaft position sensor (Magnetic pickup coil type, Hall type)/kit, exhaust gas sensor/kit, mass flow sensor, LVDT height sensors, rain sensor, knock sensor and temperature sensor, Potentiometer.		4 each
4	Solenoid stepper motor demo kit.		5
5	Automatic hydraulic transmission with Torque converter.		2
6	Automated manual transmission.		2
7	Continuously variable transmission		2
8	Air spring suspension system demo model.		1
9	Hydro-elastic spring suspension system demo model.		1
10	Engine scanner		1
11	Hydraulic power steering trainer unit.		2
12	Electrical power steering trainer unit.		2
13	ABS trainer unit.		2
14	Air bag trainer unit.		2
15	Limited Slip differential		2