

# GUJARAT TECHNOLOGICAL UNIVERSITY

## INSTRUMENTATION & CONTROL ENGINEERING (17) AUTOMOTIVE INSTRUMENTATION - Department elective- III SUBJECT CODE: 2181708 B.E. 8<sup>th</sup> SEMESTER

**Type of course:** Core Engineering

**Prerequisite:** Sensor/ Transducer, Fundamental of engineering mechanics, Control systems design

**Rationale:** The automobiles are getting converted from mechanical system to highly modernized Electro-mechanical systems and from driver to driverless vehicle. The manufacturers of automobiles are increasing usage of sensors and control system to improve safety measures and also to increase comfort of users. This subject is intended to make student aware with sensors and other technologies used in modern automobiles.

**Teaching and Examination Scheme:**

TeachingScheme			Credits C	Examination Marks						Total Marks
L	T	P		TheoryMarks			PracticalMarks			
			ESE (E)	PA(M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

**Content:**

S. N.	Content	Total Hrs	% Weight age
1	<b>Introduction of automobile system</b> Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.	08	16
2	<b>Engine management systems</b> Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.	08	16
3	<b>Vehicle power train and motion control</b> Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.	08	16
4	<b>Active and passive safety system</b> Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability	08	16

	program, air bags.		
5	<b>Automotive standards and protocols</b> Automotive standards like CAN protocol, Lin protocol, flex ray, OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262).	08	16
6	<b>System design and energy management</b> BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotives and instrumentation systems.	10	20

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	14	14	14	14	7

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Text Books

1. Understanding Automotive Electronics by William B. Ribbens, Butterworth Heinemann Woburn, 6th ed., 2003
2. Sensors Applications, Sensors for Automotive Technology by Jiri Marek, Hans Peter Trah, Wiley, 1<sup>st</sup> Edition
3. U.Kiencke, and L. Nielson, *Automotive Control Systems*, Springer Verlag Berlin, 2000

### Reference Books:

1. Automotive Electrical Equipment by Young A.P., Griffiths, ELBS & New Press, 1999.
2. Automotive computers and control system by Tom Weather Jr. & Claid C. Hunter, Prentice Hall Inc., New Jersey.
3. Automobile Electrical Equipment by Crouse W.H., McGraw Hill Co. Inc., New York, 1995.
4. Understanding Automotive Electronic by Bechhold, SAE, 1998.
5. Automotive Hand Book by Robert Boshe, Bentely Publishers, 5th ed. Germany, 2005.

### Course Outcome:

After learning this course, the students should be able to:

- CO1. evaluate the sensor and measuring system of automobile.
- CO2. acquire knowledge of various automotive standards and Protocols.
- CO3. design the basic modeling and control scheme for automotive systems.

**List of Experiments:**

1. Study of speedometer, Tachometer, Odometer, Trip odometer
2. Study of battery/ charging system lamp, low oil pressure lamp, airbag lamp
3. Study of oil pressure gauge and coolant temperature gauge
4. Study of hand-brake lamp, door ajar lamp, high beam lamp, malfunction indicator lamp/ check engine lamp
5. Study of fuel gauge and low fuel lamp
6. Study of hand brake indicator, turn light and engine service indicator
7. Study of wheel balancing instruments
8. Study of automatic vehicular washing system
9. Study of electronic engine management system
10. Study of CAN protocol.
11. Study of safety and security systems of vehicle
12. Study of heating and air-conditioning system of vehicle.

**Design based Problems (DP)/Open Ended Problem:**

Simulation of control strategy of any autonomous vehicle.

Design PLC based/ micro-controller based automatic control system for different systems of vehicle.

**Major Equipment:**

Computers, transducers for automotive applications, simulation software, etc.

**List of Open Source Software/learning website:**

<http://nptel.ac.in/video.php>

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.