

**Bachelor of Technology (B. Tech.)**

**Instrumentation and Control**

**B. Tech. Year- IV Semester – VII**

**Subject Name: Automotive Instrumentation Fundamentals**

**Subject Code: BTIC15702**

**Type of course: Open Elective Course**

**Prerequisite (if any):** Sensor/ Transducer, Fundamental of engineering mechanics,

**List of Courses where this course will be prerequisite :** Not applicable

**Rationale:**

The automobiles are getting converted from mechanical system to highly modernized Electro-mechanical systems and from driver to driver-less 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:**

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	0	3	60	25	15			100

**CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course**

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**Content:**

<b>Sr. No.</b>	<b>Content</b>	<b>Total Hrs</b>	<b>Module Weightage</b>
<b>1</b>	<b>Introduction of Automobile System</b>  Anatomy of Automobile, Systems in automobile, Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control, levels of driving automation, AUTOSAR.	06	<b>12%</b>
<b>2</b>	<b>The Basics of Electronic Engine Control</b>  Exhaust Emissions., Fuel economy, Concept of an Electronic Engine Control System, Basic Principle of Four-Stroke Engine Operation, Definition of Engine Performance -Terms, Torque, Power, Fuel Consumption, Engine Overall Efficiency, Calibration, Engine Mapping, Effect of Air/Fuel Ratio on Performance, Effect of Spark Timing on Performance, Effect of EGR on Performance, Exhaust Catalytic Converters, Oxidizing Catalytic Converter, The Three-Way catalyst, Electronic Fuel Control System, Engine Control Sequence, OL Control, CL Control , CL Operation, Analysis of Intake Manifold Pressure, Measuring Air Mass, Influence of Valve System on Volumetric Efficiency, Idle Speed Control, Electronic ignition	04	<b>9%</b>
<b>3</b>	<b>Sensors and Actuators</b>  Automotive Control System Applications of Sensors and Actuator - Variables to be Measured, Airflow Rate Sensor, Pressure Measurements, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall-Effect Position Sensor, Optical Crankshaft Position Sensor Throttle Angle Sensor, Temperature Sensors, Typical Coolant Sensor, Sensors for Feedback Control - Exhaust Gas Oxygen Sensor, Oxygen	12	<b>27%</b>

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	<p>Sensor Improvements Knock Sensors, Angular Rate Sensor, LIDAR, Digital Video Camera, Flex-Fuel Sensor - Oscillator Methods of Measuring Capacitance, Acceleration Sensor Automotive Engine Control Actuators - Fuel Injection, Exhaust Gas Recirculation Actuator Variable Valve Timing- VVP Mechanism Model Electric Motor Actuators- Two-Phase Induction Motor, Brushless DC Motors, Stepper Motors, Ignition System</p> <p>Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.</p>		
<b>4</b>	<p><b>Digital Power-train Control Systems</b></p> <p>Digital Engine Control, Digital Engine Control Features, Control Modes for Fuel Control, Discrete Time Idle Speed Control, EGR Control, Variable Valve Timing Control, Turbocharging Direct Fuel Injection Flex Fuel, Electronic Ignition Control, etc.</p>	4	<b>9%</b>
<b>5</b>	<p><b>Vehicle Motion Controls</b></p> <p>Representative Cruise Control System, Cruise Control Electronics, Antilock Braking System, Electronic Suspension System, Electronic Suspension Control System, Four-Wheel Steering CAR</p>	4	<b>9%</b>
<b>6</b>	<p><b>Automotive Instrumentation</b></p> <p>Modern Automotive Instrumentation, Input and Output Signal Conversion, Display Devices, Measurement Examples - Fuel Quantity Measurement, Coolant Temperature Measurement, Oil Pressure Measurement, Vehicle Speed Measurement, Trip Information Function of the System</p>	4	<b>9%</b>

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<b>7</b>	<b>Electronic Safety-Related Systems</b>  Airbag Safety Device, Blind Spot Detection, Automatic Collision Avoidance System, Lane Departure Monitor, Tire Pressure Monitoring System, Enhanced Vehicle Stability -ABS, ESP	<b>4</b>	<b>9%</b>
<b>8</b>	<b>Vehicle Communication</b>  IVN, CAN, Vehicle to Infrastructure Communication, Vehicle-to-Cellular Infrastructure, Quadrature Phase Shifter and Phase Modulation (QPSR), Short-Range Wireless Communications, Satellite Vehicle Communication GPS Navigation	<b>3</b>	<b>7%</b>
<b>9</b>	<b>Diagnostics and Autonomous Vehicle</b>  Electronic Control System Diagnostics, Service Bay Diagnostic Tool, Onboard Diagnostics, Model-Based Sensor Failure Detection, Expert Systems in Automotive Diagnosis Autonomous Vehicles - Automatic Parallel Parking System, Autonomous Vehicle Block Diagram	<b>4</b>	<b>9%</b>

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

<b>Distribution of Theory Marks</b>					
R Level	U Level	A Level	N Level	E Level	C Level
<b>30 %</b>	<b>30 %</b>	<b>10 %</b>	<b>10 %</b>	<b>10 %</b>	<b>10 %</b>

**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.

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**Reference Books:**

S. N.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Understanding Automotive Electronics	William B. Ribbens	Butterworth Heinemann ISBN:9780128104347	2017	8 <sup>th</sup> ed
2	Sensors for Automotive Technology	Jiri Marek, Hans Peter Trah	Wiley ISBN:9783527605071	2006	1 <sup>st</sup> ed.
3	Automotive Computers and Control system	Tom Weather Jr. & Cland C. Hunter	Prentice Hall ISBN: 9780130546937	1964	1 <sup>st</sup> ed.
4	Bosch Automotive Hand Book	Dipl.-Ing. H. Bauer	Bentley (Robert) Inc. ISBN: 9780837616865	2011	8 <sup>th</sup> ed.
5	Automotive Engineering	Kripal Singh	Standard publisher ISBN:9788180141966	2020	1 <sup>st</sup> ed.

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**Course Outcomes:**

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	classify different types of sensors and actuators used in automotive instrumentation systems	25
CO-2	evaluate vehicle motion control systems and diagnose safety-related system malfunctions	20
CO-3	formulate a comprehensive plan for an autonomous vehicle system and present their design with justifications for the selected components	20
CO-4	evaluate safety measures, environmental and ergonomics consideration in automotive vehicles.	20
CO-5	design a vehicle communication network and interpret diagnostic codes to identify and resolve faults in automotive instrumentation systems	15

**Mapping with POs:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	1	1	1	3	2	2	1	1	1	2	2	3	2	2
CO-2	1	1	1	2	2	3	2	1	1	1	1	1	2	2	2
CO-3	1	1	3	3	2	2	2	1	1	1	1	1	2	3	2
CO-4	1	1	1	2	2	3	3	2	1	1	1	1	2	2	3
CO-5	1	2	1	2	2	2	2	2	1	1	2	2	2	2	2

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**List of Open learning website:**

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

<http://coep.vlab.co.in/>

**List of Open Source Software:**

<https://ardupilot.org/>

<https://opensource.com/tags/automotive>

**Major Equipment Needed:**

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

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