Automotive Electronics		Semester	7
Course Code	**BEC714C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

This course will enable students to:

- Understand the basics of automobile dynamics and design electronics to complement those features
- Design and implement the electronics that attribute the reliability, safety, and smartness to automobile, providing add – on comforts

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher Order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to devise creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Automotive Fundamentals Overview – Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive systems, The Engine- Engine Block, Cylinder Head, four stroke Cycle, Engine Control, Ignition System- Spark plug, High voltage circuit and distribution, spark pulse generation, ignition timing, diesel engine, Drive Train – Transmission, drive shaft, differential, suspension, brakes, steering system, starter battery-operating principle. **(Text1: Chapter1, Text 2: Pg. 407-410)**

The Basics of Electronic Engine Control - Motivation for Electronic Engine, control – exhaust emissions, fuel economy, concept of an electronic engine, control system, definition of general terms, definition of engine performance terms, engine mapping, effect of air/fuel ration, spark timing and EGR on performance, control strategy, electronic fuel control system, analysis of intake manifold pressure, electronic ignition. **(Text1: Chapter 5)**

Module-2
Automotive Sensors – Automotive control system applications of sensors and Actuators – Variables to be measured, airflow rate sensor, strain gauge MAP sensor, Hall Effect position sensor, Magnetic Reluctance Crankshaft position sensor, Throttle angle sensor, Engine coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2 /EGO) Lambda sensors, piezoelectric Knock sensor **(Text 1: Chapter 6)** **Automotive Engine Control Actuators** – Solenide, Fuel Injector, EGR actuator, Ignition system **(Text 1: Chapter 6)**
Module-3
Digital Engine Control System- Digital Engine control features, Control modes for fuel control (Seven Modes), EGR Control, Electronic Ignition control- closed loop ignition timing, spark advance correction scheme, Integrated engine control system- secondary air management, Evaporative Emissions, Canister Purge, automatic system adjustment, system diagnostics **(Text 1: Chapter 7)** **Control Units –** Operating conditions, Design, Data Processing, Programming, Digital modules in the Control Unit, Control Unit Software **(Text 2: Pg. 196-207)**

Module-4
Automotive Networking – Bus Stem- classification, Applications in the Vehicle, Coupling of networks, Examples of Networked Vehicles **(Text 2: Pg. 85-91),** **Buses** – CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces **(Text 2: Pg. 92-151)** **Vehicle Motion Control –** Typical Cruise control system, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Cruse Control Configuration, Cruise Control Electronics (Digital Only), Antilock Brake System (ABS) **(Text 1: Chapter 8)**
Module-5
Automotive Diagnostics – Timing Light, Engine Analyzer, On-Board diagnostics, Off-Board diagnostics, Expert Systems, Occupant Protection Systems – Accelerometer based Air Bag Systems **(Text1: Chapter10)** **Future Automotive Electronic Systems –** Alternative Fuel Engines, Electric and Hybrid Vehicles, Fuel Cell Power Cars, Collision Avoidance Radar Warning Systems, Low tire pressure warning systems, Head Up Display, Speech Synthesis, Navigation- Navigation Sensors – Radio Navigation, Signpost Navigation, Dead reckoning navigation, Voice Recognition Cell phone Dialing, Advanced Cruise Control, Stability Augmentation, Automatic Driving Control **(Text 1: Chapter 11)**
Course Outcome (Course Skill Set) At the end of the course, students will be able to: • Describe the basics of Automobile dynamics and design electronics. • Acquire an overview of automotive components, subsystems and basics of Electronic Engine Control in today's automotive industry. • Use available automotive sensors and actuators while interfacing with microcontrollers/microprocessors during automotive system design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. **William B Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.**
2. **Robert Bosch GmbH (Ed.), "Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive", 5th edition, John Wiley & Sons Inc., 2007.**

Web links and Video Lectures (e-Resources):
Related NPTEL Courses

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Real world problem solving using group discussion.
- Present animation for Car assembly
- Real world example of Automotive Electronics concepts.