

**Government of Karnataka**  
**Department of Technical Education**  
**Board of Technical Examinations, Bengaluru**

<b>Course Title: : Automotive Electronics</b>		<b>Course Code: 15MC63B</b>
<b>Mode(L:T:P) : 4:0:0</b>	<b>Credits: 4</b>	<b>Core/ Elective: Elective</b>
<b>Type of Course: Lectures &amp; Student Activities</b>		<b>Total Contact Hours: 52</b>
<b>CIE= 25 Marks</b>		<b>SEE= 100 Marks</b>

**Prerequisites:** Knowledge of Elements of Mechanical Engineering, Fluid Power Engineering, basic electrical Engineering, Analog Electronics, Digital Electronics, Measurement systems, Microcontrollers and Industrial Electronics.

**Course Objectives:** Able to diagnose and troubleshoot the problems related to electrical and electronics systems in automobiles.

**Course Outcomes:** At the end of the course, the students will be able to

1. Explain the concept of electrical and electronics in automobiles.
2. Interpret, diagnose and troubleshoot the charging and starting systems.
3. Interpret, diagnose and troubleshoot the Ignition and fuel control systems.
4. Interpret, diagnose and troubleshoot the Engine management system.
5. Explain the operations of the various electrical chassis systems in automobiles.
6. Explain the importance of comfort and safety systems in automobiles.

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Explain the concept of electrical and electronics in automobiles	U	2	05
CO2	Interpret, diagnose and troubleshoot the charging and starting systems	U	2	11
CO3	Interpret, diagnose and troubleshoot the Ignition and fuel control systems	U	2	11
CO4	Interpret, diagnose and troubleshoot the Engine management system	U	2	11
C05	Explain the operations of the various electrical chassis systems in automobiles	U	2	07
C06	Explain the importance of comfort and safety systems in automobiles.	U	2	07
		<b>Total sessions</b>		<b>52</b>

**Legend: R; Remember, U: Understand A: Application**

### Mapping Of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Automotive Electronics	-	3	-	-	-	-	-	-	-	-

### Course Content and Weightage For SEE

Unit No	Unit Name	CO	Hour	Marks allocated for different Cognitive level Questions			Marks weightage (%)
				R	U	A	
1	Introduction to automotive electronics	1	05	-	15	-	10.34
2	Charging and starting systems	2	11	-	25	-	17.25
3	Ignition and fuel control systems	3	11	-	30	-	20.68
4	Engine management systems	4	11	-	25	-	17.25
5	Chassis electrical systems	5	07	-	25	-	17.25
6	Comfort and safety systems	6	07	-	25	-	17.25
	Total		52	145 marks			100

### Contents

#### Unit-I

#### INTRODUCTION TO AUTOMOTIVE ELECTRONICS

Meaning of automotive electronics, various electrical components in automobiles, complete electrical circuit diagram of automobiles, simplified vehicle system block diagram, open and closed loop systems in automobiles, color codes and terminal designations, multiplex data bus, CAN.

**5Hours**

#### Unit-II

#### CHARGING AND STARTING SYSTEMS

**Charging systems:** Requirements of charging system, principle of charging system, principle of Mechanical Regulators, charging circuits with graphical representation for winter commuting, power management system and smart charge system and Fault conditions.

**Starting Systems:** Requirements of starting system, general layout starting system design, equivalent circuit for a starter and battery, basic starting circuit, necessity of starter motor, types, pre-engaged starter circuit, integrated starters, features of electronic starter control, Diagnosing starting system faults, Circuit testing procedure.

**11Hours**

### **Unit-III**

#### **IGNITION AND FUEL CONTROL SYSTEMS**

**Ignition systems:** Functional requirements of ignition systems, types of ignition system, Advance angle (timing), fuel consumption & exhaust emissions, conventional and electronic ignition components, electronic ignition system, hall-effect pulse generator, closed loop dwell and current limiting, capacitor discharge ignition system, programmed ignition system, Distributor less ignition system.

**Electronic fuel Control:** Meaning of Combustion, combustion process in spark ignition engine, phenomenon of Detonation, pre-ignition process in engines, fuel injection process in engines, typical control layout of fuel injection system, common fuel injection system, single and multi-point injection system, Diesel fuel injection system, typical electronic diesel control system and common rail fuel injection system.

**11Hours**

### **Unit-IV**

#### **ENGINE MANAGEMENT SYSTEMS**

Introduction, Lambda, Knock, Idle speed, combined engine and fuel management, ignition and fuel control system, exhaust emission control process in engines, process and techniques of control of diesel emissions and full vehicle control system.

**11Hours**

### **Unit-V**

#### **CHASSIS ELECTRICAL SYSTEMS**

ABS system, Active suspension system, various sensors and actuators used in chassis system, electronic traction control system, automatic transmission system, active steering system and electronic clutch.

**7 Hours**

### **Unit-VI**

#### **COMFORT AND SAFETY SYSTEMS**

Electric seat adjustment, door locking circuit, door locking system, electric window circuit, airbag system, belt tensioners, Car navigation system, GPS, basic security, reverse sensing and parking aid, wiper mechanisms with different linkage arrangements and electronic control of windscreen wipers.

**7 Hours**



## Reference

- 1.0 “Automobile Electrical and Electronic System ” by Tom Denton , 3<sup>rd</sup> ed,2004 – ELSEVIER publication
- 2.0 Hillier’s Fundamentals of Automotive Electronics By VAW. Hillier, 2<sup>nd</sup> edn.

## e-References/ URLs

[http://www.dailymotion.com/video/xiynbx\\_car-starting-system-video\\_auto](http://www.dailymotion.com/video/xiynbx_car-starting-system-video_auto)

<http://www.howacarworks.com/basics/how-the-starting-system-works>

[http://www.procarcare.com/icarumba/resourcecenter/encyclopedia/icar\\_resourcecenter\\_encyclopedia\\_starting1.asp](http://www.procarcare.com/icarumba/resourcecenter/encyclopedia/icar_resourcecenter_encyclopedia_starting1.asp)

<http://www.autoshop101.com/forms/h8.pdf>

<https://www.youtube.com/watch?v=umdoG7qdWWs>

<https://www.youtube.com/watch?v=xtaUkrsJ3Z8>

## Student Activity

Activity No.	Description of the Student Activity
1	Visit auto garage/ service station and identify different components/ sensors of automobiles.
2	Visit any service centre and observe the function of various systems and prepare a report on diagnostic tools.

### Note:

1. Group of max four students should do any one of the above activity or any other similar activity related to the course Cos and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by different groups must cover all COs
4. Teacher should asses every student by using suitable **Rubrics** approved by HOD

### Sample Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation-- student jumps around	Cannot understand presentation-- no sequence of information	Ex: 2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary	Does not have a grasp of the information. Cannot answer	3				

	explanations and elaborations		questions	questions about subject					
<b>Graphics</b>	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	4				
<b>Oral Presentation</b>	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	5				
<b>Total Score=2+3+4+5=14/4=3.5=4</b>									

### Institutional Activity

Activity No.	Description of the Institutional Activity
1	Organize Seminar, workshop, Lecture, from an experts in the following domain: Fundamentals of automobiles, modern diagnostic tools
2	Organize an auto industrial visit.
3	Motivate student to take case study on modern trends in automotive Electronics.

### Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
<b>Direct Assessment</b>	<b>CIE</b>	Three tests (Average of three tests)	20	Blue books	1,2,3,4,5,6
		Student Activity	05	Student Activity Sheets	1,2,3,4,5,6
	<b>SEE</b>	End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
<b>Indirect Assessment</b>	<b>Student Feedback on course</b>	Middle of the course		Feedback forms	1,2,3
		End of the course		Feedback forms	4, 5, 6

**Note:** I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

**Note to IA verifier:** The following documents to be verified by CIE verifier at the end of semester

1. Blue books ( 20 marks)
2. Student suggested activities report for 5 marks and should be assessed on RUBRICS
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

### Model Question Paper (CIE)

**Note:** Internal Choice may be given in each CO at the same cognitive level (CL).

Date and Time	Semester	Course	Max Marks		
2 Test(10 <sup>th</sup> weak of sem ) 10-11 Am	VI SEM	Automotive Electronics	20		
	Year: 2015-16	Course code:15MC63B			
Name of Course coordinator :			Units:3,4 Co: 3,4		
All questions carries equal marks					
Question No	Question		CL	CO	PO
1	Explain the significance of the Fuel consumption and Exhaust emissions OR Explain the differences between single point and multi point injection system.		U	3	2
2	Explain the conventional ignition components. OR Explain the block diagram of inputs and outputs common to most fuel injection systems.		U	3	2
3	Explain the hall effect pulse generator. OR Explain the diesel fuel injection system with block diagram.		U	4	2
4	Explain the block diagram of Closed loop dwell control system OR Explain the block diagram of typical electronic diesel control system.		U	4	2



**Model Question Paper**  
**VI Semester Diploma in Mechatronics Engineering**  
**Automotive Electronics**

**Instructions:** Answer any six questions from part-A and Seven full questions from part-B.

**PART- A**

**Answer any six questions.**

**5X6=30 marks.**

1. Explain the simplified vehicle system block diagram.
2. Explain Basic principles of charging system.
3. Explain Block diagram of smart charging system.
4. Explain the block diagram of CDI system.
5. Explain the combustion process in both the stages.
6. Explain the requirements of ABS.
7. Explain the operation of electric seat adjustment.
8. Explain the operation of air bag system.
9. Explain the operation of Car navigation system.

**PART- B**

**Answer any seven full questions.**

**10x7=70 Marks.**

1. a) Explain the open and closed loop systems in automobiles.  
b) Explain the CAN signal format.
  2. a) Explain charging circuit with graphical representation for winter commuting.  
b) Explain Block diagram of smart charging system.
  3. a) Explain the Starter system general layout.  
b) Explain pre engaged starter and motor.
  4. a) Explain the significance of the Fuel consumption and Exhaust emissions.  
b) Explain the conventional ignition components.
  5. a) Explain the Programmed ignition system.  
b) Explain the comparison of ESA over conventional mechanical advance with respect to detonation.
  6. a) Explain the block diagram of inputs and outputs common to most fuel injection systems.  
b) Explain the block diagram of typical electronic diesel control system.
  7. a) Explain the Typical Control Layout for a Fuel Injection System.  
b) Explain the Common rail injection system.
  8. a) Explain the operation of active suspension system.  
b) Explain the block diagram of traction control system.
  9. a) Explain the ECAT system.  
b) Explain the operation of active/ electronic power steering.
  10. a) Explain the operation of belt tensioners,  
b) Explain the Simple alarm circuit.
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**Model Question Bank**  
**VI Semester Diploma in Mechatronics Engineering**  
**Automotive Electronics**

**Unit-I**

**Introduction to Automotive electronics**

**Cognitive level**  
**Understanding**

1. Explain complete electrical circuit diagram of automobile.
2. Explain briefly the importance of vehicle electrical Loads.
3. Explain the simplified vehicle system block diagram.
4. Explain the open and closed loop systems in automobiles.
5. Explain the CAN signal format.

**Unit-II**

**Charging and Starting systems**

**Cognitive level**  
**Understanding**

1. Explain Basic principles of charging system.
2. Explain with diagram of Mechanical regulator principles.
3. Explain charging circuit with graphical representation for winter commuting.
4. Explain Block diagram of smart charging system.
5. Explain diagnosis and testing procedure of charging system faults.
6. Explain the operating principles of a power management system
7. Explain common symptoms and faults of a charging system malfunction
8. Explain basic starting system circuit.
9. Explain the Starter system general layout
10. Explain the equivalent circuit for a starter system
11. Explain pre engaged starter and motor.
12. Explain the features of electronic starter control.
13. Explain diagnosis and testing procedure of starting system faults.

**Unit-III**

**Ignition and Fuel control systems**



**Cognitive level  
Understanding**

1. Explain the factors to be considered while design of an ignition system
2. Explain the following : Advance angle, Lambda, Detonation
3. Explain the significance of the Fuel consumption and Exhaust emissions.
4. Explain the conventional ignition components.
5. Explain the hall effect pulse generator.
6. Explain the block diagram of Closed loop dwell control system.
7. Explain the block diagram of CDI system.
8. Explain the block diagram of distributor less ignition system.
9. Explain the Programmed ignition system
10. Explain the comparison of ESA over conventional mechanical advance with respect to detonation.
11. Explain diagnosis and testing procedure of ignition system faults.

**Unit-IV**

**Engine management system**

**Cognitive level  
Understanding**

1. Explain the combustion process in both the stages.
2. Explain the phenomenon of detonation, pre-ignition process in engines.
3. Explain the Typical control Layout for a Fuel Injection System
4. Explain the differences between single point and multi point injection system.
5. Explain the block diagram of inputs and outputs common to most fuel injection systems
6. Explain the diesel fuel injection system with block diagram.
7. Explain the block diagram of typical electronic diesel control system
8. Explain the Common rail injection system.
9. Explain each advantages of electronic unit injection.
10. Explain diagnosis and testing procedure of fuel control system faults.
11. Explain the general block diagram of an ignition and fuel control system.
12. Explain the main issues of engine management system.
13. Explain the general block diagram of an ignition and fuel control system
14. Explain the factors involved in exhaust emissions control.
15. Explain the significance of EGR.
16. Explain the process of catalytic conversion in emission control.
17. Explain the operation of closed loop lambda control.
18. Explain the block diagram of complete vehicle control system and explain.

## **Unit-V**

### **Chassis electrical systems**

#### **Cognitive level Understanding**

1. Explain the requirements of ABS.
2. Explain the operation of ABS.
3. Explain the operation of active suspension system.
4. Explain the functions of various sensors and actuators used in chassis system.
5. Explain the block diagram of traction control system.
6. Explain the ECAT system.
7. Explain the operation of electronic clutch.
8. Explain the operation of active/ electronic power steering.

## **Unit-VI**

### **Comfort and Safety systems**

#### **Cognitive level Understanding**

1. Explain the operation of electric seat adjustment
2. Explain the operation of door locking system.
3. Explain the operation of electric window circuit
4. Explain the operation of air bag system.
5. Explain the operation of belt tensioners
6. Explain the operation of Car navigation system
7. Explain the significance of GPS in automobiles.
8. Explain the Simple alarm circuit.