



**Government of Karnataka**

**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

**1.Rationale:** The course aims to impart basic skills and understanding of automotive electrical systems,

<b>Programme</b>	Automobile Engineering	<b>Semester</b>	III
<b>Course Code</b>	20AT32P	<b>Type of Course</b>	Programme Core
<b>Course Name</b>	Automotive Electrical System	<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

equipment and their working details. Automobile electrical system has gradually evolved over the years. The automobiles electrical system comprises of wiring technologies that are used for distributing power to other parts of a vehicle and various electrical components for production, storage and distribution of electrical power.

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

CO-01	Test a battery, identify the problem, service and charge it using the right method suitable for that battery type.
CO-02	Test charging, cranking, ignition systems and dashboard instruments and service or troubleshoot it for any problems identified.
CO-03	Diagnose the electrical system, estimate the cost of repairing or replacement and make recommendation of either repair or replace based on cost benefit analysis.
CO-04	Study a given wiring diagram, list all the components, build the wiring circuits, test and repair to ensure the circuit provides the necessary output/result as required.

**3. Course Content**

Week	CO	PO	<b>Lecture (Knowledge Criteria)</b>	<b>Tutorial (Activity Criteria)</b>	<b>Practice (Performance Criteria)</b>
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1,4	1,2,4	<b>1. Earth Return System:</b> Introduction-Earth return and insulated systems, 6 volts and 12 volts system.  2. Fusing of circuits, low and high voltage automobile cables, cable specifications and sizes, Colour cables, Circuit tracing  3. Diagram of typical wiring system, Wiring Harness. Tracing fault in wiring, Fault location test. Symbols used in automobile electrical systems.	Refer Table 1	1. a) Demonstrate the wiring flow pattern in the Vehicle. b) Demonstrate the wiring color code used for different circuits. 2. a) Study a given wiring diagram and list all the components b) Practice on troubleshooting of wiring defects.

2	1	1,2,4	<p>1. <b>Battery</b> -purpose-types, construction and working-Lead acid.</p> <p>2. Methods of charging the Battery and how to choose which type of Charging method.</p> <p>3. Battery capacity-Battery efficiency, ratings.</p>	Refer Table 1	<p>1.a) Test the battery charge condition using hydrometer, Voltmeter, Test the battery condition using battery tester.</p> <p>b) Practice on preparation of electrolyte.</p> <p>2. a) Charging of Lead acid battery by constant voltage method.</p> <p>b) Practice on Charging multiple batteries</p>
3	1	1,2,4	<p>1. Battery maintenance and troubleshooting.</p> <p>2. Construction and working of Lithium-ion battery.</p> <p>3. Maintenance-free batteries.</p>	Refer Table 1	<p>1. a) Practice on Charging multiple batteries by trickle charging</p> <p>b) Practice on finding the defects and troubleshooting of batteries.</p> <p>2. Practice on Servicing of lithium-ion battery.</p>
4	3	1,2,4	<p><b>1.Estimation &amp; Costing:</b> Introduction, Procedure of Estimation.</p> <p>2. Introduction to Costing, Elements of cost, Components of cost.</p> <p>3. Procedure of Costing.</p>	Refer Table 1	<p>1. Estimate the cost of repairing or replacement the battery/Wiring system, make recommendation of either repair or replace based on cost benefit analysis.</p> <p>2. Case study on estimation of servicing/repair of any one electrical component in vehicle.</p>
5	2	1,2,4	<p>1. <b>Charging system</b>-purpose-circuit diagram. DC generator- principle, construction and working.</p>	Refer Table 1	<p>1. Practice on servicing of the Alternator.</p> <p>2. Test the stator, rotor and rectifier for</p>

			<p>2. Alternator charging circuit with alternator principle, construction and working.</p> <p>3. Regulator for A.C. Generators- Construction and working.</p>		<p>continuity, short and open circuit using Multifunction Tester/ Test lamp.</p>
6	2,3	1,2,4	<p>1. Electronic voltage regulators- Construction and working.</p> <p>2. Defects and troubleshooting Alternators.</p> <p>3. <b>Starting system</b> -requirements- circuit diagram-working principle.</p>	Refer Table 1	<p>1. Practice on testing of voltage regulators.</p> <p>2. Practice on finding the Defects and troubleshooting of alternators and estimate the same.</p>
7	2	1,2,4	<p>1. Construction and working: series, shunt wound motor.</p> <p>2. Construction and working of Bendix drive.</p> <p>3. Construction and working of positive engaging drive with shift lever.</p>	Refer Table 1	<p>1. Practice on servicing of the starter motor.</p> <p>2. Servicing of Bendix drive.</p>
8	2,3	1,2,4	<p>1. Construction and working of overrunning clutch drive</p> <p>2. Construction and Working of Axial Sliding armature drive.</p> <p>3. Solenoid switch with two winding- construction and working.</p>	Refer Table 1	<p>1. Test field windings, brush holder's armature and solenoid switch for continuity, short and open circuit using growler/ Multifunction Tester.</p> <p>2. Repair and Service Estimation of the stator motor.</p>
9	2,3	1,2,4	<p>1. <b>Ignition System:</b> Fundamentals- Ignition timing (with respect to load &amp; speed). Types of ignition systems, components.</p> <p>2. Construction &amp; Working of battery Ignition system. Construction &amp; working of magneto ignition systems.</p>	Refer Table 1	<p>1. a) Diagnose Ignition problems and demonstrate the trouble shooting of the same</p> <p>b) Repair/Service estimation the same.</p> <p>2. Checking and setting ignition timing and starting the engine.</p>

			3. Construction & Working of Electronic Ignition system. Distributor less ignition system (DIS).		
10	2,3	1,2,4	1. <b>Spark plug</b> -classification 2. construction-Types-specification. 3. Spark plug gap, heat range and reach- definition and importance.	Refer Table 1	1. Servicing of the DIS and repair/Service estimation the same. 2. a) Servicing of the sparkplug cleaning, testing and adjusting gap. b) Service estimation of the same.
11	3,4	1,2,4,7	1. Principle of automobile illumination. 2. Different bulbs used in automobile, fuses and relay. 3. Head lamp mounting and construction -Types.	Refer Table 1, Study the latest technological changes in this course and present the impact of these changes on industry.	1.Practice on replacement of bulbs, fuses and relays and estimate the cost of replacement of the same. 2. Practice on aiming of head lights.
12	2,3	1,2,4,7	1. Working and Construction of windscreen-wipers. Working of Horn. 2. Working of electrical fuel pump, fuel gauge. 3. Working of oil and temperature gauge.	Refer Table 1, Study the latest technological changes in this course and present the impact of these changes on industry.	1. Practice on servicing of the Wiper and horn & service estimation of the same. 2. Practice on testing of fuel gauge, oil gauge & Temperature gauge.



13	2,3	1,2,4,7	1. Speedometer, odometer, etc. (Dash board instruments). 2. Wiring diagram of 2-wheeler - Circuit & construction. 3. Wiring diagram of 4-wheeler- Circuit & construction.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1. Practice on Circuit building of electrical Components, test and repair to ensure the circuit provides the necessary output/result as required. 2. Practice on testing of dashboard instruments.
<b>Total in hours</b>			<b>39</b>	<b>13</b>	<b>52</b>

**Note: At the end of each practical, student has to prepare trouble shooting chart and prepare repair estimation.**

**\* 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 Co-Ordinator. (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 Tutorial
1	1	Study and present different ampere ratings of fuses used in different Vehicle.
2	2	Study any one research papers about "Environmental impact on battery recycling of automobile batteries" and present the environmental effects of battery recycling.
3	3	Study on different types of batteries used for electric vehicles compare their durability and present the materials used in positive and negative plates and electrolyte and how long each battery lasts.
4	4	Visit the nearby service center and note down the estimation procedure followed for the servicing or repairing of electrical parts and component of the vehicle.
5	5	Study whether alternators are used in electric vehicle, justify your answer. With proper documentation submit the report as an assignment.
6	6	Document what are the symptoms of faulty working of the regulators and how it can be troubleshooted.
7	7	Study starting system used in any one of the heavy vehicles and present how they differ from the starting system used in cars.
8	8	Build a starter solenoid relay circuit in given vehicle and test for its working.
9	9	Study the ignition system of the given vehicle, note down the causes of ignition coil failure and demonstrate the remedial solution for the diagnosed fault.
10	10	Study and present at least one of the latest technologies in ignition innovation.
11	11	Study and present the innovation on "Night Vision Technology."
12	12	Study any one journal on windscreen wiper and present the advancements in the wiper.
13	13	Study and present on automobile lighting technology for modern automobile.

#### 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 evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					100

#### 5. a) Format for CIE written Test

Course Name	<b>Automotive Electrical System</b>	Test	I/II/III	Sem	III/IV
Course Code	<b>20AT32P</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

**Duration:180min.**

SL. No.	CO	Particulars/Dimension	Marks
1	1,4	One Skill oriented question on Earth return system/wiring system based on the given Condition.  a) Identification of the color code - 05m b) Identification of the defect - 05 m c) Troubleshooting - 10m	20
2	1	One Skill oriented question on Battery based on the given Condition.  a) Analyzing/finding the faults and recording it - 10 m b) Servicing/ troubleshooting - 10 m	20
3	3	Question on the given case (case study)  a) Identification of the key facts in the case - 05m b) Identification of the key issues - 05m	20

		c) Evaluate and recommend the course of action -10m	
4	2,3	One question on "Troubleshoot and Service the Charging systems used in automotive vehicles and its service estimation".  a) Identification of the fault and recording it - 05 m b) Troubleshooting/ Servicing - 20 m c) Service Estimation - 05 m	30
5	1,2,3,4	Portfolio evaluation of practical session (1-6) week	10
<b>Total Marks</b>			<b>100</b>

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

**Duration:180min.**

SL. No.	CO	Particulars/Dimension	Marks
1	2,3	One question on "Troubleshoot and Service the Cranking systems used in automotive vehicles and its service estimation".  d) Identification of the fault and recording it - 05 m e) Troubleshooting/ Servicing - 20 m f) Service Estimation - 05 m	30
2	2,3	One question on "Troubleshoot and Service the Ignition systems used in automotive vehicles and its service estimation".  c) Identification of the fault and recording it - 05 m d) Troubleshooting/ Servicing - 30 m e) Service Estimation - 05 m	40
3	2,3	One question on "Troubleshoot and Service dashboard instruments used in automotive vehicles and its service estimation".  d) Identification of the fault and recording it - 05 m e) Troubleshooting/ Servicing - 10 m f) Service Estimation - 05 m	20
4	2,3	Portfolio evaluation of practical session (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	Automobile Engineering Vol-2 by Kirpal Singh (Standard Publications).
2	Automobile Electrical Equipment by P.M. Kohli (Tata McGraw-Hill).
3	The Automobile Engineering by Harban Singh Reyath (S Chand & Co).
4	The Automobile Engineering Vol-2 by K.M Guptha (Umesh publications).
5	Automobile Electrical and Electronic systems by Tom Denton (SAE publication).
6	Vehicle Maintenance & Garage Practice by Jigar A. Doshi (PHI Learning, Delhi).
7	Mechanical Estimating and Costing by S.C. Sharma & T.R.Banga (KHANNA PUBLISHERS).

## 8. SEE Scheme of Evaluation

**Duration:180min**

SL. No.	CO	Particulars/Dimension	Marks
1	1,3,4	<p>One Skill oriented question on Battery based on the given Condition.</p> <p>a) Analyzing/finding the faults and recording it - 10 m</p> <p>b) Servicing/ troubleshooting - 10 m</p> <p><b>or</b></p> <p>One question on “cables/ bulbs/ fuses/colour codes, circuit construction and faults arising in automotive wiring and lighting system also to repair &amp; estimate”</p> <p>a) Identification of the different cables/ bulbs/ fuses - 05 m</p> <p>b) Fault finding - 05m</p> <p>c) Replace/ repair - 10 m</p>	20
2	2,3	<p>One question on “Troubleshoot and Service the Charging/ Cranking/ Ignition systems used in automotive vehicles and its service estimation”.</p> <p>g) Identification of the fault and recording it - 10</p> <p>h) Troubleshooting/ Servicing - 30</p> <p>i) Service Estimation - 10</p>	50
4	1,2,3,4	Portfolio evaluation of practical session (1-13)	10
5	1,2,3,4	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	Lead acid batteries.		3



2	lithium-ion batteries.		3
3	Battery chargers.		2
4	Cut-section model of DC generators.		1
5	Alternators.		5
6	Electronic voltage regulators for alternators.		3
7	Starting motors of different starting drives (Bendix, axially sliding armature, overrunning clutch type).		2 each
8	Spark plug testing machine.		2
9	Digital timing light.		3
10	Distributor assemblies.		4
11	Ignition coils.		5
12	Magneto assembly.		3
13	Fuel, Oil, Temperature gauges.		2 each
14	Wiper motors.		3
15	All types of bulbs, fuses, relays.		5 each
16	Petrol engine with coil ignition system.		2
17	Recent make 4-wheeler.		1
18	Electrical test bench.		2
19	Growlers		5
20	Battery tester		5
21	Bench vice		5
22	Hydraulic Press (10 ton)		3
23	Demo model of 2 & 4-wheeler Vehicle Electrical system		1 Each
24	Modern engine with electronic ignition/ DIS		1 Each