



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Electrical Engineering / Renewable Energy

Course / Subject Code: DI03000071

Course / Subject Name: Electrical and Electronics Workshop

w. e. f. Academic Year:	2024-25
Semester:	3 rd
Category of the Course:	ESC

Prerequisite:	A Basic Understanding of Fundamentals Concepts of Electrical & Electronics Circuits
Rationale:	Diploma holders in electrical and allied branches are expected to assemble, test, and troubleshoot electrical and electronic circuits while ensuring safety in various applications. To develop these competencies, this course is designed to provide essential skills in selecting electrical and electronic components, implementing circuits and using measuring instruments. Through hands-on practice, students will gain practical exposure to workshop tools, basic wiring practices and troubleshooting common electrical appliances. Moreover, by engaging in real-world applications, they will be well-prepared to handle industry challenges with confidence and competence.

Course Outcomes: After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level*
01	Identify electrical hazards and adopt safety measures to ensure electrical safety.	R, U
02	Test electrical and electronic components using measuring instruments.	R, U, A
03	Implement electronic circuits on breadboards and PCBs.	U, A
04	Use Workshop tools, switches, and cables in Electrical Wiring.	U, A
05	Troubleshoot Common Electrical appliances like Ceiling fan, Electric Iron etc.	U, A

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
0	1	4	3	0	0	20	30	50



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Course Content: (Tutorial Contents focusing on mostly discussions for reinforcing theoretical concepts and problem-solving through discussions)

Unit No.	Content	No. of Hours	% of Weightage
1.	Unit 1 – Electrical Safety: Precautions and Preventing Hazards 1.1 Electrical Hazards: Electric Shock, Burns, Fires and Explosions; Protective Measures to Prevent Direct Electrical Contact 1.2 Safety Tips to Avoid Electrical Shock, Safety Precautions While Working with Power Tools, General Safety Rules	2	13%
	1.1 Electrical Safety Devices: Fuse, MCB, ELCB, RCBO etc. 1.2 Earthing: Need, Components (Earth Wire, Earthing Lead and Earth Electrode), Important Parts, Requirements of Good Earthing		
2.	Unit 2– Electrical, Electronic Components & Measuring Instruments 2.1 Digital multimeter, Clamp on Meter, Voltage/Continuity Tester, Megger, Test Lamp, Series Lamp, 2.2 CRO, DSO, Function Generator, LCR-Q meter	3	20%
	2.3 Different types of resistors, inductors, capacitors 2.4 Batteries: Different types of Batteries (Pencil cell AAA, AA Type, +9V, Rechargeable Cell & Other), AC and DC power supply		
	2.5 Electronic Devices/Components: The terminals and the functions of Transformer, Diodes, Zener diode, LED, Photo diode, Transistors, Photo transistor, Op Amp and Timer IC 741 and 555, LDR, Solar cell, Photocell, Opto-coupler, Relays		
3.	Unit 3 – Electronic Circuits Design 3.1 Symbols of Electronic Components, Basic Circuit Diagrams (e.g., Rectifiers, Op-Amp, Voltage Regulator & Timer IC 555 Based Circuits) 3.2 Breadboard Layout, Electronic circuit on breadboard, Jumper wires, switches, knob.	2	13%
	3.3 Electronic Workshop Tools: General Purpose PCB, Copper clad laminate sheet, Solder iron, solder-stand, solder-wire, flexible wire, hookup wire, Wire Stripper, de-solder pump, De-solder wick		



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	3.4 Soldering and Desoldering Process, Electronic circuit on general purpose PCB		
4.	Unit 4 – Electrical Wiring: Tools, Components and Basic Practices 4.1 Electrical Workshop Tools: Screwdrivers, Cutting Tools, Pliers, Linesman Plier, Wire Stripper, Measure Tap, Standard Wire Gauge, Hammer, Allen Wrench, Portable drilling Machine, Fish Tapes 4.2 Different Types of Switches (Toggle switch, Rotary switch, Push button switch, micro switch, MCB, ELCB, etc.), Plugs and Sockets; Different Wires (single strand and multi strand wire, shielded wire), Wiring Layout of Switch Board, Extension Board 4.3 Wiring Layout of Test Lamp Board and Distribution Board 4.4 Introduction to Control Circuits: The role of control circuits, Push buttons, relays, contactors and overload relays, Contactor operation, NO/NC contacts, Start-Stop Operation, application in motor control 4.5 Different types of Cables, Lugs, Glands, Cable Joint, Tags 4.6 Types of Lamps: Fluorescent Tube light, CFLs, Sodium Vapor Lamp, Metal Halide Lamp, LED Lamp	6	40%
5.	Unit 5 – Common Electrical Appliances 5.1 Internal Construction & Troubleshooting of Electric Iron, Geyser 5.2 Internal Construction & Troubleshooting of Electric Fans, Mixer	2	14%
	Total	15	100%

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
10 %	40 %	50 %	00	00	00

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Reference Books:

- 1 "A Textbook of Electrical Workshop Practices", Dr. Umesh Rathore, Naresh Kumar Sharma, S.K. Kataria & Sons, latest edition, ISBN-13: 978-9350146958



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- 2 "Electrical Workshop", R. P. Singh, I.K. International Publishing House Pvt. Ltd., latest edition
- 3 "Electrical Workshop: Safety, Tools & Installation", R.P. Singh, I.K. International Publishing, latest edition, ISBN-13: 978-9386768213
- 4 "Handbook of Electrical Engineering", S. L. Bhatia, Khanna Publication, 2012
- 5 "Industrial Electrical Wiring", Thomas L. Harman, McGraw Hill, latest edition
- 6 "Modern Wiring Practice: Design and Installation", W.E. Steward & R.A. Stenning, Routledge, latest edition, ISBN-13: 978-1138900997
- 7 "Handbook of Electrical Design Details", Neil Sclater, John E. Traister, McGraw Hill, latest edi.
- 8 "Encyclopedia of Electronic Components Volume 1: Resistors, Capacitors, Inductors, Switches, Encoders, Relays, Transistors: Resistors, Capacitors, Inductors, Semiconductors, Electromagnetism", Charles Platt, O'Reilly, 1st edition, ISBN-13: 978-1449333898
- 9 "Textbook of Applied Electronics", R. S. Seclha, S. Chand, latest edition
- 10 "The First Book of Electronics Workshop: Can't Beat a Practical Approach!", Chowdhry Shankar Bhawani, River Publishers, 1st edition, ISBN-10: 879310247X, ISBN-13: 978-8793102477
- 11 "Electronic Components and Materials", Joshi Madhuri, Shroff Publishers & Distributors Private Ltd., latest edition
- 12 "Build Your Own Printed Circuit Board", Al Williams, TAB Books, ISBN-13: 978-0070054080

(b) Open-Source Software and Website:

1. Electrical Safety Related

- a. Safety: <https://technologystudent.com/health1/ed1.htm>
- b. MCB, ELCB: <https://www.electricaltechnology.org/2019/07/mcb-mccb-elcb-rcb-rcd-rccb-rcbo.html> , <https://electricalgang.com/circuit-breaker-trips-without-load/>
- c. Protective Devices: <https://electricalgang.com/category/switchgear/>
- d. Protection: <https://www.electrical4u.net/protection/>,
https://electricalnotebook.com/category/switchgear_and_protection/
- e. Chemical Earthing: <https://electricalgang.com/chemical-earthing>

2. Electrical and Electronic Components

- a. Full Electronics Articles (All in One Guide): <https://electronicsclub.info/> ,
<https://technologystudent.com/elec1/elecex.htm>
- b. Types of Resistor: <https://www.electrical4u.com/types-of-resistor> ,
https://www.electronics-tutorials.ws/resistor/res_1.html
- c. Type of Capacitors: https://www.electronics-tutorials.ws/capacitor/cap_2.html



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- d. Type of Batteries: <https://www.electronicshub.org/types-of-batteries/>
- e. Type of Sensors: <https://www.electronicshub.org/different-types-sensors/>
- f. Components: <https://electricalnotebook.com/category/feee/>
- g. Instru.: <https://electricalnotebook.com/category/electrical-electronics-measurement/>
- h. Datasheets Websites: www.alldatasheet.com , www.datasheetcafe.com

3. Electronic Circuits

- a. Circuit Simulation: <https://www.tinkercad.com/> , <https://www.circuitlab.com/editor/>
- b. (Virtual Lab) Power Supply: <https://ade2-iitr.vlabs.ac.in/exp/regulated-power-supply/simulation.html>
- c. (V. Lab) Components: <https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html>
- d. (V. Lab) Breadboard: <https://ade-iitr.vlabs.ac.in/exp/general-bread-board/theory.html>
- e. (V. Lab) Op-Amp, Timer: <https://ade2-iitr.vlabs.ac.in/List%20of%20experiments.html>
- f. Integrated Circuits (ICs): <https://electricalgang.com/types-of-integrated-circuits/>
- g. Clipper Circuit: <https://www.electronics-tutorials.ws/diode/diode-clipping-circuits.html>
- h. Electronics Circuits: <https://www.electronics-circuits.com/blog/> , <https://www.dapj.net/category/basic-electronics/>
- i. Basic Electronics Tutorials: <https://www.electronicshub.org/tutorials/> , <https://www.electronics-tutorials.ws/>
- j. Electronics: <https://electronics.howstuffworks.com/solid-state-electronics-channel.htm>
- k. Electronic Circuits: <https://www.circuitstoday.com/>

4. Soldering and PCB Design

- a. Soldering Articles: <https://www.electronicshub.org/?s=solder> , <https://electronicsclub.info/soldering.htm>
- b. PCB Designing Open-Source Software (KiCAD, Fritzing): <https://www.kicad.org/> , <https://circuitmaker.com/> , www.freepcb.com/
- c. PCB Design Youtube Playlist: https://www.youtube.com/playlist?list=PLkEZIY-NgCD_tuHk_gR0RWVecNoOZ157G

5. Workshop Tools and Wiring

- a. Tools: <https://home.howstuffworks.com/home-improvement-tools.htm>
- b. Practical Use: <https://www.electrical4u.net/basic-accessories/>
- c. Electrical wiring: <https://electricalgang.com/types-of-wiring-systems/> , http://en.wikipedia.org/wiki/Electrical_wiring
- d. Control Circuit: <https://electricalnotebook.com/category/control-of-electrical-machines/>



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- e. Tubelight: <https://www.electrical4u.com/wiring-diagram-for-a-single-tube-light-circuit/>
- f. Cable Lugs Crimping: <https://www.electrical4u.net/basic-accessories/electrical-cable-lugs-crimping-procedure-for-beginner/>
- g. (NPTEL Course) Illumination: <https://archive.nptel.ac.in/courses/108/105/108105060/>

6. Common Electrical Appliances

- a. Electrical Appliances: <https://sriyncollege.org/wp-content/uploads/2021/03/Unit-III-Electrical-Appliances.pdf> , <https://www.bijlibachao.com/>
- b. Home Appliances: <https://home.howstuffworks.com/home-appliances.htm>

7. General Learning Websites:

- a. <https://instrumentationtools.com/> , <https://www.electronicshub.org/how-to/>
- b. <https://www.electrical4u.net/practical-electrical/>
- c. <https://www.electrical4u.net/electrical-basic/>
- d. <https://www.electricaltechnology.org/> , <https://www.electricaltechnology.org/2013/09/electrical-and-electronics-engineering-and-technology-library.html>
- e. www.electronicsforu.com , <https://www.buildcircuit.com/>
- f. <https://technologystudent.com/energy1/engex.htm>

Suggested Course Tutorial List: Tutorial Contents focusing on mostly discussions, demonstrations for reinforcing theoretical concepts and solving the problems. The concepts learned in tutorials will be applied in the corresponding practical, ensuring a smooth transition from theory to hands-on learning.

Sr. No.	Tutorial Outcome/Title of Tutorial	Unit/ CO	Approx. Hours required
1	Study about Various Electrical Hazards & Protective measures to prevent it.	1	1
2	Study the requirement of electrical safety devices & earthing practices.	1	1
3	Identify the Use of Electrical & Electronic Measuring Instruments.	2	1
4	Identify Different types of Components used in Electrical circuits.	2	1
5	Identify Different types of Components used in Electronics circuits.	2	1
6	Demonstrate/Explain breadboard utilization for making electronics circuits.	3	1
7	Understand Soldering Process using Electronic Workshop Tools.	3	1
8	Identify the Use of Electrical Workshop Tools in Wiring Practices.	4	1
9	Identify Different Switches, Plugs, Sockets & Wires used in Wiring Practice	4	1
10	Understand the Basic Layout of Wiring in Any Distribution Board.	4	1



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11	Identify the Function of components of basic control circuit and study operation of contactor.	4	1
12	Identify the use of Lugs, Glands, Cable Jointing Kit, Tags with Cables.	4	1
13	Study about Different Types of Lamps used in Various Applications.	4	1
14	Study Internal Construction and Parts of Electrical Iron and Electric Geyser.	5	1
15	Study Internal Construction and Parts of ceiling fan/table fan and mixer.	5	1
			15 Hrs

Suggested Course Practical List: Each week includes one tutorial session (1 hour) and two lab sessions (2 hours each), designed such that they complement each other, means Each tutorial directly supports the upcoming four-hour (one or two) practical.

Sr. No.	Practical Outcome/Title of experiment	Unit/ CO	Approx. Hours required
1	Study the electrical safety measures as per IE safety rules and conduct electrical shock treatment by first aid exercises and artificial respiration.	1	2
2	Study the use of different fire extinguishers for electrical safety and perform mock drill for fire safety in workshop.	1	2
3	Demonstrate & perform the use of protective devices like Fuse, MCB and ELCB etc.	1	2*
4	Demonstrate the different types of earthing including chemical earthing.	1	2
5	Use common testing instruments used in electrical workshops like Test lamp, line tester, Multimeter, Clamp on meter, Megger.	2	2
6	Identify phase, neutral and earth of domestic appliances, connect them to power supply and measure current drawn by them using Clamp on meter.	2	2
7	Identify and specify different types of resistors, inductors and capacitors, diodes and LEDs. (as per standard color code practice)	2	2
8	Identify different types of batteries with their specifications and measure their voltages.	2	2
9	Identify the terminals and test the functionality of components and devices used in Electronic Circuit.	2	2
10	Find Specifications, package and applications of electronic components from Datasheet. (Ex. Diodes, Zener Diode, LEDs, seven segment LED,	2	2



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	Transistors, Op-Amp & Timer IC 555, Voltage Regulator ICs etc.)		
11	Implement and test any basic electronic circuit on breadboard. (Ex. Rectifiers, Filters, Op-Amp & Timer IC 555 Based Circuits etc.)	3	2*
12	Simulate / Build + 12 Volt DC supply on bread board.	3	2*
13	Implement any electronic circuit on general purpose PCB by soldering various components (and De-solder any component afterwards).	3	4*
14	Dismantle and Re-assemble any machine/appliances using Electrical workshop tools.	4	2
15	Use Electrical workshop tools to cut copper/aluminum cable & carry out crimping.	4	2
16	Wire/Rewire given switch board/ extension board.	4	4
17	Wire/Rewire given series/parallel Test Lamp Board and to use it for finding out simple faults.	4	4*
18	Test the functionality of push buttons, relays, and contactors using a multimeter to check continuity, coil resistance, and contact operation.	4	2
19	(1) Design and test a basic contactor circuit to Operate a Contactor using NO, NC Switch (without a holding feature). (2) Modify the circuit by adding a self-holding feature using an auxiliary NO contact.	4	2
20	Demonstrate installation of lugs and gland on the cable.	4	2
21	Study Power cable jointing using epoxy based jointing kits (straight joint).	4	2
22	Connect and Test a Compact Fluorescent Lamp (CFL).	4	2
23	Connect and Test a Fluorescent Tube light and Identify Common fault, their causes and remedies.	4	2
24	Dismantling, Testing, Repairing & maintenance of electric Iron & Geyser.	5	4
25	Dismantling, Testing, Repairing and maintenance of ceiling fan / table fan.	5	4
			60 Hrs

* Compulsory performance on practical point of view

List of Laboratory / Learning Resources Required:

1. Various **Safety devices** used for first aid and electrical hazards
2. Electrical **Safety devices for Protection** such as Fuse, MCBs, ELCBs, earthing rods.
3. Various **Electrical and Electronics Components** like Various types of Resistors, Inductors,



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Capacitors, LEDs, Diodes, Transistors, Necessary ICs, PCBs etc.

4. Various **Electrical Powers Supplying Equipments** (e.g. transformer, variac, d.c. power supply, Different Batteries etc.)
5. Various **Electrical Measuring Instruments** such as Multimeter, Ammeters, Voltmeters, Watt meters, Clamp on Meter, earthing rods, Megger, insulation tester, tong tester etc.
6. Various **Electronics Instruments** such as CRO, DSO, Function generator, LCR –Q meter.
7. Various **Electrical Tools** like pliers, Screwdriver set, Wire stripper, Electric tester, Drilling Machine with drill bits, cramping tools, bearing puller and other etc.
8. Soldering - Desoldering Station, **Soldering Kit** (Breadboard, General purpose PCB, General purpose Copper clad laminate sheet, soldering iron, soldering core, Solder-stand, soldering flux, De-soldering pump, Cutter, Desolder wick, Hook up wire etc.)
9. Different types of Electrical wires and Cables, cable Ferrule, Lugs, Gland, tags, switches, socket, light sources/lamps, Contactor, Push button, insulating & conducting materials, etc.
10. Various **Domestic appliances** like ceiling fan / table fan, tube light, electrical iron, Electric Mixy, geyser etc.

Suggested Activities for Students:

Beyond tutorial and laboratory learning, the following co-curricular activities are recommended to enhance the achievement levels of various outcomes in this course. The activities are such that it strengthens their understanding of electrical and electronic components, safety procedures, circuit implementation, and troubleshooting techniques. Students are encouraged to undertake these activities either individually or in groups and prepare comprehensive reports of approximately five pages. Additionally, students should gather and document physical evidence for their portfolios, which could be beneficial during placement interviews:

- a) Students can start with basic tasks like preparing component specification sheets and conducting market surveys.
- b) They can gradually move to circuit design, PCB fabrication, and wiring projects. Micro-projects, workshops, and research activities will encourage teamwork and problem-solving.
- c) Case studies on electrical accidents, troubleshooting exercises, and presentations on emerging technologies will provide deeper insights into industry standards and best practices.
- d) Students should maintain a portfolio of experiments, findings, and projects to support their academic and professional development.



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Suggested Project List: Suggested Project List as given below:

Individual Level - Fundamental Activities

- Prepare specification sheets for electrical and electronic components.
- Conduct a market survey of various electrical safety devices, (MCBs, RCCBs, and fuses etc)
- Undertake a market survey of electrical and electronics workshop tools and document findings.
- Prepare a job hazard analysis report for soldering and de-soldering, identifying risks and preventive measures.
- Prepare a classification chart of different safety aids and protective equipment used in electrical installations.

Group Level - Hands-on Projects / Circuit Implementation and Testing

- Search at least one circuit online (using diodes, transistors or ICs) and simulate it in software (e.g., Tinkercad, Proteus).
- Design and test an LED Blinking Circuit using a 555 Timer or a transistor (group activity).
- Practice soldering techniques by assembling & testing a basic power supply or amplifier circuit.
- Identify faults in given Electronic Circuit, suggest solutions, and rectify them practically.

Advanced Activities (Skill-Based Activities)

- Simulate and design a PCB layout using KiCad or EasyEDA for a simple rectifier or voltage regulator circuit.
- Conduct a seminar on PCB layout techniques, software (KiCad, Eagle), & fabrication methods.