

**Unit 4026:**

# **Electrical Systems and Fault Finding**

**Unit Code:** **K/651/0749****Level:** **4****Credits:** **15**

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## **Introduction**

Electrical systems can be found in a very wide range of locations such as in manufacturing facilities, airports, transport systems, shopping centres, hotels and hospitals; people will come across them every day in their workplace and at home. The system must take the electrical supply from the national grid, convert it to a suitable voltage and then distribute it safely to the various system components and uses such as electric motors, lighting circuits and environmental controls.

This unit introduces students to the characteristics and operational parameters of a range of electrical system components that are used in a variety of applications; and how to fault find when they go wrong.

On successful completion of this unit students will be able to follow electrical system circuit diagrams, understand the operation of the various components that make up the system and select the most suitable fault-finding technique. Therefore, students will develop skills such as critical thinking, analysis, reasoning, interpretation, decision-making, information literacy, information and communication technology literacy, innovation, creativity, collaboration, and adaptability, which are crucial skills for gaining employment and developing academic competence for higher education progression.

## **Learning Outcomes**

By the end of this unit students will be able to:

- LO1 Investigate the key constructional features and applications of electrical systems, including identification and resolution of potential faults
- LO2 Examine the types, applications, and common fault-finding methodologies of electrical motors and generators
- LO3 Analyse potential faults and fault diagnostics in the various types of lighting circuits available in the industry by assessing their practical application
- LO4 Discuss the operating characteristics of electrical safety components including evaluation of their effectiveness through fault-finding techniques.

## **Essential Content**

### **LO1 Investigate the key constructional features and applications of electrical systems, including identification and resolution of potential faults**

*Electrical systems:*

Purpose and types of electrical systems, role of electrical power distribution systems, modern trends and diverse range of applications

Key elements of electrical distribution systems, such as transformers, circuit breakers, protection devices, and wiring techniques. Constructional features of the key elements, for example, transformers such as step up/down, isolating, shell and core, windings, connections, efficiency

Common faults within these systems and the steps to troubleshoot and fix them.

Example scenarios include short-circuits, ground faults, and overloads.

Non-common and complex faults. Application of tools such as multimeters, circuit testers, and thermal imagers in fault finding could also be covered.

*Fault finding, location and signal tracing techniques/methodologies:*

Input-to-output, output-to-input, half-split method, symptom to cause fault, unit substitution, visual examination, top-down approach, module and component isolation.

Use of fault-finding aids:

Risk assessment, test plans, functional charts, diagrams, trouble-shooting charts, component data sheets, operation and maintenance manuals, software-based records and data; fault/repair reporting, mean time between failure (MTBF) figures.

### **LO2 Examine the types, applications, and common fault-finding methodologies of electrical motors and generators**

*Types, methodologies, and applications of electrical motors and generators:*

Different types of motors and generators such as DC motors, AC motors, synchronous generators, and induction generators

Current and future uses and industrial applications

Fault finding – typical issues such as winding failures, mechanical failures, control circuit faults; overcurrent, overvoltage and overload

Fault finding/mitigation methodologies for diagnosis, repair, and future maintenance.

### **LO3 Analyse potential faults and fault diagnostics in various types of lighting circuits available in the industry by assessing their practical application**

*Lighting circuits, applications and fault finding:*

Types of lighting circuits such as series and parallel

Combination circuits analysis and use in residential and industry contexts

Lighting design considerations – quality of light, control of glare, luminance, internal/external lighting for visual tasks, emergency lighting

Construction and practical applications

Typical faults including circuit overload, faulty switches, wiring issues; fault diagnostics

Safety requirements for use in hazardous zones.

### **LO4 Discuss the operating characteristics of electrical safety components including evaluation of their effectiveness through fault-finding techniques**

*Electrical safety components and applications:*

Various electrical safety components such as circuit breakers, ground fault interrupters, surge protectors, and safety switches

Operating principles, uses and common malfunctions of electrical safety components

Selection of appropriate component types for a selection of industry scenarios

Role of safety components in protecting equipment and personnel

Techniques to test effectiveness and reliability of safety components (e.g., using an insulation resistance tester)

*Electrical safety standards:*

Approved codes of practice

Safety first culture and active engagement with health and safety policies and procedures, regulations and compliance, risk assessment process and procedures.

## Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
<b>LO1</b> Investigate the key constructional features and applications of electrical systems, including identification and resolution of potential faults		
<b>P1</b> Investigate constructional features of an electrical distribution system, demonstrating the ability to detect and resolve common faults, for a given scenario.	<b>M1</b> Analyse constructional features of multiple electrical systems, their applications, with demonstrable proficiency in identifying, diagnosing, and resolving common and less common faults.	<b>D1</b> Present modern trends in electrical systems, their constructional features and applications across various industries, with demonstrable knowledge of effective strategies for fault prevention and system optimisation.
<b>LO2</b> Examine the types, applications, and common fault-finding methodologies of electrical motors and generators.		
<b>P2</b> Examine the types and applications of electrical motors and generators, and relevant fault-finding methodologies.	<b>M2</b> Analyse efficiency aspects of electrical motors and generators in a given application scenario with focus on fault-finding and fault mitigation.	<b>D2</b> Perform an examination of a wide range of modern electrical motors and generators and their usage in large applications across diverse industries, with a focus on fault-finding methodologies to diagnose and resolve complex faults.

<b>Pass</b>	<b>Merit</b>	<b>Distinction</b>
<b>LO3</b> Analyse potential faults and fault diagnostics in the various types of lighting circuits available in the industry by assessing their practical application		
<b>P3</b> Analyse two types of lighting circuits used in the industry including diagnosis of common faults found in a specific practical application.	<b>M3</b> Conduct a detailed analysis of various types of lighting circuits, their practical industry applications, including diagnosis of common and less common faults.	<b>D3</b> Evaluate a broad spectrum of modern lighting circuits in practical application scenarios, with a focus on diagnosing, troubleshooting and proposing solutions for a range of serious faults.
<b>LO4</b> Discuss the operating characteristics of electrical safety components including evaluation of their effectiveness through fault-finding techniques		
<b>P4</b> Discuss the operating characteristics of commonly used electrical safety components.  <b>P5</b> , Demonstrating the ability to evaluate the effectiveness of electrical components using simple fault-finding techniques.	<b>M4</b> Analyse the operating characteristics of a selection of electrical safety components and fault-finding scenarios in an industrial situation.	<b>D4</b> Critically analyse the operating characteristics of modern electrical safety components, using sophisticated fault-finding techniques, with strategies for improving safety component performance and reliability.

## **Recommended Resources**

*Note: See HN Global for guidance on additional resources.*

### **Print Resources**

- Boss M.J. and Norris G.M. (2015) *Electrical Safety: Systems, Sustainability, and Stewardship*. 1st Ed. CRC Press.
- Cadena R. (2021) *Electricity for the Entertainment Electrician & Technician*. 3rd Ed. Routledge.
- Fuchs E.F. and Masoum M.A.S. (2023) *Power Quality in Power Systems, Electrical Machines, and Power-Electronic Drives* (Paperback). Elsevier Science Publishing Co Inc.
- Gill P. (2016) *Electrical Power Equipment Maintenance and Testing*. 2nd Ed. CRC Press.
- Gonen T. (2014) *Electric Power Distribution Engineering*. 3rd Ed. CRC Press.
- Guru B.S. and Hiziroglu H.R. (2001) *Electric Machinery and Transformers*. 3rd Ed. Oxford University Press.
- Herman S.L. (2013) *Electric Motor Control*. 10th Ed. Cengage Learning.
- Hughes A. and Brury B. (2019) *Electric Motors and Drives: Fundamentals, Types and Applications*. 5th Ed. Newnes.
- Kitcher C. (2018) *Practical Guide to Inspection, Testing and Certification of Electrical Installations*. 4th Ed. Routledge.
- Kumar J., Tripathy M. and Jena P. (Editors) (2023) *Control Applications in Modern Power Systems: Select Proceedings of EPREC 2021 – Lecture Notes in Electrical Engineering 870* (Paperback). Springer Verlag.
- Maycock W.P. (2023) *Electric Lighting and Power Distribution: An Elementary Manual On Electrical Engineering, Suitable For Students Preparing For The Preliminary And Ordinary Grade Examinations Of The City And Guilds Of London Institute*; Volume 1 (Hardback). Legare Street Press.
- Neitzel D.K. (2019), Capelli-Schellpfeffer M. and Winfield A. (2019) *Electrical Safety Handbook (ELECTRONICS)* Hardcover. McGraw Hill.
- Olsen I. (2017) *Electrical Generation and Distribution Systems and Power Quality Disturbances* (Hardback). Scitus Academics LLC.
- Ree J.M.P. (2022) *Lecture Notes on Electrical lighting illumination: Simplified Approach* (Paperback).
- Taylor W.T. (2023) *Electric Power Systems: A Practical Treatment of the Main Conditions, Problems, Facts and Principles in the Installation and Operation of Modern Electric Power Systems, for System Operators, General Electrical Engineers and Students* (Paperback). Legare Street Press.
- The Institution of Engineering and Technology. *BS 7671 – 18th Edition: The IET Wiring Regulations Information and help for electrical installers*.

## **Journals**

*Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.*

[IEEE Industry Applications Magazine](#)

[IEEE Power and Energy Magazine](#)

[IEEE Sensors](#)

[IEEE Transactions on Power Systems](#)

[Journal of Electrical Systems](#)

## **Links**

This unit links to the following related units:

*Unit 4019: Electrical and Electronic Principles*

*Unit 4021: Electrical Machines*

*Unit 4022: Electronic Circuits and Devices.*