Unit 31: Electrical Systems and Fault Finding

Unit code A/615/1500
Unit level 4
Credit value 15

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 work place 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:

1. Investigate the constructional features and applications of electrical distribution systems.

2. Examine the types and applications of electrical motors and generators.

3. Analyse the types of lighting circuits available in the industry by assessing their practical application.

4. Explain the operating characteristics of electrical safety components.
Essential Content

**LO1** Investigate the constructional features and applications of electrical distribution systems

*Operating principles:*
Three-phase, single-phase distribution methods and connections
Earthing system connections

*Transformer constructional features:*
Construction, application, characteristics of transformers such as step up/down, isolating, shell and core, windings, connections, efficiency
Electrical circuit symbols and layout diagrams

*Fault finding techniques and test equipment:*
Input/output, half split
Meters, insulation testers
Typical faults found

**LO2** Examine the types and applications of electrical motors and generators

*Types and applications:*
Construction, application, characteristics, and testing
Types of electric motors and generators
Practical applications
Generation methods
Starting methods
Voltages, power, speed, torque, inertia
EMI, efficiency
Cooling and protection devices
LO3  **Analyse the types of lighting circuits available in the industry by assessing their practical application**

*Types available and applications:*
Construction, application, characteristics and testing of lighting circuits
Types of lights available (high-intensity discharge lamps (HID lamps) such as metal-halide and sodium, fluorescent, light emitting diode (LED) and halogen)
Practical applications
Voltages, energy usage, lumen output, efficiency, recycling
Safety requirements for use in hazardous zones
Heat and protection devices

*Lighting design:*
Quality of light, control of glare, luminance, internal/external lighting for visual tasks, emergency lighting, use in hazardous environments

LO4  **Explain the operating characteristics of electrical safety components**

*Electrical safety standards:*
Approved codes of practice

*Component types available and applications:*
Construction, application, characteristics and testing of: distribution boards, circuit breakers, residual current devices (RCDs), fuses, thermal devices, relays, contactors, switch gear, emergency stop buttons, interlocks, disconnectors, earth connections, Insulation Protection (IP) rating
## Learning Outcomes and Assessment Criteria

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<thead>
<tr>
<th>Pass</th>
<th>Merit</th>
<th>Distinction</th>
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<tbody>
<tr>
<td><strong>LO1</strong> Investigate the constructional features and applications of electrical distribution systems</td>
<td><strong>D1</strong> Examine the operation of an electrical distribution system</td>
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<tr>
<td><strong>P1</strong> Describe the features of an electrical distribution system</td>
<td><strong>M1</strong> Summarise the methods of safe fault finding on an electrical distribution system</td>
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<td><strong>P2</strong> Review the electrical component symbols used in circuit diagrams</td>
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<td><strong>P3</strong> Explain the different methods of single and three-phase connections</td>
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<tr>
<td><strong>LO2</strong> Examine the types and applications of electrical motors and generators</td>
<td><strong>D2</strong> Justify the selection of a motor for a specific industrial application</td>
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<tr>
<td><strong>P4</strong> Explain the types of electrical motors and generators available</td>
<td><strong>M2</strong> Outline the efficiency of motors and generators</td>
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<td><strong>P5</strong> Select suitable motors for various industrial applications</td>
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<td><strong>P6</strong> Review the different methods of starting induction motors and synchronous machines</td>
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<tr>
<td><strong>LO3</strong> Analyse the types of lighting circuits available in the industry by assessing their practical application</td>
<td><strong>D3</strong> Evaluate the practical application of a specific type of lighting circuit</td>
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<tr>
<td><strong>P7</strong> Examine the types and construction of lighting devices</td>
<td><strong>M3</strong> Analyse the efficiency of lighting circuit designs</td>
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<td><strong>P8</strong> Explore a suitable lighting type for a specific application, considering its characteristics</td>
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<td><strong>LO4</strong> Explain the operating characteristics of electrical safety components</td>
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<td><strong>D4</strong> Validate the selection of suitable electrical safety devices for a specific industrial application</td>
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<tr>
<td><strong>P9</strong> Describe the operation, types and uses of electrical safety devices</td>
<td><strong>M4</strong> Determine the practical application of electrical safety devices in an industrial situation</td>
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<td><strong>P10</strong> List suitable safety components for a specific application</td>
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Recommended Resources

Textbooks

Websites
https://ocw.mit.edu/ MIT open courseware
Electric Machines
(Tutorials)

Links
This unit links to the following related units:
Unit 19: Electrical and Electronic Principles
Unit 21: Electrical Machines
Unit 22: Electronic Circuits and Devices