Industrial Electrical Systems

Course Outline

Welcome to this eLearning course on Industrial Electrical Systems.

Electrical systems are essential to the operation of modern manufacturing plants, industrial facilities and commercial premises. From powering electric motors and production machinery to controlling automated equipment, electrical systems play a vital role in maintaining productivity, reliability and operational efficiency.

A sound understanding of industrial electrical systems helps personnel recognise electrical hazards, understand how electrical equipment operates, interpret electrical diagrams and identify faults that can affect the safety and performance of industrial installations.

The aim of this course is to develop your knowledge, understanding and practical competence in industrial electrical systems, with particular emphasis on electrical safety, electrical principles, power distribution, motor operation, motor control, electrical testing and fault diagnosis.

By the end of this course, you will be able to describe how to achieve safe isolation and switching for mechanical maintenance, as well as electrical isolation. You will also develop an understanding of the relationship between cable sizes, current-carrying capacities, fuses, circuit breakers and the conditions under which electrical installations operate.

You will learn about the methods used to protect people against direct contact with live electrical parts. These include basic insulation, barriers and enclosures, and the use of extra-low voltage where appropriate.

The course will also explore protection against indirect contact, including double insulation, automatic disconnection of supply through earthing arrangements, residual current devices, equipotential bonding, and the use of isolating or reduced-low-voltage transformers in suitable applications.

You will develop your understanding of direct current and alternating current, including single-phase and three-phase systems. You will examine their operating principles, relative advantages and typical industrial applications.

Another important outcome is the ability to predict voltages at specified points in an electrical circuit and then measure those voltages using a multimeter. This will help you connect theoretical electrical principles with practical testing and measurement.

The course is organised into fifteen lessons, progressing from fundamental electrical principles to motor control, testing and the interpretation of electrical drawings.

Lesson 1: Electrical Safety Awareness

Introduces the hazards associated with electricity and the precautions required when working with electrical equipment. You will explore safe working practices, isolation procedures and the importance of ensuring equipment is safe before maintenance begins.

Lesson 2: Electrical Concepts and Units

Covers fundamental electrical quantities, including voltage, current, resistance and power. You will examine the relationships between these quantities and apply basic calculations to electrical circuits.

Lesson 3: AC Systems

Introduces alternating current and its characteristics. You will also consider the differences between AC and DC, including single-phase and three-phase supplies, and explore their relative merits and applications.

Lesson 4: Electrical Protection

Examines how electrical installations and equipment are protected. You will explore the relationship between cable sizes, current-carrying capacity, fuses, circuit breakers and installation conditions. You will also examine methods of protection against direct and indirect contact, including insulation, barriers, earthing, residual current devices and equipotential bonding.

Lesson 5: Three-Phase Power Systems

Explores the principles of three-phase electricity and its importance in industrial power distribution. You will develop an understanding of three-phase supplies and their role in powering industrial machinery and motors.

Lesson 6: Three-Phase Induction Motors

Introduces the construction and operating principles of three-phase induction motors. You will examine how these motors operate and why they are widely used in industrial applications.

Lesson 7: Motor Poles, Speed and Slip

Explains how supply frequency and the number of motor poles influence motor speed. You will also examine the meaning of slip and its importance in the operation of an induction motor.

Lesson 8: Contactors, Overloads and Motor Protection

Focuses on the components used to control and protect electric motors. You will learn about contactors, auxiliary contacts, thermal overloads and the roles these components play in motor control circuits. You will also develop an understanding of typical control switches, including functional control switches, emergency control switches, latched and unlatched switches, and normally open and normally closed contacts.

Lesson 9: Direct-On-Line Motor Starters

Examines the operation of direct-on-line starters. You will explore how contactors, control switches and overload protection are combined to start and stop a motor. You will also develop an understanding of how a DOL control circuit is designed and constructed.

Lesson 10: Star and Delta Motor Connections

Explains star and delta connections for three-phase motors. You will examine their characteristics, the relationship between winding voltage and supply voltage, and their relevance to motor operation and starting arrangements.

Lesson 11: Forward and Reverse Motor Control

Explores how a three-phase motor can be controlled to rotate in either direction. You will examine the role of contactors, auxiliary contacts and interlocking arrangements, and develop an understanding of how forward and reverse control circuits are designed and constructed.

Lesson 12: Variable Speed Drives

Introduces variable speed drives and their role in controlling motor speed. You will explore typical industrial applications and consider how drive technology can support process control and operational efficiency.

Lesson 13: Single Phasing and Motor Faults

Examines the effects of losing one phase of a three-phase supply and considers other common motor faults. You will learn why recognising these conditions is important for protecting motors and maintaining reliable operation.

Lesson 14: Motor Testing and Fault Diagnosis

Focuses on inspection, testing and fault-finding techniques. You will consider how electrical measurements can help identify faults and assess motor condition, including the use of appropriate instruments and systematic testing procedures.

Lesson 15: Reading Electrical Schematics

Develops your ability to interpret wiring diagrams, circuit diagrams and electrical schematics. You will learn to recognise common electrical symbols and understand how components and connections are represented in industrial control systems.

Throughout the course, you will connect electrical theory with practical industrial applications. You will develop the knowledge needed to understand motor connections, identify the function of electrical protection devices, interpret circuit diagrams and predict and measure voltages within electrical circuits.

You will also develop an understanding of how to design and construct control circuits using typical industrial components, including control switches, emergency control switches, auxiliary contacts, contactors and thermal overloads. Particular attention will be given to direct-on-line starter circuits and forward and reverse motor control circuits.

By completing this course, you should have a stronger foundation in industrial electrical systems and be better prepared to understand, interpret, test and investigate electrical circuits and motor control arrangements within your area of competence.

Electrical work must always be undertaken by appropriately competent and authorised personnel, following applicable regulations, safe isolation procedures, risk assessments and the correct use of test instruments.

We hope you enjoy the course and find the knowledge and practical skills useful in your work with industrial electrical systems.