

# **OBJECTIVE SYLLABUS FOR PRINCIPLES OF ELECTROPLATING MODULE**

## **SECTION A - Why Surface Finishing?**

### **Lesson 1 - Surface Finishing Techniques and Applications**

**At the end of Lesson 1 you should be able to:**

- 1.1 Define surface finishing.
- 1.2 Describe the main processes used for Surface Finishing and their basic principles.
- 1.3 Describe the purposes for which these finishes are applied to substrates.
- 1.4 Describe the nature of the Surface Finishing Industry and its economic importance.

### **Lesson 2 - Properties of Different Surface Finishes**

**At the end of Lesson 2 you should be able to:**

- 2.1 List the strengths and weaknesses of various surface finishes.
- 2.2 Decide which finish is appropriate for a particular function.

## **SECTION B – General Principles of Electroplating**

### **Lesson 3 - Why Electroplating is used as a Coating Method**

**At the end of lesson 3 you should be able to:**

- 3.1 Explain why electroplating is such a popular way of putting metal coatings onto substrates.
- 3.2 Deduce what properties of a plated coating should be specified so that the plated part should be suitable for a certain use.
- 3.3 List the main processes in a typical plating sequence.
- 3.4 State why it is so important to rinse the parts in water after different processes

### **Lesson 4 - Basic Electroplating Circuits and Calculations**

**At the end of lesson 4 you should be able to:**

- 4.1 List the main components of an electroplating electrical circuit and draw the associated circuit diagram.
- 4.2 Know the parameters and their units for the control of the electrical supply to an electroplating tank.

- 4.3 Calculate the operating parameters associated with the electrical supply to an electroplating tank.

## **SECTION C - Chemical Reactions at the Surface of an Electrode**

### **Lesson 5 - Chemical Symbols and Chemical Equations**

**At the end of lesson 5 you should be able to:**

- 5.1 Write the chemical symbols for the chemicals used most often in electroplating
- 5.2 Write chemical equations for simple chemical reactions.
- 5.3 Understand how atoms join together by ionic, covalent and metallic bonds.

### **Lesson 6 - Electrode Reactions in Electroplating**

**At the end of Lesson 6 you should be able to:**

- 6.1 Explain the difference between a homogeneous and a heterogeneous reaction.
- 6.2 Identify an electrochemical reaction
- 6.3 List different types of cathode reduction reactions

### **Lesson 7 - Electrode Reactions and Faraday's Laws**

**At the end of Lesson 7 you should be able to:**

- 7.1 Identify different anodic reactions
- 7.2 List problems of secondary cathodic reactions
- 7.3 Understand the effect of imbalance of cathode and anode efficiencies
- 7.4 Recognise a Faradaic Reaction and know how its rate can be measured.

### **Lesson 8 - Electrode Reactions and Deposition Rate**

**At the end of Lesson 8 you should be able to:**

- 8.1 List the factors affecting the rate of a Faradaic Reaction.
- 8.2 Understand what makes a reaction take place and what causes the reactants to reach the surface.
- 8.3 Understand why there are limits to the maximum plating rate
- 8.4 Understand that substances adsorbed onto a cathode surface can affect electrodeposition

## **SECTION D - Care and Maintenance of Solutions and Product Quality**

### **Lesson 9 – The Physical and Chemical Properties of Electroplating Solutions**

**At the end of Lesson 9 you should be able to:**

- 9.1 List the components of an electrodeposition bath.
- 9.2 Explain the role played by each component.
- 9.3 Measure pH, metal ion concentration and solution density.

## **Lesson 10 - The Structure of Electrodeposits**

**At the end of Lesson 10 you should be able to:**

- 10.1 Recognise the major microstructural features of an electrodeposited metal.
- 10.2 Recognise the major macrostructural features of an electrodeposited metal.
- 10.3 Recognise the factors giving good adhesion of electrodeposited metals.
- 10.4 Recognise that metals may be deposited in a state of tensile or compressive stress.
- 10.5 Appreciate that metals can be co-deposited with other metals to form alloys and that non-metallic particles can be co-deposited with metals to form composite coatings.

## **Lesson 11 – Testing Electroplated Coatings**

**At the end of Lesson 11 you should be able to:**

- 11.1 List deposit properties to control.
- 11.2 Describe techniques for measuring the thickness deposits.
- 11.3 Describe test methods for deposit properties.

## **Lesson 12 – Process Control and the Hull Cell**

**At the end of Lesson 12 you should be able to:**

- 12.1 Explain the meaning of Process Control.
- 12.2 Explain the benefits of Process Control.
- 12.3 Keep a log of a Surface Finishing Process.
- 12.4 Use a Hull cell.
- 12.5 Explain the importance of Plant Control.
- 12.6 Appreciate what a Hull cell test can show.
- 12.7 Appreciate some Hull cell test applications.
- 12.8 List common faults that can occur when electroplating.
- 12.9 Identify sources of contamination which affect product quality.
- 12.10 Know how to remove contamination from plating solutions.

## **SECTION E – Introduction to Corrosion**

### **Lesson 13 - How Coatings can prevent Corrosion**

**At the end of lesson 13 you should be able to:**

- 13.1 Define corrosion and understand its consequences.
- 13.2 Understand the chemistry of corrosion of iron.
- 13.3 Understand the electrochemical nature of the aqueous corrosion of metals.

- 13.4 Know how the electrochemical series can be used to select coatings for the prevention of corrosion.
- 13.5 Understand the importance of the electrochemical series.
- 13.6 Understand how coatings prevent corrosion.
- 13.7 Describe the need for accelerated corrosion tests for coated products and explain the main tests.

## **SECTION F - Anodising**

### **Lesson 14 - The Principles of Anodising**

**At the end of lesson 14 you should be able to:**

- 14.1 Understand what is meant by the term 'anodising'.
- 14.2 Describe what metals are practically anodised.
- 14.3 Describe the structure of anodically formed oxide on aluminium.
- 14.4 List the various conditions which can be used to anodise aluminium and how these affect the properties and thickness of the oxide thus formed.
- 14.5 Describe the differences between anodising and electroplating.
- 14.6 List the advantages and disadvantages of anodising.
- 14.7 List applications of anodised aluminium.
- 14.8 Know the advantages of plasma electrolytic oxidation.

### **Lesson 15 - The Anodising of Aluminium**

**At the end of lesson 15 you should be able to:**

- 15.1 Describe how to jig components for anodising.
- 15.2 Describe how to anodise a sample of aluminium in a sulphuric acid electrolyte.
- 15.3 Describe how to colour a sample of anodised aluminium and seal it.
- 15.4 Describe the chromic acid anodising process
- 15.5 Compare the oxide films produced by sulphuric and chromic acid anodising.
- 15.6 Know about other electrolytes for anodising aluminium.

## **SECTION G - Services**

### **Lesson 16 - Water chemistry, utilities and prime services**

**At the end of lesson 16 you should be able to:**

- 16.1 Appreciate the meaning and purpose of utilities and prime services in the Finishing Shop.
- 16.2 Realise the importance of water and know what it is.
- 16.3 Be aware of the properties of water.
- 16.4 Know about the treatment of water.
- 16.5 Be aware of the quality of deionised water.
- 16.6 Appreciate the value of water as a heat transfer fluid for cooling and heating.
- 16.7 Understand the key properties of utilities and services.
- 16.8 Be knowledgeable of the Factory Coding System.

## **SECTION H – HEALTH, SAFETY AND ENVIRONMENTAL ISSUES IN SURFACE FINISHING**

### **Lesson 17 – Health, Safety and Environmental Legislation**

**At the end of Lesson 17 you should be able to:**

- 17.1 Understand what is required of an employer under the Health & Safety at Work Act (1974).
- 17.2 Understand what is required of an employee under the Health & Safety at Work Act (1974).
- 17.3 Be aware of the requirements of Control of Substances Hazardous to Health (COSHH).
- 17.4 Understand the need for risk assessments and their relevance to COSHH and the Health and Safety at Work Act.
- 17.5 Be aware of the use and meanings of Risk and Safety phrases.
- 17.6 Be aware of REACH.
- 17.7 Understand the role of the Environmental Protection Act and how it relates to surface finishing.
- 17.8 Be aware of other legislation that may affect the processes used in surface finishing.

### **Lesson 18 – Health and Safety Hazards and Precautions**

**At the end of Lesson 18 you should be able to:**

- 18.1 List and identify the most important items of safety equipment in a surface finishing department.
- 18.2 Identify the most common hazards to be found in the workplace.
- 18.3 Be aware of the most common chemical hazards.
- 18.4 Identify the principal hazards in the electroplating shop.
- 18.5 Be aware of specialist hazards to be found in other types of surface finishing areas.
- 18.6 Know how to avoid any short and long term effects of these hazards.
- 18.7 Discuss the importance and role of training in the prevention of accidents.
- 18.8 Know how to avoid a fire and to mitigate its effects.

### **Lesson 19 – The Treatment and Disposal of Metal Finishing Wastes**

**At the end of Lesson 19 you should be able to:**

- 19.1 Discuss how the discharge of hazardous effluents can cause danger, damage or loss.
- 19.2 List the main hazardous wastes from Surface Finishing.
- 19.3 Explain how heavy metal ions can be removed by alkaline precipitation and flocculation.
- 19.4 List the main methods for disposal of cyanides.
- 19.5 Discuss how to minimise the amounts of waste produced.
- 19.6 Explain the principles of ion-exchange and its application to effluent treatment.
- 19.7 Discuss the concept that valuable materials can be recovered from effluent streams.

- 19.8 List alternatives to precipitation for recovery or removal of metal ions from effluent streams.
- 19.9 Discuss methods for reducing water usage.
- 19.10 Identify how energy is wasted.

