

# **OBJECTIVE SYLLABUS FOR ELECTROPLATING PRACTICE MODULE**

## **SECTION A - Introduction to Surface Finishing Technologies**

### **Lesson 1 - Surface Finishing Technologies**

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

- 1.1 Know the range of surface finishing processes
- 1.2 Know the applications for the different surface finishing technologies

## **SECTION B - Basic Science for Electroplating**

### **Lesson 2 - Basic Electroplating Circuits and Calculations**

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

- 2.1 List the main components of an electroplating electrical circuit and draw the associated circuit diagram.
- 2.2 Know the parameters and their units for the control of the electrical supply to an electroplating tank
- 2.3 Calculate the operating parameters associated with the electrical supply to an electroplating tank.

### **Lesson 3 - Chemical Symbols and Chemical Equations**

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

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

## **SECTION C - Substrate Preparation and Pretreatment**

### **Lesson 4 – Substrates and their Cleaning**

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

- 4.1 Understand why metals require cleaning and pretreatment before electroplating.
- 4.2 Classify, according to the properties and likely contaminants of their surfaces, the metal and non-metal substances that are commonly electroplated.
- 4.3 Understand the advantages and disadvantages of solvent degreasing.

## **Lesson 5 – Final Preparation of Substrates before plating**

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

- 5.1 Clean common metals using alkaline solutions.
- 5.2 Remove oxides from the surfaces of common metals using acid solutions.
- 5.3 Discuss the causes of hydrogen embrittlement of steel and know how to prevent and alleviate it.

## **Lesson 6 - How to Prepare Difficult Substrates for Plating**

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

- 6.1 Plate onto zinc alloy die-castings.
- 6.2 Plate onto aluminium and its alloys.
- 6.3 Plate onto stainless steel and iron.

## **Lesson 7 - How to Prepare Plastic Mouldings for Plating**

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

- 7.1 Understand why ABS is a popular moulding material for plastics that are to be electroplated.
- 7.2 Know how mouldings should be designed for ease of plating.
- 7.3 Know how to test the suitability of plastic mouldings for plating.
- 7.4 Know the processing sequence for ABS plastic mouldings.

## **SECTION D - Electroplating of Metal Coatings**

### **Lesson 8 - Applications of Electroplated Coatings and Formulation of Electroplating solutions**

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

- 8.1 List the main metals that are electrodeposited and describe plating processes in a clear manner.
- 8.2 State the main reasons for using these popular electrodeposited coatings and relate these to the most common substrates.
- 8.3 Understand the differences between simple salt and complex salt plating solutions.

### **Lesson 9 - Solutions and Anodes Used for Copper Electrodeposition**

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

- 9.1 List uses of electroplated copper coatings
- 9.2 Describe and compare the three most important plating solutions that are used for the electrodeposition of copper.

- 9.3 Make up these plating solutions.
- 9.4 Electrodeposit copper from these plating solutions.

## **Lesson 10 - Solutions and Anodes Used for Nickel Electrodeposition**

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

- 10.1 List uses of electroplated nickel coatings.
- 10.2 Describe and compare the most important plating solutions that are used for the electrodeposition of nickel.
- 10.3 Make up these nickel plating solutions and electrodeposit nickel from them.
- 10.4 State how improved electrodeposited nickel coatings can be obtained.
- 10.5 Describe high speed nickel deposition solutions.

## **Lesson 11 - Solutions and Anodes Used for Chromium Electrodeposition**

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

- 11.1 List uses of electroplated chromium coatings
- 11.2 Describe the common types of plating solutions used for the electrodeposition of chromium and explain the importance of their operating conditions.
- 11.3 Make up typical chromium plating solutions and electrodeposit chromium from them.

## **Lesson 12 – Solutions and Anodes used for the Electrodeposition of Zinc and Cadmium**

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

- 12.1 State when it is best to use a zinc or cadmium coating.
- 12.2 List and describe the types of plating solutions used for the electrodeposition of zinc.
- 12.3 Make up and operate these zinc plating solutions.
- 12.4 Make up and operate a cadmium cyanide plating solution.
- 12.5 List and describe types of solutions for the electrodeposition of zinc alloys

## **Lesson13 – Solutions and Anodes for the Electrodeposition of Tin**

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

- 13.1 Describe and compare the most important types of plating solutions used for the electrodeposition of tin.
- 13.2 Make up and operate acid stannous sulphate and alkaline stannate tin plating solutions.

## **Lesson 14 - Electrodeposition of Precious Metals : Silver and Gold**

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

- 14.1 List and know the uses of the various types of silver cyanide plating solutions.
- 14.2 Make up and operate these plating solutions.
- 14.3 List and describe the different types of plating solutions used for the electrodeposition of gold and gold alloys.
- 14.4 Describe the main uses of the coatings deposited from these different gold plating solutions.

## **Lesson 15 - Electrodeposition of Alloys and Composite Coatings**

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

- 15.1 Understand how the electrodeposition of alloys occurs.
- 15.2 Understand how plating parameters influence the composition of the deposited alloy.
- 15.3 Know the main benefits of electroplated zinc alloys and how to deposit these alloys.
- 15.4 Know the benefits of electroplated copper alloys and tin alloys and how to deposit these alloys.
- 15.5 Know the difference between an alloy deposit and a composite coating.
- 15.6 Understand how the codeposition of particles can enhance the properties of electroplated metal coatings.
- 15.7 List some of the applications of composite coatings.

## **Lesson 16 - Producing Conversion Coatings on Electroplated Components**

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

- 16.1 Explain what is meant by conversion coatings and list their different types.
- 16.2 List and compare the different types of chromate coatings used on zinc and cadmium.
- 16.3 Make up and use a simple chromating solution for zinc coatings.
- 16.4 Test chromated and unchromated zinc coatings for their corrosion resistance.

## **SECTION E - Plating Metal Coatings without Electricity**

### **Lesson 17 – Mechanisms for the Deposition of Metal Coatings Without Electricity**

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

- 17.1 Discuss the meaning of the terms ‘Immersion Coating’, ‘Displacement Reaction’ and ‘Exchange Reaction’.
- 17.2 Explain the significance of the Galvanic Series
- 17.3 Discuss how the behaviour of dissimilar metals in contact with one another is governed by the Galvanic Series.

## **Lesson 18 - Electroless Deposition of Nickel and Copper**

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

- 18.1 State the basic chemistry underlying the electroless deposition processes.
- 18.2 List the main types of electroless deposition coatings in commercial use.
- 18.3 State the effects on the rate of an electroless deposition of change of pH, temperature and reactant concentration.
- 18.4 Discuss the underlying causes of 'runaway' conditions in electroless deposition systems.
- 18.5 Describe the recommended procedures for day-to-day operation of electroless baths.
- 18.6 Describe the properties and applications of an electroless nickel-phosphorus coating.
- 18.7 Know how to activate a plastics surface for electroless deposition.

## **SECTION F - Plant and Equipment used for Electroplating**

### **Lesson 19 – Governing Laws, Workflow and Plating Tanks**

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

- 19.1 State the law governing siting of industrial premises.
- 19.2 State the laws affecting the operation of a Surface Finishing plant.
- 19.3 Explain the concept of 'work flow' through a Surface Finishing installation.
- 19.4 Describe how plating tanks are constructed and heated.
- 19.5 Explain how a pump should be connected to a plating tank.
- 19.6 Explain how to filter a solution.
- 19.7 Describe techniques for agitating a solution.

### **Lesson 20 – Jigs, Jigging and Barrel Plating**

**At the end of Lesson 20 you should be able to:**

- 20.1 State the function of a jig.
- 20.2 Describe and compare the different types of anodes.
- 20.3 Appreciate the use of barrel plating.
- 20.4 Recognise the need for special plating techniques.

## **SECTION G – SERVICES**

### **Lesson 21 - Water chemistry, utilities and prime services**

**At the end of Lesson 21 you should be able to:**

- 21.1 Appreciate the meaning and purpose of utilities and prime services in the Finishing Shop.
- 21.2 Realise the importance of water and know what it is.
- 21.3 Be aware of the properties of water.
- 21.4 Know about the treatment of water.
- 21.5 Be aware of the quality of deionised water.
- 21.6 Appreciate the value of water as a heat transfer fluid for cooling and heating.
- 21.7 Understand the key properties of utilities and services.
- 21.8 Be knowledgeable of the Factory Coding System.

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

### **Lesson 22 – Health, Safety and Environmental Legislation**

**At the end of Lesson 22 you should be able to:**

- 22.1 Understand what is required of an employer under the Health & Safety at Work Act (1974).
- 22.2 Understand what is required of an employee under the Health & Safety at Work Act (1974).
- 22.3 Be aware of the requirements of Control of Substances Hazardous to Health (COSHH).
- 22.4 Understand the need for risk assessments and their relevance to COSHH and the Health and Safety at Work Act.
- 22.5 Be aware of the use and meanings of Risk and Safety phrases.
- 22.6 Be aware of REACH.
- 22.7 Understand the role of the Environmental Protection Act and how it relates to surface finishing.
- 22.8 Be aware of other legislation that may affect the processes used in surface finishing.

### **Lesson 23 – Health and Safety Hazards and Precautions**

**At the end of Lesson 23 you should be able to:**

- 23.1 List and identify the most important items of safety equipment in a surface finishing department.
- 23.2 Identify the most common hazards to be found in the workplace.
- 23.3 Be aware of the most common chemical hazards.
- 23.4 Identify the principal hazards in the electroplating shop.
- 23.5 Be aware of specialist hazards to be found in other types of surface finishing areas.
- 23.6 Know how to avoid any short and long term effects of these hazards.
- 23.7 Discuss the importance and role of training in the prevention of accidents.

23.8 Know how to avoid a fire and to mitigate its effects.

## **Lesson 24 – The Treatment and Disposal of Metal Finishing Wastes**

**At the end of Lesson 24 you should be able to:**

- 24.1 Discuss how the discharge of hazardous effluents can cause danger, damage or loss.
- 24.2 List the main hazardous wastes from Surface Finishing.
- 24.3 Explain how heavy metal ions can be removed by alkaline precipitation and flocculation.
- 24.4 List the main methods for disposal of cyanides.
- 24.5 Discuss how to minimise the amounts of waste produced.
- 24.6 Explain the principles of ion-exchange and its application to effluent treatment.
- 24.7 Discuss the concept that valuable materials can be recovered from effluent streams.
- 24.8 List alternatives to precipitation for recovery or removal of metal ions from effluent streams.
- 24.9 Discuss methods for reducing water usage.
- 24.10 Identify how energy is wasted.