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PREFACE

This distance learning module is based on the notes for the tutored course module that has been offered for several years by the Institute of Materials Finishing.

Changes and additions have been made to the original notes to take into account the various technical innovations that have taken place in more recent years and, in particular, the changes in environmental, health & safety practices and general changes in industrial working.

One major change has been to ensure that study by distance learning mirrors the course offered by the tutored route. The Objective Syllabus for both paths is now identical and the courses are examined in the same way, both leading to the same qualification and certification.

The Institute appreciates the hard work in carrying out this revision by Clive Barnes and Trevor Crichton. Further, thanks are expressed to all those other members of the Institute who have contributed by way of offering advice, reading of revised lessons etc.

INTRODUCTION TO DISTANCE LEARNING AND THIS MODULE

Distance Learning differs from the traditional method of learning that you will have used at school or college, where you work at a fixed rate that is determined by your teacher or lecturer. Their rate of teaching may be too fast or too slow for different students, so you either get bored or cannot keep up. Furthermore, if you miss a lesson, you will have to catch up before the next lesson, or you will quickly fall behind.

Distance Learning is not a new concept and has been around for several decades and it allows you to work at your own pace and in your own time. The Institute of Materials Finishing has been offering their courses for many years and after listening to our students, we realised that the preferred method of teaching was by offering scripted lecture notes.

Although you will be often working alone in your studies, the Institute makes sure that you have enough support if and when you have any problems.

In this latest revision of our courses, each lesson is a self contained and complete unit. This 2010 revision has also reviewed the course content to make it more applicable to the modern surface finishing and surface engineering industry and has allowed us to include new and recently introduced technologies.

As you are aware, you have been allocated an 'Industrial Counsellor' who, hopefully, is a member of your company. One of the roles of the Industrial Counsellor is to help you understand what you are being taught. We fully accept that non-one will fully understand every part of their course the first time they see it. Every person is different and has different skills and attributes, so they will find different parts of the course either easy or more difficult. When you meet a difficulty, you should ask the Industrial Counsellor to help you; it is their role to help you to understand the content of the lessons. If a suitable person is not immediately available within your company then the Institute will have made arrangements for you to be linked to a suitable local member of the Institute who has agreed to be available to assist you. Even if this person cannot immediately answer your problem, he or she will know someone who can. Most importantly, do not become disheartened in your studies. If, on any occasion, your Counsellor is unable to help, you should contact the Education Manager at The IMF's Head Office who will arrange for a Professional Member to contact and assist you.

You will find it very useful to have a pencil or pen and paper with you when you are studying, as you can quickly write down any extra notes or explanations; these can be very useful when you come to revising or are seeking further help.

This module is made up from a set of lessons of various lengths that are composed of written text with some illustrations where relevant. You may need to read the text several times to fully understand it and before moving on to the next lesson.

There is a series of different tasks set throughout the text; these are headed SAQs, SMAs and MAs.

SAOs - Self Answered Questions

SAQ's are questions relating to what you have just studied. Their purpose is to check that you have understood the lesson so far. Firstly, you should try to answer the question without checking back through your notes and then check your answer with the model answer provided at the end of the Lesson. If your answer is correct, you should continue with the next part of the lesson. If, however, you are unable to answer the question or have incorrectly answered the question, we suggest you go over the section again and get a better understanding of the lesson.

SMA – Self Marked Assessment

SMA's are usually found at the end of a lesson, but by no means every lesson. They are a series of questions that you should try to answer. The questions will be relevant to the lessons that you have just studied and there will be four or five possible answers for each question. You should identify which one you think is correct and when you have completed the series of questions, you should check your answers against those given at the end of the lesson. You will also find a short explanation explaining why each answer is correct or incorrect.

These SMAs, as both questions and answers, are also included in Appendix 1 and can be a useful source of revision prior to your examination.

MA –Marked Assignment

You will be expected to carry out a series of 4 assignments during your studies. These will cover some of the Module's objectives and are designed to test your understanding of the study material and that you can use the knowledge gained to suggest answers to specific problems or situations. In the traditional system of learning, this may have been called 'homework'.

You will find detailed instructions on how to carry out the assignments in Appendix 2. Please pay particular attention to the information regarding **plagiarism** and make sure you fully understand it and the consequences of plagiarism

After completing each assignment, it should be sent to the Institute to be externally marked. (NOTE Students on tutored courses will have their assignments marked by their tutor.) Once marked, it will be returned to you. The total marks you receive for the four assignments contribute up to a maximum of 20% towards your final examination mark, so you are rewarded for your efforts.

Please note: marked assignments are compulsory and must be submitted by the due date for you to be eligible for the final examination. This is fully explained in Appendix 2 and Appendix 5.

The Examination

Your examination will last for 2 hours and the examination paper consists of two sections:

Section A 5 short essay questions, all of which should be attempted, for which it is suggested you should allow about 30 minutes in total for your 5 answers.

Section B consists of 8 longer essay questions, of which you should attempt five; it is suggested that you allow about 15 minutes for each answer.

Section A gives a maximum of 25% of your total marks and Section B gives 75% of your total marks for the examination. Your answer papers will be marked by an external examiner of the Institute and the examiner's mark will be moderated by the Institute's Examination and Qualifications Board (EQB).

A mark of 60% and over gives a '**Pass with Merit**' whilst a mark of over 75% gives a '**Pass with Distinction**'. If you achieve these marks, the credit will be shown on your certificate. (An average mark of at least 40% must be obtained for the 4 assignments for a merit or distinction to be awarded)

NOTE: Candidates whose first language is not english may use a dictionary book during the examination, other types of dictionary, e.g. electronic ones and technical dictionaries, are not permitted. The examination's invigilator will check that the dictionary is suitable before the start of the examination. (Examples of suitable dictionaries are standard english dictionaries and dictionaries providing translation from english to another language and vice versa.)

Additional Distance Learning Modules

There are additional modules of a similar academic standard. These are:

- Principles of Electroplating
- Electroplating Practice
- Powder Coating
- Paint, Lacquer & Varnish OR Automotive Surface Finishing
- Materials Science
- Electroforming

Any one of the above, combined with the module you have just completed, can lead to the award of a '**Technician Certificate**'. The benefit here is that you can apply for the professional qualification '**Technician of the Institute of Materials Finishing**' and the insignia **TechIMF**, with which you can apply for the international award from the UK Engineering Council of '**Engineering Technician**' and the insignia **EngTech**, which is internationally recognised across all industries.

OBJECTIVE SYLLABUS FOR ENVIRONMENTAL, HEALTH AND SAFETY MODULE

SECTION A - THE ENVIRONMENT

LESSON 1 An Introduction to the Environment

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

- 1.1 Understand how human activity affects the environment.
- 1.2 Understand the importance of environmental, health and safety controls.
- 1.3 Know how energy use affects the environment.
- 1.4 Appreciate the need for resource conservation.
- 1.5 Understand how waste and pollution affects the environment.
- 1.6 Know how carbon dioxide affects the environment and appreciate the need to reduce carbon dioxide emissions.

SECTION B - WHY SURFACE FINISHING?

LESSON 2 - Surface Finishing Techniques and Applications

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

- 2.1 Define surface finishing.
- 2.2 Describe the main processes used for Surface Finishing and their basic principles.
- 2.3 Describe the purposes for which these finishes are applied to substrates.
- 2.4 Describe the nature of the Surface Finishing Industry and its economic importance.

LESSON 3 - Properties of Different Surface Finishes

At the end of Lesson 3, you should be able to:

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

LESSON 4 - How Coatings Can Prevent Corrosion

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

- 4.1 Define corrosion and understand its consequences.
- 4.2 Understand the chemistry of corrosion of iron.
- 4.3 Understand the electrochemical nature of the aqueous corrosion of metals.
- 4.4 Know how the electrochemical series can be used to select coatings for the prevention of corrosion.
- 4.5 Understand how coatings prevent corrosion.
- 4.6 Describe the need for accelerated corrosion tests for coated products and explain the main tests.

SECTION C - WASTE

LESSON 5 - Sources of Waste

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

- 5.1 Identify the sources of waste in cleaning and pre-treatment operations.
- 5.2 Identify the sources of waste from inorganic coating operations.
- 5.3 Identify the sources of waste from organic coating operations.
- 5.4 Recognise that ancillary operations also produce waste.

LESSON 6 - Waste Avoidance

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

- 6.1 Understand the recycle hierarchy.
- 6.2 Develop a strategy to avoid spills and leaks.
- 6.3 Deal with spills and leaks and organise a spills team.
- 6.4 Reduce energy use in a surface finishing facility.
- 6.5 Manage quality to reduce waste.

LESSON 7 - Waste reduction and disposal

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

- 7.1 Understand the waste reduction hierarchy.
- 7.2 Discuss process substitution in surface finishing.
- 7.3 Discuss strategies for reducing the amount of waste going for disposal.
- 7.4 Reduce water usage in a finishing facility.
- 7.5 Develop strategies to reduce energy usage in surface finishing.

SECTION D - TREATMENT AND DISPOSAL OF WASTES

LESSON 8 - Waste Processing

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

- 8.1 Discuss techniques to reduce surface finishing wastes by elimination, substitution, reduction, recycling and recovering.
- 8.2 Appreciate that disposing of waste by landfill is an expensive option.
- 8.3 Describe some of the equipment used for waste processing.
- 8.4 Understand the importance of monitoring the pH value and oxygen redox potential of waste streams
- 8.5 Understand the importance of good mixing when carrying out chemical processes.
- 8.6 Discuss the options available for waste treatment.

LESSON 9 - Effluent Treatment

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

- 9.1 Discuss the principles of effluent treatment.
- 9.2 Safely treat cyanide.
- 9.3 Treat effluent containing hexavalent chromium.
- 9.4 Remove heavy metal ions from effluent by precipitation.
- 9.5 Remove phosphates and oils and greases from effluent.
- 9.6 Remove water from the sludge produced by effluent treatment.
- 9.7 Safely dispose of the solid waste from effluent treatment.

LESSON 10 - Treatment Systems for Waste Water

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

- 10.1 Explain how ion exchange works and the benefits it can give to a surface finishing facility.
- 10.2 Discuss the limitations of ion exchange technology.
- 10.3 Use vacuum evaporation techniques for some applications.
- 10.4 Discuss the use of membrane technologies for the treatment of waste water from a surface finishing facility.
- 10.5 Use electrowinning techniques to recover valuable metals from waste water.

LESSON 11 - Air Pollution Control Systems

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

- 11.1 Discuss the different methods for the abatement of particulates in waste air streams.
- 11.2 Use scrubbers to remove both particulates and gases from waste air streams.
- 11.3 Remove noxious gases from waste air streams.
- 11.4 Prevent paint overspray escaping into the environment.
- 11.5 Discuss designs of spray booths to trap and treat paint overspray.

SECTION E - LEGAL AND OTHER ASPECTS

LESSON 12 - General Legislation

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

- 12.1 Discuss the Environmental Protection Act (1990).
- 12.2 Discuss the Pollution Prevention and Control Act (1999) and Environment Damage and Liability Regulations (2009).
- 12.3 Comply with the COMAH regulations.
- 12.4 Comply with the RoHS and WEEE regulations.
- 12.5 Comply with CHiPS and End of Life Vehicle regulations.
- 12.6 Discuss the Solvent Emissions Directive.

LESSON 13 - Environmental and Health and Safety Legislation

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

- 13.1 Discuss the legislation relating to air pollution.
- 13.2 Discuss the legislation relating to water pollution.
- 13.3 Discuss the legislation relating to land pollution.
- 13.4 Understand the objectives of REACH.
- 13.5 Discuss the Health and Safety at Work Act.
- 13.6 Apply the CoSHH regulations.

SECTION F - PROTECTION FROM ENVIRONMENTAL, HEALTH AND SAFETY HAZARDS

LESSON 14 - Health and Safety Equipment

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

- 14.1 List safe working procedures.
- 14.2 List and identify the most important items of primary safety equipment in a hazardous workplace.
- 14.3 List and identify the most important items of secondary safety equipment in a hazardous workplace.
- 14.4 Discuss the first aid requirements in the work place.

LESSON 15 - Health and Safety Hazards in the Workplace

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

- 15.1 Identify physical hazards in the workplace.
- 15.2 Apply remedies to avoid physical hazards in the workplace.
- 15.3 Avoid long term health and safety hazards.
- 15.4 Identify chemical hazards in the work place.
- 15.5 Identify hazards associated with blast cleaning.
- 15.6 Discuss the causes of fire and develop strategies to avoid fires.
- 15.7 Know how to develop procedures to implement in the event of a fire.
- 15.8 List the 5 steps to fire safety.

LESSON 16 - Health and Safety Hazards in Surface Finishing

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

- 16.1 Identify hazards in the electroplating shop and know the precautions to take against these hazards.
- 16.2 Identify the hazards in the vacuum deposition shop.
- 16.3 Identify the hazards in the paint shop and know the precautions to take against these hazards.
- 16.4 Identify the hazards in the powder coating shop and know the precautions to take against these hazards.
- 16.5 Know how to safely access plant and equipment.

SECTION G - MANAGING HEALTH, SAFETY AND ENVIRONMENTAL IMPACTS

LESSON 17 - How to Assess and Manage Risks

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

- 17.1 Explain the difference between hazard and risk.
- 17.2 Use the hierarchy for minimising risks.
- 17.3 Carry out a risk assessment.
- 17.4 Identify hazards.
- 17.5 Identify risk and safety phrases.
- 17.6 Prioritise and reduce risks.

LESSON 18 - The Environmental Management System.

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

- 18.1 Discuss the need for management control of potential environmental impacts.
- 18.2 Explain what is an environmental management system.
- 18.3 Use an environmental management system.
- 18.4 Create an environmental objectives plan.
- 18.5 Implement an environmental management system.
- 18.6 Know how to maintain the environmental objectives plan and the environmental management system.

LESSON 19 - Other Environmental Impact Assessment Processes.

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

- 19.1 Carry out an Environmental Impact Analysis.
- 19.2 Prepare an Environmental Impact Statement.
- 19.3 Appreciate the need for a Cost Benefit Analysis of an environmental project.
- 19.4 Know the benefits of Life Cycle Analysis of products, processes or services.
- 19.5 Understand the importance of controlling energy use.
- 19.6 Discuss the Eco Management and Audit System.

SECTION H - SURFACE FINISHING AND THE ENVIRONMENT

LESSON 20 - The interplay between Surface Finishing and the Environment

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

- 20.1 Understand what is meant by sustainability.
- 20.2 Discuss the environmental impact of some surface finishing processes.
- 20.3 Understand the use of carbon equivalents for assessing environmental impact.
- 20.4 Discuss the economic importance of surface finishing for environmental protection.
- 20.5 Understand the environmental benefits of green chemistry in surface finishing.
- 20.6 How new technologies can help surface finishing to meet environmental challenges.