

## **130 – FOUNDRY CRAFT PRACTICE**

### **EXAMINATION STRUCTURE**

The trade consists of the following trade related courses:

191 – General Metal Work

192 – General Wood Work

194 – Building/Engineering Drawing

### **EXAMINATION SCHEME**

Candidates are expected to take only one paper – Foundry Practice

131-1 – OBJECTIVE & ESSAY:

SECTION A: There will be forty (40) multiple choice Objective questions.

Candidates will be required to answer all in 40 minutes. This section carries forty (40) marks.

SECTION B: This will be a written paper of seven (7) Essay questions, out of which five (5) questions will be answered in 2 hours. This Section carries sixty (60) marks. Each question carry twelve (12) marks.

131-2 – PAPER II: PRACTICAL: This paper will comprise one (1) Practical Question for all candidates for fifteen (15) hours duration and carries 100 marks.

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131 – INTRODUCTION TO FOUNDRY, PATTERN AND CORE MAKING (CFD 10, 11, 12)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	<p><b><u>Foundry Practice</u></b></p> <ol style="list-style-type: none"> <li>1. Define Foundry.</li> <li>2. Explain procedure of casting.</li> <li>3. Describe and explain the history of foundry development and practice.</li> </ol>	<ol style="list-style-type: none"> <li>1. Definition of Foundry.</li> <li>2. Differences between casting from other methods e.g. Forging, Machining and Fabrication.</li> <li>3. Description of Foundry Practice.</li> <li>4. History of Foundry development and Practice.</li> </ol>	<ol style="list-style-type: none"> <li>1. Give explanation of the meaning of Foundry.</li> <li>2. Use relevant literature and videotapes to emphasize Benin Bronze Casting and the NOK, Igboukwu and Ife cultures.</li> <li>3. Demonstrate the procedure for a casting</li> </ol>
2.	<p><b><u>Safety Aspect of Foundry work</u></b></p> <ol style="list-style-type: none"> <li>1. Explain the factory of safety act as regards foundry practice.</li> <li>2. Identify the principal hazards in the foundry and associated areas.</li> <li>3. Use of protective equipment in the Foundry shop.</li> </ol>	<ol style="list-style-type: none"> <li>1. Factory safety act as regards foundry practice: <ol style="list-style-type: none"> <li>a. The effect of excess noise in the shop.</li> <li>b. Adequate ventilation.</li> <li>c. Lighting requirement.</li> <li>d. Vision, glare, colour and colour contrast in shop.</li> </ol> </li> <li>2. Principal hazards in foundry and associated areas: <ol style="list-style-type: none"> <li>a. Storage and handling of corrosive, toxic, silicosis and inflammable materials.</li> <li>b. Danger arising from melting, tapping, transfer and teaming molten metal. <ol style="list-style-type: none"> <li>i. Misuse of mechanical, electrical.</li> <li>ii. Manual lifting, use of levers and other lifting tackles in the foundry and pattern making shop.</li> <li>iii. Shop cleanliness, benches, gangways and the shop floor.</li> </ol> </li> <li>c. Danger of obstruction and disposal of shop refuse.</li> </ol> </li> <li>3. Protective safety wears and equipment in the foundry shop: <ol style="list-style-type: none"> <li>a. Barrier cream and cleaning agents, safety boots, respirators, first aid, goggles, hand of gloves, helmets, aluminized apron and foot sprat etc.</li> <li>b. Danger associated with incorrect clothing at work place.</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>1. Explain the various safety requirement in the foundry shop.</li> <li>2. State and identify the various danger/areas in the foundry shop.</li> <li>3. Demonstrate the effective use of protective safety wears.</li> </ol>
3.	<p><b><u>Common Foundry Tools and Devices</u></b></p> <ol style="list-style-type: none"> <li>1. Name, identify, and describe the use of various foundry tools and devices.</li> <li>2. Apply the use of various</li> </ol>	<ol style="list-style-type: none"> <li>1. Use/Operation of Flask, Trowels, scope, Dowel Pin, Drag, Sprue Pin, Draw Spike, Board, Crucible, Rammer, Riddles, Vent Wire, Stickle Bar, Pattern, Bellow, Swaps, Brushes, Cleaner etc.</li> <li>2. Description and explanation of the application of various foundry tools and</li> </ol>	<ol style="list-style-type: none"> <li>1. List and draw foundry tools and devices for easy identification.</li> <li>2. Carry out the use of foundry tools and devices.</li> </ol>

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	foundry tools and devices.	devices.	
4.	<p><b><u>Types and Techniques of Foundry Works</u></b></p> <ol style="list-style-type: none"> <li>1. Explain the principle and techniques of foundry works.</li> <li>2. State the classes and types of foundry work.</li> <li>3. State the advantages and disadvantages of foundry practice.</li> </ol>	<ol style="list-style-type: none"> <li>1. Principles and techniques of foundry works: <ol style="list-style-type: none"> <li>a. Hand Moulding</li> <li>b. Machine Moulding</li> <li>c. Die Casting</li> <li>d. Centrifugal Castings and other casting methods.</li> </ol> </li> <li>2. Classes and types of foundry work.</li> <li>3. Advantages and disadvantages of foundry practice.</li> <li>4. Differences between: <ol style="list-style-type: none"> <li>a. Hand moulding and machine moulding.</li> <li>b. Die casting and centrifugal casting etc.</li> </ol> </li> <li>5. Explanation of: <ol style="list-style-type: none"> <li>a. Jabbing, repetitive and captive foundries.</li> <li>b. Ferrous and non ferrous foundries.</li> </ol> </li> </ol>	Use hand moulding tools, moulding machines and casting equipment to differentiate between hand moulding and machine moulding.
5.	<p><b><u>Foundry Materials Composition, Properties and Applications</u></b></p> <ol style="list-style-type: none"> <li>1. Describe foundry engineering, materials, their chemical symbols, boiling, melting and pouring points and their relative densities.</li> <li>2. Identify and describe simple alloy composition of foundry metals.</li> <li>3. State the properties of metals used for foundry.</li> <li>4. State the advantages and disadvantages of the materials.</li> </ol>	<ol style="list-style-type: none"> <li>1. Explanation of foundry engineering.</li> <li>2. Materials, their properties.</li> <li>3. Chemical symbols, boiling, melting and pouring temperatures.</li> <li>4. Densities of various metals.</li> <li>5. Identification and description of simple alloy.</li> <li>6. Composition of Brass and Bronze alloys, Grey cast iron, Bearing steel, gun metal, steel, Aluminium.</li> <li>7. Properties of metals used for foundry: <ol style="list-style-type: none"> <li>a. Strength</li> <li>b. Ductility</li> <li>c. Hardness</li> <li>d. Malleability</li> <li>e. Brittleness</li> <li>f. Impact resistance</li> <li>g. Creep.</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>1. Use chart and tables to list out foundry materials and their following properties and chemical symbols.</li> <li>2. Use charts and tables to identify the areas of application of various alloy metal.</li> <li>3. Describe the various properties of metals.</li> <li>4. Identify and demonstrate the principal hazards in the foundry and associated areas.</li> </ol>
6.	<p><b><u>Different Types of Patterns Making</u></b></p> <ol style="list-style-type: none"> <li>1. Explain the principles, techniques, uses of pattern making in foundry work.</li> <li>2. State the characteristics of patterns.</li> <li>3. Explain the various terms in pattern making.</li> <li>4. Draw a simple pattern</li> </ol>	<ol style="list-style-type: none"> <li>1. Definition of pattern.</li> <li>2. Explanation of principles and techniques of pattern making.</li> <li>3. Solid pattern, split pattern, loose pattern etc.</li> <li>4. Description of pattern making terms – Flask, Cope, Drag, Draft, Taper, Shrinkage, Follow-Board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Illustrate the use of pattern in foundry.</li> <li>2. Use relevant texts to explain the terms in pattern making.</li> <li>3. Draw simple pattern.</li> </ol>
7.	<p><b><u>Principles of Common Pattern Making Tools and Their Application</u></b></p> <ol style="list-style-type: none"> <li>1. State and explain the working principles of pattern making tools.</li> </ol>	<ol style="list-style-type: none"> <li>1. The working principles of: <ol style="list-style-type: none"> <li>a. Vermeer caliper</li> <li>b. Barrel Protractor</li> <li>c. Set Square</li> <li>d. Auger Timing Machine</li> <li>e. Timing Chisel</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>1. Use items of equipment, tools, to produce a simple pattern.</li> <li>2. Demonstrate the working principles of pattern making tools.</li> </ol>

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	2. State the application of each pattern making tools. 3. Usage and maintenance of the pattern making tools. 4. Identify pattern materials. 5. State the characteristics and properties of pattern making materials.	f. Contraction Rule g. Band Saw etc. 2. Characteristics of pattern making tools. 3. The application of pattern making tools. 4. Pattern making materials: a. Wood – Mahogany i. Obeche ii. Iroko etc. b. Metal – Iron i. Brass ii. Aluminium c. Plastics d. Plaster of Paris e. Wax f. Chemical Resin etc.	
8.	<b><u>Safety Aspects of Pattern Making</u></b> 1. Explain the factory safety acts of pattern making workshop. 2. Identify various devices used in pattern making.	1. Importance of safety in pattern shop. 2. Safety acts. 3. Safety Regulations 4. Identification of various devices and their differences: a. Bench Vice b. Wood Clamp c. Template d. Making out Table e. Rapping and Lifting f. Plate g. Slings h. Dowel Pins i. Numbering Punch 5. Advantages and disadvantages of various devices.	1. Show how to use safety regulations and safety wears in pattern making shop. 2. Describe the various properties of metals. 3. Identify and demonstrate the principal hazards in the foundry and associated areas.
9.	<b><u>Production of Different Types of Pattern Specifications</u></b> Tools and materials for production of different types of patterns.	1. Preparation of tools and suitable materials for production of different types of patterns. 2. Pattern arrangement and layout on plates for moulding. 3. Calculation relating to pattern and casting weights estimation and costs, contraction allowances.	1. Select and use suitable tools, materials to produce different types of pattern. 2. Carry out pattern arrangement and layout on plates for moulding 3. Using single mathematical symbols calculation relating to pattern and casting weights estimation allowances.
10.	<b><u>Production Method and Techniques of Producing Different Types of Good Cores</u></b> 1. Explain the types of cores. 2. Designs for core production.	1. Definition and explanation of different types of cores: a. Air set b. Shell c. CO <sub>2</sub> d. Oil sand (use of linseed oil) 2. Core designs production.	Demonstrate the use of different materials for core making.
11.	<b><u>Various Processes of Core Making, Bonding of Materials</u></b>	1. Description of different types of core making process e.g. Core Box System, Extrusion System, Core blowing System,	1. Demonstrate the use of core box equipment. 2. Produce cores of any

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	<ol style="list-style-type: none"> <li>Describe the types of core-making process.</li> <li>Describe materials for core bonding.</li> <li>Identify the various precautions against linseed oil and the fast drying agent.</li> </ol>	<p>Core Shooting System, Shell Moulding (Core System).</p> <ol style="list-style-type: none"> <li> <ol style="list-style-type: none"> <li>Description of materials for bonding – Sodium Silicate, CO<sub>2</sub> linseed Oil, Cereal, Clay, Molasses, Cement, Starch.</li> <li>Different between various core binders.</li> <li>Curing temperature.</li> </ol> </li> <li>Precautions against oil and the fast drying agent.</li> <li>The basic chemistry of core making – CO<sub>2</sub>, Air-set processes.</li> </ol>	<ol style="list-style-type: none"> <li>type.</li> <li>Carry out core making using any processes.</li> <li>Demonstrate the basic reactions arising from various core making process.</li> <li>identify the various core binders materials and equipment.</li> </ol>
12.	<p><b><u>Essential Features and Working Principles of Core Making Machines (Equipment) for Mixing Sand, Drying and Manipulation of Cores</u></b></p> <ol style="list-style-type: none"> <li>Explain the essential features and working principles of core machines for mixing sand drying and manipulation.</li> <li>Explain the general properties of sand used in core making.</li> </ol>	<ol style="list-style-type: none"> <li>Explanation of the essential features and working principles of core making machines: <ol style="list-style-type: none"> <li>Mixing machines</li> <li>Extrusion machines</li> <li>Core Blowing Machines</li> <li>Shell Core Machines</li> <li>Continuous mixer Machine Dispenser.</li> </ol> </li> <li>General properties of sand used in core making: <ol style="list-style-type: none"> <li>Porosity</li> <li>Adhesiveness or bonding</li> <li>Refractoriness</li> <li>Moisture Contents</li> <li>Finess etc.</li> </ol> </li> </ol>	<p>Carry out test such as:</p> <ol style="list-style-type: none"> <li>Moisture content</li> <li>Silica and clay content</li> <li>Shatter Index</li> <li>Dry Strength</li> <li>Permeability</li> <li>Green Strength</li> <li>Sieve Test for Build up Fitness.</li> </ol>
13.	<p><b><u>Simple Calculations Involving Core Sand Preparation</u></b></p> <p>Carry out simple calculations involving ingredients for mixing volumes used for moulding, test results, losses etc.</p>	<p>Calculation of sand composition:</p> <ol style="list-style-type: none"> <li>Base Sand</li> <li>Additions</li> <li>Binders</li> </ol>	<p>Perform simple calculations involving sand composition.</p>

**132 – MOULDING PROCESS, MELTING, MOLTEN METAL HANDLING,  
TREATMENT AND ELECTROPLATING**

TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
<p><b>1. TYPES OF MOULDS, THEIR USES, TECHNIQUES AND METHODS OF PRODUCTIONS</b></p> <p>1. Explain all types, techniques and methods of moulding.</p> <p>2. Explain the general properties of sand used in moulding.</p> <p>3. Explain the use of moulding fixtures.</p> <p>4. Carry out simple calculations relating to liquid and metallostatic pressure and force.</p> <p>5. Explain the need for good clamping and weighting of moulds before casting.</p>	<p>1. Types, techniques and methods of moulding.</p> <p>2. Properties of sand used in moulding:</p> <ul style="list-style-type: none"> <li>▪ Moisture content strength</li> <li>▪ Green and dry compressive strength</li> <li>▪ Permeability</li> <li>▪ Shatter index</li> <li>▪ Refractoriness</li> <li>▪ Grain Size etc.</li> </ul> <p>3. The uses of testing equipment.</p> <p>4. Moulding fixtures:</p> <ul style="list-style-type: none"> <li>▪ Springs</li> <li>▪ Studs</li> <li>▪ Chaplets</li> <li>▪ Gaggers</li> <li>▪ Reinforce Wire etc.</li> </ul> <p>1. Calculations relating to liquid and metallostatic pressure and force.</p>	<p>Use relevant texts to demonstrate sand testing equipment and moulding fixtures.</p> <p>Demonstrate with relevant texts simple calculations involving upward force, downward force, and side forces on moulds.</p> <p>Demonstrate the production of:</p> <ul style="list-style-type: none"> <li>▪ Open mould</li> <li>▪ Cope and drag mould</li> <li>▪ Pit mould</li> </ul>
<p><b>2. ESSENTIAL EQUIPMENT AND MACHINES USED IN MOULDING</b></p> <p>1. Make simple sketches of essentials moulding machines.</p> <p>2. Explain the working principles of moulding machines.</p>	<p>1. Description of moulding machines with the use of sketches</p> <p>2. Differences between the moulding machines</p> <p>3. The working principles of:</p> <ul style="list-style-type: none"> <li>▪ Hand moulding machines</li> <li>▪ Jolt moulding machines</li> <li>▪ Squeeze moulding machines</li> <li>▪ Jolt and squeeze moulding machines</li> <li>▪ Sand slinger</li> </ul> <p>4. Importance of maintaining the moulding equipment.</p>	<p>Sketch different moulding machines.</p> <p>Operate moulding machines of all types.</p> <p>Demonstrate the operation of moulding machines.</p>
<p><b>3. THE IMPORTANCE OF FACING AND DRESSING THE MOULD WITH APPROPRIATE MATERIALS</b></p> <p>1. Explain the importance of facing and dressing mould.</p> <p>2. Explain and apply the knowledge the properties of sand in the selection of dressing materials.</p> <p>3. Assess finished surfaces.</p>	<p>1. The importance of facing and dressing of moulds.</p> <p>2. Explanation and application of the knowledge of properties of sand in the selection of dressing materials.</p> <ul style="list-style-type: none"> <li>▪ Roughness</li> <li>▪ Finesse</li> <li>▪ Moisture content</li> <li>▪ Viscosity</li> <li>▪ Penetration</li> <li>▪ Suspension etc.</li> </ul> <p>3. The effects and implication of properties of sand on mould facing and dressing.</p> <p>4. Application of plumbago, blacking lampblack, talc, refractory materials etc. as facing materials.</p>	<p>Emphasise the need for good mould surface.</p> <p>Carry out facing and facing application using appropriate materials of the prepared moulds</p>

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<p><b>4. THE PRINCIPLE OF POST CASTING KNOCKING CLEANING AND FETTLING</b></p> <ol style="list-style-type: none"> <li>1. carry out knock-out operations by manual and mechanical means.</li> <li>2. Recognise and avoid the dangers of premature knock-out</li> <li>3. Observe all safety measure involved in knock-out cleaning and fettling operations</li> </ol>	<ol style="list-style-type: none"> <li>1. Knock-out operations by manual and mechanical means <ul style="list-style-type: none"> <li>▪ Intermittent</li> <li>▪ Vibrating grits</li> </ul> </li> <li>2. Effects of premature knock-out</li> <li>3. Safety measures involved in knock-out, cleaning and fettling operations</li> </ol>	<p>Perform knockout operations by manual and mechanical means</p> <p>Emphasise on the effects of premature knock out.</p> <p>Identify the safety wears to be adopted during knock-out clearing and fettling operations.</p>
<p><b>5. THE DEFECTS CAUSED BY INCORRECT MOULDING, CORE MAKING AND GATING</b></p> <p>Explain the defects caused By incorrect moulding, Core making and gating.</p>	<ol style="list-style-type: none"> <li>1. The defects caused by incorrect: <ol style="list-style-type: none"> <li>(a) moulding: <ul style="list-style-type: none"> <li>▪ Mismatch</li> <li>▪ Crush</li> <li>▪ Swelling etc.</li> </ul> </li> <li>(b) core making: <ul style="list-style-type: none"> <li>▪ Variation in wall thickness of casting</li> <li>▪ Blows</li> <li>▪ Scabbing etc.</li> </ul> </li> <li>(b) gating: <ul style="list-style-type: none"> <li>▪ Slag inclusion</li> <li>▪ Shortrun</li> <li>▪ Sand inclusion</li> <li>▪ Misrun etc.</li> </ul> </li> </ol> </li> <li>2. Differences between various defects caused by incorrect moulding, core making and gating.</li> </ol>	<p>Identify, describe and differentiate between various defects caused by moulding, core making and gating.</p>
<p><b>6. MAINTENANCE AND OPERATION OF COMMON FOUNDRY MELTING FURNANCES</b></p> <ol style="list-style-type: none"> <li>1. Describe the construction, function and operation of different furnaces.</li> <li>2. Distinguish melting losses and gains and be able to effect them by adding and removing during charge preparations.</li> </ol>	<ol style="list-style-type: none"> <li>1. Different types of furnaces: <ul style="list-style-type: none"> <li>▪ Cupola</li> <li>▪ Crucible</li> <li>▪ Reverberatory</li> <li>▪ Rotary</li> <li>▪ Electric arc</li> <li>▪ Induction</li> <li>▪ Resistance etc.</li> </ul> </li> <li>2. The losses and gains in charge make-up.</li> <li>3. Tapping operations.</li> </ol>	<p>Operate the furnace.</p> <p>Perform tapping operation.</p> <p>Carry out furnace linings, repair and fire different types of furnaces and charge different types of furnaces available.</p>
<p><b>7. THE PRINCIPLES OF HEAT EFFECT OF THE HEAT ON MATERIALS</b></p> <ol style="list-style-type: none"> <li>1. Carry out basic mathematical calculations involving the effect of</li> </ol>	<ol style="list-style-type: none"> <li>1. Calculation involving the effect of heat on metals: <ul style="list-style-type: none"> <li>▪ Expansion of metals</li> <li>▪ Contraction of metals</li> <li>▪ Specific heat</li> <li>▪ Melting point</li> <li>▪ Freezing point</li> </ul> </li> </ol>	<p>Use relevant texts to perform in simple calculation involving the effect of heat on metals.</p> <p>Identify heat treatment and temperature measuring instruments.</p>

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<p>heat on metals.</p> <p>2. Apply heat transfer process process, temperature gradient and heat diffusibility, its application to solidification and furnaces.</p> <p>3. Explain thermal efficiency and its application in foundry work.</p> <p>4. Describe the effect of metallosstatic pressure on casting process.</p> <p>5. Explain the effect of heat treatment on casting.</p>	<ul style="list-style-type: none"> <li>▪ Latent heat</li> </ul> <p>2. The major methods of heat transfer, (conduction, convection and radiation)</p> <ul style="list-style-type: none"> <li>▪ Temperature gradient</li> <li>▪ Diffusion and diffusibility</li> </ul> <p>3. The effect of thermal efficiency in melting.</p> <p>4. The effect of forces of molten metal on moulds during casting.</p> <p>5. The effect of heat treatment on castings:</p> <ul style="list-style-type: none"> <li>▪ Normalizing</li> <li>▪ Annealing</li> <li>▪ Tempering etc.</li> </ul> <p>6. Differences between the heat treatment methods.</p>	
<p><b>8. DEFECTS CAUSED BY MOLTEN METALS</b> Explain the various defects resulting from molten metals.</p>	<p>1. Defects resulting from molten metals:</p> <ul style="list-style-type: none"> <li>▪ A mismatch</li> <li>▪ A misrun</li> <li>▪ Cold laps</li> <li>▪ A crush</li> <li>▪ Gas-holes (porosity).</li> </ul>	<p>List the defects associated or caused by molten metals.</p> <p>With the aid of sketches identify and describe the defects.</p>
<p><b>9. CASTING FINISHING USING MACHINING, POLISHING, PAINTING, AND CHEMICAL TREATMENT SUCH AS ELECTROPLATING, ANODIZING GALVANISING ETC. ON CAST SURFACE</b></p>	<p>1. Principles and teaching of machining using lathe, milling, drilling etc.</p> <p>2. Techniques of polishing process on artistic/ornamental casting to effect shining surface e.g. use of braso, anery cloth etc.</p> <p>3. Determining the viscosity of the paint and colour matching to be applied.</p> <p>4. The advantages and applications of chemical treatments on casting surfaces by:</p> <ol style="list-style-type: none"> <li>a. Electroplating</li> <li>b. Anodizing</li> <li>c. Galvanizing etc.</li> </ol>	<p>1. Carry out simple machining operations on casting using lathe, milling, drilling shaping machines.</p> <p>2. Polish artistic/ornamental castings using mechanical and manual techniques.</p> <p>3. Apply paints on casting by:</p> <ol style="list-style-type: none"> <li>a. brushing</li> <li>b. spraying</li> <li>c. dipping etc.</li> </ol> <p>4. Carry out chemical treatments on casting by</p> <ol style="list-style-type: none"> <li>a. electroplating</li> <li>b. anodizing</li> <li>c. galvanizing.</li> </ol>
<p><b>10. THE INDUSTRIAL METHODS OF REMOVING SCALES AND OXIDE FILMS FROM METAL SURFACES PRIOR TO ELECTROPLATING</b></p> <p>1. Explain the importance of surface cleanliness prior to Electroplating.</p> <p>2. Describe the structure of scales and oxide films on ferrous metals.</p> <p>3. Name different methods of surface cleaning.</p>	<p>1. The implication of coating on unclean surfaces.</p> <p>2. Discussion of the two basic methods of surface cleaning.</p> <ul style="list-style-type: none"> <li>▪ Degreasing</li> <li>▪ Descaling</li> </ul> <p>3. Explanation of the items used for degreasing.</p> <p>4. Descaling methods and the importance of preservation or surface conversion treatment after a descaling process.</p> <p>5. Advantages and disadvantages of each method of:</p> <ul style="list-style-type: none"> <li>▪ Degreasing</li> </ul>	<p>Show example of the structure of scales and oxide film on ferrous metals.</p> <p>Prepare a metal surface in the workshop for Electroplating.</p>



TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
4. Describe degreasing method, where applicable and the chemicals used. 5. Name descaling methods. 6. Describe chemical descaling methods and where applicable 7. Explain the need for preservation or surface conversion treatment after descaling processes. 8. Describe the mechanical descaling processes, their applications and shortcomings	<ul style="list-style-type: none"> <li>▪ Descaling</li> </ul> 6. The applications and shortcomings of mechanical descaling processes: <ul style="list-style-type: none"> <li>▪ Abrasive blasting (wet blasting, sand blasting, shot blasting).</li> <li>▪ Wire brushing</li> <li>▪ Grinding.</li> </ul>	
<b>11. ELECTROPLATING PROCESSES AND METHODS</b> 1. Describe metal coating, knowing its different methods and state the factors determining choice of methods/process for a given metal. 2. Describe hot dipping process and coating structure. 3. Explain the process, variable affecting the coating thickness in hot dipping process and coating structure. 4. Describe cementation process, its controlling variable and practical aspect with respect to chromatic soliconising. 5. Describe vapour deposition methods of metallic. 6. Coating. 7. Explain the process variables controlling deposition processes . 8. Describe metal spraying technique and state its application. 9. Describe the terms of conversion processes. 10. Describe electroplating process and its advantages. 11. Describe the role of variables in plating bath operation with respect to structure of electro-	1. Different methods of process and choice of metal coating. 2. Hot dipping process and coating, structure and the process variables affecting the coating thickness. 3. Cementation process, its controlling variables and practical aspect with respect to chromatic soliconising etc. 4. The advantages and applications of cementation with respect to chromatic soliconising. 5. Vapour deposition methods of metallic coating: <ul style="list-style-type: none"> <li>▪ Physical vapour deposition (PVD)</li> <li>▪ Chemical vapour deposition (CVP)</li> <li>▪ Cathode-sputtering process.</li> </ul> 6. Metal spraying technique and its applications. 7. Various conversion processes: <ul style="list-style-type: none"> <li>▪ Phosphoric acid/phosphate</li> <li>▪ Chronic acid/chromate</li> <li>▪ Oxide coating/blackening.</li> </ul> 8. Description of electroplating process and advantages over other processes. 9. The role of the following variables in plating bath operation with respect to structure of electro-deposits obtained: <ul style="list-style-type: none"> <li>▪ Chemical composition of the plating solution.</li> <li>▪ Temperature of the solution.</li> <li>▪ Cathodic current density.</li> </ul> 10. The thermodynamics of electrodepositing and polarization effect. 11. The quality and production cost of electrodeposited coatings: <ul style="list-style-type: none"> <li>▪ Covering power of the plating solution.</li> <li>▪ Throwing power (macro and micro) of the plating solution.</li> <li>▪ Leveling.</li> </ul>	Carry out hot dipping and electroplating of metals.  Carry out electroplating using spraying method.  Demonstrate electroplating using sprayers.  Carry out various electroplating exercises to determine the variables in chemical composition.  Calculate the variables in chemical composition after carrying out an electroplating exercise.

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deposits. 12. Explain the thermodynamics of electro-depositing and polarization effect.	12. Factors influencing the thermodynamics of electrodepositing and polarization effect: <ul style="list-style-type: none"> <li>▪ Polarization</li> <li>▪ Plating conditions (current density)</li> <li>▪ Agitation degree</li> <li>▪ Metal on concentration coatings.</li> </ul>	
<b>12. DIFFERENT ELECTROPLATING SOLUTION OR METALLIC COATINGS AND THEIR APPLICATIONS</b> <ol style="list-style-type: none"> <li>1. Describe industrial process of zinc coatings on steel by various methods.</li> <li>2. Explain the structure and application of each coatings obtained in the process of hot dipping, electroplating, cementation and vapour deposition.</li> <li>3. Describe Aluminium coatings of commercial importance.</li> <li>4. Explain the use of Boric/ Borate baths to produce thin, hard, non-porous Aluminium oxide coatings.</li> <li>5. Explain the production of thick porous Al-oxide coatings.</li> <li>6. Explain bright and hard anodizing and their applications</li> <li>7. Explain cathode/Anode process in Nickel electro-deposition and electroless Nickel plating (auto catalytic Plating).</li> <li>8. Explain electrodepositing of Nickel using different baths.</li> <li>9. State the application each deposit obtained in Nickel.</li> <li>10. Describe how bright Nickel deposit + chromium electroplating can be obtained for decorative purposes.</li> <li>11. Describe chromium plating</li> </ol>	<ol style="list-style-type: none"> <li>1. Industrial process of zinc coatings on steel by the following methods: <ul style="list-style-type: none"> <li>▪ Hot dipping</li> <li>▪ Electroplating (using acid and alkaline baths)</li> <li>▪ Cementation</li> <li>▪ Vapour deposition.</li> </ul> </li> <li>2. Explanation of structure and application of each methods listed in (1) above.</li> <li>3. Commercial importance of Aluminium coatings using the methods of: <ul style="list-style-type: none"> <li>▪ Vapour deposition</li> <li>▪ Hot dipping</li> <li>▪ Electroplating (Anodising)</li> </ul> </li> <li>4. The use of Boric and Borate baths in producing thin, hard, non-porous Aluminium oxide coatings.</li> <li>5. Production of thick porous Al-oxide using H<sub>2</sub>O<sub>4</sub> chromic acid, oxalic acid and phosphoric acid as electrolytes.</li> <li>6. Bright and hard anodizing and their application.</li> <li>7. Cathode/anode process in Nickel electro-deposition and electroless Nickel plating (auto catalytic plating)</li> <li>8. The production of bright Nickel + Chromium deposits for decorative process</li> <li>9. Description of: <ul style="list-style-type: none"> <li>▪ Nickel plating by Electroplating</li> <li>▪ Copper plating by electroplating</li> <li>▪ Brass/Bronze plating by electroplating</li> <li>▪ Silver plating by electroplating</li> <li>▪ Gold plating by electroplating</li> </ul> </li> </ol>	Demonstrate the processes of Electroplating using Zinc, Aluminium, Nickel, Chromic, Copper, Brass/Bronze, Silver and Gold.  Show a finished product of electroplating with Aluminium, Chromic, Nickel, Copper, Brass/Bronze, Silver and Gold salts.

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by electroplating and cementation methods.		
<p><b>13. WASTE CONTROL, MANAGEMENT AND DISPOSAL IN AN ELECTROPLATING INDUSTRY</b></p> <p>1. State the sources of solid and liquid waste in metal coating electroplating industry and how to control them.</p> <p>2. State how to handle solid and liquid waste in metal coating industry.</p> <p>3. State how to dispose solid and liquid waste in metal coating industry.</p> <p>4. Estimate cyanide present in waste chemicals.</p> <p>5. Measure the pH value of waste chemicals.</p>	<p>1. The importance of waste control and disposal.</p> <p>2. The control of waste and the disposal of waste generated in metal coating industry.</p> <p>3. Calculation of estimate of cyanide present in waste chemicals.</p> <p>4. Measurement of pH value in waste.</p>	<p>Demonstrate how to measure pH value in waste tank.</p> <p>Carry out measurement of cyanide level in waste tank.</p> <p>Perform waste management, control and disposal for:</p> <ul style="list-style-type: none"> <li>▪ Solid waste.</li> <li>▪ Liquid waste.</li> </ul>
<p><b>14. METHODS OF INSPECTION AND IDENTIFICATION OF FAULTS AND DEFECTS ON ELECTROPLATED COMPONENTS</b></p> <p>Discuss reasons and causes of defects and faults over electroplated components.</p>	<p>1. The causes of defects, faults and electroplated components and poor surface finishing, poor rinsing and handling of materials etc.</p> <p>2. Reasons for defects such as:</p> <ul style="list-style-type: none"> <li>▪ Blisters</li> <li>▪ Discoturation</li> <li>▪ Peeling</li> <li>▪ Spotting</li> </ul> <p>3. Explanation of proper selection of materials and chemicals for electroplating.</p>	<p>Carry out tests to detect electroplating faults and defects.</p>