

NTE and ANTE Curriculum and Module Specifications in Foundry
NATIONAL BOARD FOR TECHNICAL EDUCATION

NATIONAL TECHNICAL CERTIFICATE

AND

ADVANCED NATIONAL TECHNICAL CERTIFICATE

PROGRAMMES

CURRICULUM AND MODULE SPECIFICATIONS

IN

FOUNDRY

2001

PLOT B, BIDA ROAD, PMB 2239, KADUNA - NIGERIA

NTC and ANTC Curriculum and Module Specifications in Foundry
NATIONAL TECHNICAL CERTIFICATE AND
ADVANCED NATIONAL TECHNICAL CERTIFICATE PROGRAMMES

GENERAL INFORMATION

AIM

To give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant.

Entry Qualifications

Craft Programme

Candidates must not be less than 14 years of age and should have successfully completed three years of Junior Secondary education or its equivalent. Special consideration may be given to sponsored candidates with lower academic qualifications who hold trade test certificates and are capable of benefiting from the programme.

Advanced Craft Programme

Candidates should possess the National Technical Certificate or its equivalent and should have had a minimum of two years post qualification cognate industrial experience.

The Curriculum

The Curriculum of each programme is broadly divided into three components:

- a General Education, which accounts for 30% of the total hours required for the programme.
- b Trade Theory, Trade Practice and Related Studies which account for 65% and
- c Supervised Industrial Training/Work Experience, which accounts for about 5% of the total hours required for the programme. This component of the course which may be taken in industry or in college production unit is compulsory for the full-time students.

Included in the curriculum is the teacher's activity and learning resources required for the guidance of the teacher.

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Unit Course/Modules

A Course/Module is defined as a body of knowledge and skills capable of being utilized on its own or as a foundation or pre-requisite knowledge for more advanced work in the same or other fields of study. Each trade when successfully completed can be used for employment purposes.

Behavioural Objectives

These are educational objectives, which identify precisely the type of behaviour a student should exhibit at the end of a course/module or programme. Two types of behavioural objectives have been used as the curriculum. They are:

- a General Objectives
- b Specific learning outcomes

General objectives are concise but general statements of the behaviour of the students on completion of a unit of work such as understanding the principles and application in:

- a Orthographic projection in engineering/technical drawing;
- b Loci in Mathematics
- c Basic concepts of politics and government in Political Science
- d Demand and supply in Economics

Specific learning outcomes are concise statements of the specific behaviour expressed in units of discrete practical tasks and related knowledge the students should demonstrate as a result of the educational process to ascertain that the general objectives of course/programme have been achieved. They are more discrete and quantitative expressions of the scope of the tasks contained in a teaching unit.

General Education In Technical Colleges

The General Education component of the curriculum aims at providing the trainee with complete secondary education in critical subjects like English Language, Economics, Physics, Chemistry, Biology, Entrepreneurial Studies and Mathematics to enhance the understanding of machines, tools and materials of their trades and their application and as a foundation for post-secondary technical education for the above average trainee. Hence, it is hoped that trainees who successfully complete their trade and general education may be able to compete with their secondary school counterparts for direct entry

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into the polytechnics or colleges of education (technical) for ND or NCE courses respectively. The Social Studies component is designed to broaden the trainee's social skills and his understanding of his environment.

For the purpose of certification, only the first three courses in mathematics will be required. The remaining modules are optional and are designed for the above average students.

National Certification

The NTC and ANTC programmes are run by Technical Colleges accredited by NBTE. NABTEB conducts the final National examination and awards certificates.

Trainees who successfully complete all the courses/modules specified in the curriculum table and passed the national examinations in the trade will be awarded one of the following certificates:

S/NO	LEVEL	CERTIFICATE
	<u>Technical Programme</u>	
1.	Craft Level	National Technical Certificate
2.	Advanced Craft Level	Advanced National Technical Certificate

Guidance Notes For Teachers Teaching The Curriculum

The number of hours stated in the curriculum table may be increased or decreased to suit individual institutions' timetable provided the entire course content is properly covered and the goals and objectives of each module are achieved at the end of the term.

The maximum duration of any module in the new scheme is 300 hours. This means that for a term of 15 weeks, the course should be offered for 20 hours a week. This can be scheduled in sessions of 4 hours in a day leaving the remaining hours for general education. However, (properly organized and if there are adequate resources), most of these courses can be offered in two sessions a day, one in the morning and the other one in the afternoon. In so doing, some of these programmes may be completed in lesser number of years than at present.

The sessions of 4 hours include the trade theory and practice. It is left to the teacher to decide when the class should be held in the workshop or in a lecture room.

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**INTEGRATED APPROACH IN THE TEACHER OF TRADE
Theory, Trade Science And Trade Calculation**

The traditional approach of teaching trade science and trade calculation as separate and distinct subjects in technical college programmes is not relevant to the new programme as it will amount to a duplication of the teaching of mathematics and physical science subjects in the course. The basic concepts and principles in mathematics and physical science are the same as in the trade calculation and trade science. In the new scheme therefore, qualified persons in these fields will teach mathematics and physical science and the instructors will apply the principles and concepts in solving trade science and calculation problems in the trade theory classes. To this end, efforts have been made to ensure that mathematics and science modules required to be able to solve technical problems were taken as pre-requisite to the trade module.

Evaluation Of Programme/Module

For the programme to achieve its objectives, any course started at the beginning of a term must terminate at the end of the term.

Instructors should therefore device methods of accurately assessing the trainees to enable them give the student's final grades at the end of the term. A national examination will be taken by all students who have successfully completed their modules. The final award will be based on the aggregate of the scores attained in the course work and the national examination.

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NTC FOUNDRY CURRICULUM TABLE

S/N	Course Code	Subject Module	YEAR 1						YEAR 2						YEAR 3						Total Duration (Hrs)
			Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		
			T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	
1	CMA 12 - 15	Mathematics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	216
2	CEN 11 - 17	English Language & Communication	2	-	2	-	2	-	3	-	3	-	3	-	3	-	3	-	3	-	288
3	CPH 10 - 12	Physics	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
4	CCH 11 - 12	Chemistry	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
5	CBC 11 - 13	Economics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	216
6	CTD 11 - 13	Drawing	-	3	-	3	-	3	-	3	-	3	-	3	-	2	-	2	-	2	288
7	ICT 11 - 15	Computer	-	-	-	-	-	-	1	2	1	2	1	2	1	2	1	2	-	-	180
8	CME 11	General Metal Work I	2	5	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168
9	CME 12	General Metal Work II	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	60
10	CMW 10	General Woodwork	-	-	-	-	2	5	-	-	-	-	-	-	-	-	-	-	-	-	84
11	CBM 11	Entrepreneurship	-	-	-	-	-	-	2	-	2	-	2	-	-	-	-	-	-	-	72
12	CFD 10	Introduction to Foundry	-	-	-	-	-	-	4	6	-	-	-	-	-	-	-	-	-	-	120
13	CFD 11	Pattern Making	-	-	-	-	-	-	-	-	6	9	-	-	-	-	-	-	-	-	180
14	CFD 12	Core Making	-	-	-	-	-	-	-	-	-	-	6	8	-	-	-	-	-	-	168
15	CFD 13	Moulding	-	-	-	-	-	-	-	-	-	-	-	-	6	9	-	-	-	-	180

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20	CFD 14	Melting, Molten Metal Handling & Treatment	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	4	6	240	
		Sub-Total	12	8	12	8	14	11	18	13	20	16	20	15	20	15	18	12	17	10	3,036
		Electroplating (optional)																			
		Total	12	8	12	8	14	11	18	13	20	16	20	15	20	15	18	12	17	10	3,036

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ANTC FOUNDRY (CURRICULUM TABLE)

S/N	COURSE CODE	SUBJECT MODULE	TERM 1		TERM 2		TERM 3		TOTAL DURATION (HRS)
			T	P	T	P	T	P	
1	CMA 21 - 22	Mathematics	2	-	2	-	2	-	72
2	CEN 21 - 22	English Language & Communication	2	-	2	-	2	-	72
3	CTD 21	Engineering Drawing	-	3	-	3	-	-	72
4	CBM 21	Entrepreneurship	2	-	2	-	2	-	72
5	ICT 21 - 22	Auto CADI	1	2	1	2	-	-	72
6	CFD 20	Workshop Organisation & Management	3	-	-	-	-	-	36
7	CFD 21	Pattern Making	4	8	-	-	-	-	144
8	CFD 22	Moulding & Core-making	-	-	6	9	-	-	180
9	CFD 23	Melting & casting processes	-	-	2	3	4	6	180
10	CFD 24	Finishing & quality control	-	-	-	-	4	6	120
		Total	14	13	15	17	14	12	1,020

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE		
Course: General metal Work I	Course Code: CME 11	Contact Hours: 168hrs
Goal: The module is designed to introduce the trainee to the fundamentals of general metal work processes including fitting of mechanical parts and production of simple engineering component.		
General Objective: On completion of this module the student will be able to: <ol style="list-style-type: none">1. Understand workshop safety rules and their application in machine shop.2. Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use3. Select and use common measuring, marking out, cutting and striking tools.4. Understand the basic working principles of drilling machine and be able to use it for various types of screw threads, rivets, and be able to rivet and cut screws by hand.5. Understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand.6. Understand the ISO system of tolerances and fit their application in engineering production.7. Produce simple engineering components on the bench.8. Understand the essential features and working principles of the centre-lathe and carry out basic operations such as turning, step turning, facing, taper turning., knurling, chamfering and undercutting.		
Practical Competence: On completion of this module, the student will be able to: <ol style="list-style-type: none">1. Use all tools correctly ensuring the machinery guards and protective eye shields are used at all times.2. Comply with the general rules for safe practice in the work environment at all times.3. Use and select hand tools for carrying out various bench fitting and assembly tasks4. Tools: hacksaws, taps, reamers, drills, dividers, surface gauge5. Produce threads using taps and dies6. Correctly grind drill point angles: Drills: Twist and flat drills7. Select and set drilling machine speeds to carryout a range of operations using the appropriate coolants. Drilling, reaming, counter sinking, counter boring8. Perform metal joining by a range of processes. Cut through the joints and investigate the depth of penetration of the metals at the interface. Processes: Soldering, brazing, and fusion welding.9. Mark out on metals and other materials, datum lines, angles, radii/ circles and hole positions using a range of tools.		

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PRACTICAL TASKS

WEEK	General Objective: On completion of the following practical task, the trainee will demonstrate the following abilities:		
	Specific Learning Outcome:	Teachers Activities	Resources
1-3	General Objective: 1.0 Safety and Practice		
	1.1 Using and handling hand tools, portable power tools and machine 1.2 Lifting, moving and storing materials or job 1.3 Demonstrate first aid application in cases of minor cuts, electric shock, burns.	<ul style="list-style-type: none"> ▪ Demonstrate safe ways of handling basic hand tools ▪ Show a film on industrial safety ▪ Demonstrate how to treat energy cases like artificial respiration cold compress, etc ▪ Assess the students. 	<ul style="list-style-type: none"> ▪ Hand tools files, hacksaw ▪ Television, Video machines ▪ Posters on artificial respiration
	General Objective 2.0: Measuring, Marking, Cutting and Striking		
4-6	2.1 Describe the essential features and use of the following a micrometer b vernier calliper c Venier height gauge d combination set 2.2 Maintain and care for the instruments listed above 2.3 Perform marking out exercise on plane surfaces including profiles 2.4 File a piece of metal to given specifications using any of the following: Cross filing, draw filing, filing square and flat surfaces 2.5 Test surface for flatness using surface plate and try square and state precautions to be taken to avoid pinning 2.6 Maintain files in good working conditions 2.7 Apply various hammers and mallets e.g ball pein, rubber mallets, etc for engineering purposes 2.8 Select and insert hacksaw blade correctly 2.9 Cut metal and other engineering materials to given specification using the adjustable hacksaws, junior hacksaws, piercing saw, etc drills and Drilling.	<ul style="list-style-type: none"> ▪ Demonstrate how to use micrometer, venier caliper, vernier height gauge, combination set ▪ Demonstrate the maintenance and care of the instruments listed above ▪ Perform marking out for the students to learn and practise till they become competent ▪ Demonstrate how flat surface can be tested using surface plate and try square ▪ Demonstrate how files are cleaned and state the precautions to be taken against pinning. Students to practice till competent ▪ Demonstate the application of hammers and mallets for engineering purposes ▪ Demonstrate how a hacksaw blade can be inserted correctly ▪ Demonstrate how to use adjustable 	<ul style="list-style-type: none"> ▪ Micrometer, vernier calipers, vernier height gauge, combination sets ▪ Steel rules, dividers, punches, trammel, scribe angle plate, vee block center square ▪ Flat file, hand file, try square ▪ File card, flat file ▪ Ball pein hammers, mallet ▪ Hacksaw blade, Hacksaw frame

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		<p>hacksaw, junior hacksaw piercing</p> <ul style="list-style-type: none"> ▪ Students should be allowed to practice till competent ▪ Guide student to produce simple engineering components like open ended spanner, engineers square, tool makers clamp, centre square, etc. ▪ Assess the students. 	
	General Objective 3.0: Machine Tools		
7-9	<p>3.1 Setting up and operate a drilling machine in given situations Note Setting up drilling machine should include</p> <ol style="list-style-type: none"> a) change of spindle speed b) adjustment of drilling table to required height and angle, holding of work on drilling table to required height and angle, using appropriate clamping device. c) Install the drill bit in chuck <p>3.2 Sharpen a twist drill correctly to manufacturers' specification</p> <p>3.3 Perform with facility the following operations:</p> <ul style="list-style-type: none"> - drilling blind holes - drilling round stock - counter-boring and counter-sinking - drilling large diameter holes <p>3.4 List the operation sequence and cut internal (through and blind) and external threads by hand method and state precautions to be taken when tapping on the bench</p> <p>3.5 Rivet metals together in any given situations</p> <p>3.6 Mark out only given bench work using datum points, datum lines, datum faces, chalk or marking solution, center or dot, punch, scribing block or measurement transfer.</p>	<ul style="list-style-type: none"> ▪ Demonstrate how to set up and operate a drilling machine in given situation ▪ Students to practice till competent ▪ Demonstrate how a twist drill can be sharpened correctly ▪ Demonstrate with the appropriate facility how to perform all the drilling operations ▪ Students to practice till they become competent ▪ Give notes as well as demonstrate the operation sequence in cutting internal (through and blind) and external threads by hand method ▪ Demonstrate how riveting can be done and let the students practice same till they become competent ▪ Demonstrate the marking out procedures on bench working using datum lines, datum faces, etc ▪ Students to practice till they become competent ▪ Assess the students. ▪ 	<ul style="list-style-type: none"> ▪ Bench drill, pillar drill, drill bits ▪ Bench drill, pillar drill, twist drill, flat drill, counter sink drill, counterbore drill, center drill ▪ Drills, taps, tap wrench, die and die stock ▪ Rivets and sets of drill bits ▪ Surface table, surface plate, marking solution, center/dot punches, scribing block

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General Objective 4.0: Lathe and Lathework			
10-12	<p>4.1 Sharpen cutting tool for plain turning, shouldering, parting off and facing operations</p> <p>4.2 Set up rough and turned stock in 3-jaw-chuck</p> <p>4.3 Select appropriate cutting tool and set them up to centre height for turning or facing operations</p> <p>4.4 Carryout chuck work involving facing, step turning, undercutting radiusing, chamfering, parting off and knuring Note, Components should be produced to specified tolerance and finish</p> <p>4.5 Produce simple components involving taper turning using the compound slide</p>	<ul style="list-style-type: none"> ▪ Guide the students to sharpen cutting tool for plain turning shouldering, parting off and facing operations and allow students to practice till competent ▪ Demonstrate how to set up rough and turned stock in a 3-jaw-chuck and operate lathe. Allow students to practice till competent ▪ Guide the students to select appropriate cutting tools and set them up to center height for lathe work (turning or facing) ▪ Make a simple precision fitting project like hexagonal mild steel bar making push fit through a mild steel plate ▪ Students should be allowed to practice till they become competent ▪ Prepare simple exercises that will guide students to produce components involving taper turning using the compound slide. Assess the students 	<ul style="list-style-type: none"> ▪ Point tools, grinding machine, lathe machine ▪ 3-jaw chuck and lathe machine ▪ Point tools lathe machine ▪ Lathe machine and accessories ▪ Centre lathe and accessories like catch plate, face plate, dog lathe, lathe centers fixed steady and traveling steading ▪ Round nose turning tool, fine finishing tool, form tool, parting off tool, boring tool, bar of good length and 4mm diameter, Live/dead centers catch plates ▪ Standard exercises or prepared exercises.

Assessment profile: Practical to take 60% of the overall assessment

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: General Metal Work I		Course Code: CME 11	Contact Hours 7hrs/wk PER WEEK: T2, P5
Course Specification: Knowledge Requirement			
WEEK	General Objective 1.0: understand workshop safety rules and application in machine shop		
1	Specific Learning Outcome	Teachers Activities	Resources
	General Objective: 1.0 Workshop Safety rules and practice		
	<p>On completion of this module, the trainee should be able to:</p> <p>1.1 State sources of hazards in the workshop and how to prevent them. e.g.</p> <p>a handling and using hand tools, portable power tools and machines;</p> <p>b stepping on or striking obstructions left on floors or benches;</p> <p>c lifting, moving and storing materials or jobs;</p> <p>d using inflammable or corrosive liquids and gases;</p> <p>e inhaling vapours or fumes;</p> <p>1.2 Explain the application of factory safety regulations in the machine shop.</p> <p>1.3 Name safety equipment and wears essential in the machine shop, and state their application in working situations.</p> <p>Note: Example of safety wears and equipment should include overall, eye goggles, gloves, safety boots, helmet, fire extinguishers, etc</p>	<ul style="list-style-type: none"> ▪ State sources of hazards in the workshop. ▪ Through questions and answers, determine whether the students grasped the topic ▪ Show a film on industrial safety. ▪ Through questions and answers determine comprehension. ▪ Demonstrate how to treat emergency cases like artificial respiration, cold compress etc. ▪ List the safety equipment and wears that are essential in the workshop. ▪ Give detail notes and explanation in each topic a-e. ▪ Use questions and answers to determine comprehension. ▪ Assess the students 	<ul style="list-style-type: none"> ▪ Safety posters, common hand tools like files hacksaw ▪ Television, Video machine. ▪ Overall, goggles, gloves, hard shoes, head shield, fire extinguishers.
	<p>1.4 Outline safety rules and regulations relating to:-</p> <p>a. Clothing and health hazards;</p> <p>b. Workshop hygiene;</p> <p>c. Movement and other behaviour of workers in the workshops;</p>	<ul style="list-style-type: none"> ▪ Give detail notes and explanation on appropriate procedures to be taken in the event of workshop accident 	

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	<p>d. Materials handling; e. Tool handling, storage and usage; f. Machine operation; g. Fire protection.</p> <p>1.5 Understand appropriate procedures in the events of a workshop accident</p> <p>1.5 Examples of procedures may include: a application of first aid to the victim; b removal or rectification of the accident; c reporting the accident to the appropriate authority; keeping a record of accidents for management use.</p>		
General Objective 2.0: Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use note:			
2	<p>2.1 Explain the meaning of the following general physical properties of metals:-ductility, malleability, strength, toughness, brittleness, elasticity, plasticity.</p>	<ul style="list-style-type: none"> ▪ Give detail notes and explanations to explain the meaning of the following general physical properties of metals: ductility, malleability, strength, toughness, brittleness, elasticity, plasticity. Assess the students ▪ Give detailed notes and explanations for the topics in 2.1 	<ul style="list-style-type: none"> ▪
	<p>2.3 Describe the basic composition and properties of plain carbon steels, cast iron and alloy steel and state their application in the engineering industry.</p> <p>Note: Specific examples of tools and equipment made from the various steel and cast iron should be mentioned. Examples of steels and cast irons should include: plain carbon steels, dead mild steels, mild steel, medium carbon steel, high carbon steel. Cast Irons - grey cast iron, malleable cast iron, iron carbide, alloy cast irons (spheroidal and acicular). Alloy Steels - high speed steels, high tensile steels, tungsten, stainless steels.</p>	<ul style="list-style-type: none"> ▪ Give notes and specific examples of tools and equipment made from the various steels and cast iron. ▪ Examples of steels and cast irons should include plain carbon steels, dead mild steels, mild steel, medium carbon steel high carbon steel, grey cast iron, malleable cast iron, iron carbide, alloy cast iron, high speed steels, high tensile steels, tungsten, stainless steels ▪ Give notes and explanation on the cupola process, the blast furnace and the direct reduction process of manufacture of steel 	<ul style="list-style-type: none"> ▪ Video and television including cassettes on production processes.

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	<p>2.4 Outline:</p> <p>a The copula process of manufacture of cast iron;</p> <p>b The blast furnace process of manufacture of pig iron;</p> <p>c The direct reduction process of manufacture of steel.</p> <p>Note: A visit to a steel manufacturing plant is recommended.</p> <p>2.5 Describe the physical properties and applications of non-ferrous metals below: copper, tin, zinc, aluminium and aluminium alloys, brass (muntz metal, cartridge brass, gilding etc) metal, bronze (manganese bronz, tunmetal, bell metal, aluminium bronze, phosphor bronze and lead.</p>	<ul style="list-style-type: none"> ▪ This can be preceded by film show and a visit to be manufacturing plant. ▪ Give detail notes and explanations describing the physical properties and applications of the following non-ferrous metals: copper, tin, zinc, aluminium, aluminium alloys, brass, (muntzmetal, cartridge brass, gilding metal) etc. bronze, manganese bronze, bell metal, aluminium bronze, phosphor bronze and lead. Assess the students 	
<p align="center">General Objective 3.0: Select and use common measuring, marking out, cutting and striking tools.</p>			
3	<p>3.1 Explain with examples the difference between "line" and "end" measurement.</p> <p>3.2 Explain the use of datum points, datum lines and datum faces in marking out.</p> <p>3.3 Describe, the functions and application of the following instruments used in metal-work; steel rule, dividers, calipers (inside, outside and odd-legs), trammel, scribe angle plate, vee-block, centre square.</p> <p>3.4 Describe the various types of files, stating their grades and applications. Note: Types of files should include: flat, square, round, half round, three square, warding pollar, mill and rasp.</p> <p>3.5 Classify the common files use in metal work and state their composition of material used for their manufacture.</p> <p>3.6 Sketch the bench vice, explain its clamping power</p>	<ul style="list-style-type: none"> ▪ Prepare notes that will clearly differentiate between "line" and "end" measurement. ▪ Prepare notes and examples that will explain the use of datum points, datum lines, and datum faces in marking out. ▪ Demonstrate, give detailed notes and explanations regarding the functions and application of: steel rule, dividers, calipers (inside, outside and oddleg) trammel, scribe, angle plate, vee block, centre square ▪ Prepare notes that will describe the various types of files stating their grades and applications. By type it means: flat, square round, half round, three square, warding, mill and rasp. 	<ul style="list-style-type: none"> ▪ Steel rule, dividers calipers, trammel, scribe, angle plate, vee block, centre square. ▪ Micrometer vernier callipers vernier height gauge combination set ▪ Flat file, hard file, round file square, half round, triangular warding, mill file, rasp file. ▪ Flat file, hand file engineers square. ▪ Surface plate try square (engineers square) ▪ File card ▪ Flat file

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	<p>and demonstrate the technique of holding work in the vice for filing, tapping and designing operations.</p> <p>3.7 Describe the functions of the various parts of a bench vice, its holding power while performing various operations on its, such as filing, tapping sawing etc.</p> <p>3.8 Describe and use the following tools:</p> <ol style="list-style-type: none"> a. cold chisels (flat, cross, cut half round, diamond-point) b. centre punch and dot punch c. scrappers (flat, triangular, half round) d. power hack saw 	<ul style="list-style-type: none"> ▪ Prepare detail notes that will classify the common files used in the metal work as well as stating the composition of materials used for their manufacture. 	<ul style="list-style-type: none"> ▪ Bench vice.
4	<p>3.9 Describe the various parts of a hack saw and their function.</p> <p>3.10 Describe the common types of hacksaw blades, their range of pitches and their applications.</p> <p>3.11 Show a bench vice and demonstrate the technique of holding work in the vice for filing, tapping and designing operations.</p> <p>3.12 Prepare detailed notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operations.</p> <p>3.13 State the safety precautions to be observed when using a hand hacksaw</p>	<ul style="list-style-type: none"> ▪ Show a bench vice and demonstrate the work in the vice for filing, tapping and designing operations ▪ Prepare detailed notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operations ▪ Assess the students ▪ Prepare detailed notes and demonstrations that will describe the uses of: cold chisels, centre punch, dot punch, scrapers and power hacksaw. ▪ Prepare notes that will describe the various parts of a hacksaw and their functions. ▪ Show samples of hacksaw blades as well as prepare notes that will describe the common types of hacksaw blades, their range of pitches and their applications. ▪ Prepare notes that will show correct way of inserting blades. ▪ Prepare detail notes and explanation, 	<ul style="list-style-type: none"> ▪ Bench vice. ▪ Ball pein hammers mallets. ▪ Cold chisels, centre punches, dot punch, scrapers, power hacksaw and blades. ▪ Hacksaw blade ▪ Hacksaw frame ▪ Adjustable hacksaw junior hacksaw piercing saw.

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		<p>stating the safety precautions to be observed when using a hand hacksaw.</p> <ul style="list-style-type: none"> ▪ Prepare notes that will describe the uses of various hacksaws. Assess the students 	
	<p align="center">General Objective 4.0: Understand the working principles of a drilling machine, use it to drill and ream holes on metals and other engineering materials.</p>		
5-6	<p>4.1 Identify the various types of drilling machines.</p> <p>4.2 Describe with sketches, the main features of a bench or pillar drilling machine.</p> <p>4.4 Describe with sketches and state where each of the following types of drills are best suited. e.g. twist drill (taper shank, parallel shank and jobbers drill, and their relative merits), flat drill, countersink drill, counter bore drill, combination centre drill.</p> <p>4.5 Explain the effects of the following faults in a ground twist drill bit:</p> <ol style="list-style-type: none"> a. point angle too acute; b. point angle too obtuse; c. cutting edges at unequal angles; d. insufficient lip clearance; e. excessive lip clearance. <p>4.6 Calculate spindle revolution or cutting speed for specified size of drill using the formulae:- <u>1000S</u> $N = \frac{1000S}{\pi d} \quad S = \frac{\pi d N}{1000}$ Where S = cutting speed (m/min) N = revolution/minute D = diameter of drill (mm) $\phi = 3.142$</p> <p>4.8 State the cause and remedy of drilling faults such as:-</p> <ol style="list-style-type: none"> a. drill breaking; b. drill coloured blue; c. walls of drilled hole left rough; d. chipped cutting lips. 	<ul style="list-style-type: none"> ▪ Show different types of drilling machines ▪ Make notes and drawings that will identify the various types of drilling m/cs. ▪ Prepare detailed notes and drawings that will describe the main features of a bench or pillar drilling machine. ▪ Solve many problems for students to practise. ▪ Prepare notes and drawings that will describe where each of the following drills are best suited ▪ Twist drill (taper shank, parallel shank, jobber drill and their relative merits), flat drill, counterbore drill and combination center drill. ▪ Assess the students. 	<ul style="list-style-type: none"> ▪ Bench drill ▪ Pillar drill. ▪ Twist drill, flat drill counter sink drill, counter bore drill combination centre drill. ▪ Ball peen hammers, mallet, cold chisels, dot/center punches, hacksaw and hacksaw blades ▪ Drilling machines and its accessories.

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	<p>4.9 State the safety precautions to be observed when using a drilling machine.</p> <p>4.10 Explain the purpose of reaming and describe different types of hand and machine reamers.</p> <p>4.11 Ream to given specification by hand and machine method.</p>		
General Objective 5.0: Understand the applications of various types of screw threads, rivet and cut screws by hand.			
7	<p>5.1 Sketch the thread forms below and state their applications:-</p> <p>a the ISO metric thread</p> <p>b the unified thread</p> <p>c Whitworth and British fine threads</p> <p>d British Association (BA) thread</p> <p>e British Standard pipe</p> <p>f Square thread</p> <p>g Acme thread</p> <p>h Buttruss thread.</p> <p>5.2 Sketch and state the functions of:-</p> <p>a taps (taper tap, second tap, plug)</p> <p>b tap wrench</p> <p>c die and die stock.</p> <p>5.3 Explain the meaning of tapping size or tapping drill and estimate its value in given situations using formulae such as:-</p> <p>$T = D - P$</p> <p>Where T = tapping diameter</p> <p>D = thread top diameter</p> <p>P = pitch</p> <p>5.4 State precautions to be taken when taping on the bench.</p>	<ul style="list-style-type: none"> ▪ Give detailed notes with diagrams that will show the various forms of thread and their uses. ▪ State the functions of taps, tap wrench, die and die stock . ▪ Demonstrate how to produce internal and external threads. ▪ Give detailed notes that will explain the meaning of tapping size or tapping drill and estimate its values using the formula: $T = D - P$ ▪ Where T = tapping diameter D = thread top diameter and P = Pitch ▪ Prepare notes that will state precautions to be taken when tapping on bench. 	<ul style="list-style-type: none"> ▪ Diagrams/charts of thread forms ▪ Parallel reamers taper reamers twist drills. ▪ Rivet sets
	<p>5.5 Describe and differentiate types of rivets. e.g. Snap and pan head, mushroom and counter-sunk head, flat head, dod rivet, etc.</p> <p>5.6 Sketch the rivet set and state its use.</p>	<ul style="list-style-type: none"> ▪ Give notes and diagrams that will describe and differentiate types of rivets, rivet sets, and its uses and guide to calculate the diameter of rivet and 	

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	5.7 Calculate the diameter of rivet and riveting allowance in given situations.	<ul style="list-style-type: none"> riveting allowance. ▪ Assess the students. 	
	General Objective 6.0: Understand the ISO tolerances and fits and its application in engineering production.		
8	<p>6.1 Differentiate between the following:-</p> <ul style="list-style-type: none"> a nominal size b limits (upper and lower) c tolerance (unilateral and bilateral) d fit (clearance, transition interference). <p>6.2 Explain the importance of tolerance and fit in engineering production and describe briefly the ISO system of limits and fits.</p> <p>6.3 Determine by calculation the amount of tolerance and types of fit in given situations.</p>	<ul style="list-style-type: none"> ▪ Give detailed notes that will differentiate between nominal size, limits, tolerance and fits. ▪ Prepare detailed note and diagrams that will explain the important of tolerance and fits in engineering production as well as describing the ISO systems of limits and fits. ▪ Give notes and explanations that will guide in calculating the amount of tolerance and types of fits in given situations. ▪ Assess the students. 	<ul style="list-style-type: none"> ▪ Charts on tolerances, limits and fits.
	General Objective 7.0: Produce simple Engineering Components on the bench. production		
9	<p>7.1 Explain layout procedures from working drawing of simple engineering components or tools such as:-</p> <ul style="list-style-type: none"> a open ended spanner b engineer's try square c tool maker's clamp d plate bracket or gusset (involving rounds, angles, holes) e centre square. <p>7.2 Explain how to produce any simple engineering component to given specifications including dimensions, tolerance and finish</p> <p>7.3 Explain how to carry out simple precision fitting project. e.g. hexagonal mild steel bar making push fit through a mild steel plate.</p>	<ul style="list-style-type: none"> ▪ Teachers to prepare notes and explanations to guide the students in producing simple engineering components as in 7.1 ▪ Assess the students. 	<ul style="list-style-type: none"> ▪ Lesson notes ▪ Diagrams and charts.

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General Objective 8.0: Understand the essential features and working principles of the centre lathe and use it to carry out basic operations such as plain turning, stepped turning, facing taper turning, chamfering, and under-cutting			
10	<p>8.1 Describe the essential features of a centre lathe and state their functions e.g lathe bed, headstock, tailstock, saddle or carriage, etc.</p> <p>8.2 Explain the working principles of the centre lathe.</p> <p>8.3 Identify and state the functions of centre lathe accessories such as: catch or driving plate, face plate, lathe dog or carrier, lathe centres, fixed and travelling steadies.</p> <p>8.4 Explain the difference between the centre lathe, capstan lathe, in terms, of their main features and functions.</p> <p>8.5 Name types of cutting fluids used for lathe turning operations and state their composition and purposes.</p> <p>8.6 Outline safety precautions to be observed when working on the lathe</p> <p>8.7 Sketch and describe common tools: e.g. butt-brazed tool, tipped tool, bit and holder. Note: Tool description should include tool materials e.g plain carbon steel, high speed steel, stellite, cemented carbide, diamond.</p> <p>8.8 Explain with sketches the functions of tool angles (rake, clearance), and state their values for different metals to be machined.</p>	<ul style="list-style-type: none"> ▪ Prepare detailed notes that will describe the essential features of center lathe and their functions. ▪ Give notes and diagrams that will explain the working principles of center lathe and functions of its accessories. ▪ Give explanations that will show the difference between center lathe and capstan lathe in terms of their main features and functions. ▪ Prepare notes that will list types of cutting fluid used for lathe turning operations and their composition and purposes. ▪ Prepare detailed notes and explanation that will outline safety precautions, common tools and materials used in marking them. ▪ Give detailed notes and diagrams that will explain the functions of tool angles, (rake, clearance) stating their values for different metals to be machined. ▪ Assess the students 	<ul style="list-style-type: none"> ▪ Centre lathe and accessories like catch plates, face plates, centers, fixed and traveling steadies. ▪ Charts of center lathe and capstan lathe. ▪ Round nose turning tool, finishing tool, site finishing, knife tool, form tool, parting off tool, and boring tool.
11-12	<p>8.9 Differentiate between various tool shapes and state their uses e.g. Round nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool, etc.</p> <p>8.10 Explain with sketches the effects of wrong setting of cutting tool: e.g vibration and chatter, tool rubbing against or digging into the job.</p> <p>8.11 Define cutting speed and feed with respect to lathe</p>	<ul style="list-style-type: none"> ▪ Give notes and diagrams of various tool shapes and their uses. ▪ Prepare detailed notes and explanations to cover 8.10 to 8.15 ▪ Solve many problems for the students practise. ▪ Assess the students 	<ul style="list-style-type: none"> ▪ Charts on tool height ▪ Charts and diagrams of different machining operations.

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	<p>operation.</p> <p>8.12 Calculate the cutting speed and feed for given turning operation.</p> <p>8.13 Estimate the rate of metal removal and time required for carrying out specified turning operations</p> <p>8.13 State precautions to be observed when turning between centres.</p> <p>8.14 Set up the lathe for and carry out basic turning operations between centres.</p> <p>8.15 Compute required taper dimensions from given data using taper ratio angle formulae i.e.</p> <p>Taper Ratio = $\frac{d2 - d1}{L}$</p> <p>OR</p> <p>$\frac{\tan \theta}{2} = \frac{d2 - d1}{2L}$</p> <p>where θ = taper angle d1 - small end diameter d2 = large end diameter L = length of taper</p>		
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NTC and ANTC Curriculum and Module Specifications in Foundry

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: CME 12 GENERAL METAL WORK II

PRE-REQUISITE: CME 11

DURATION: 60 HOURS (5 HOURS PER WEEK)

GOAL: The module is designed to introduce the trainee to basic processes in mechanical engineering such as forging, sheet-metal work and welding.

General Objectives:

On completion of this module, the trainee should be able to:

1. Understand the basic principles and processes of heat treatment of metal in the workshop.
2. Produce simple engineering components by forging.
3. Understand the basic principles and techniques of gas and metal arc welding and apply them in fabricating simple metal components.

PRACTICAL COMPETENCE:

On completion of this module students will be able to:

1. Carry out heat treatment of metal in the workshop
2. Produce simple engineering components by forging
3. Carryout gas/arc welding and apply them in fabricating simple engineering components

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PRACTICAL TASKS

WEEK	General Objective: 1.0 Heat Treatment		
	Specific Learning Outcome:	Teachers Activities	Resources
1-2	1.1 Carry out the following heat treatment processes Hardening, tempering, annealing, normalizing, case hardening on given plain carbon steel, engineering component or tool 1.2 Anneal copper, brass and aluminium for various purposes	<ul style="list-style-type: none"> ▪ Demonstrate heat treatment processes and explain the stages ▪ Demonstrate the annealing process on brass, copper and aluminium for various purposes. ▪ Assess the students. 	<ul style="list-style-type: none"> ▪ Furnace, Forge tongs
	General Objective: 2.0 Forging Processes		
3-4	2.1 Select appropriate forging tools and produce to specification given engineering components by forging processes a. Upsetting – drawing down b. Setting down – twisting c. Forge welding (scarf and splice welds) d. Bending, turning closed ring 5-8 e. Forming an eye	<ul style="list-style-type: none"> ▪ Demonstrate with appropriate forging tools how to produce some engineering components and let the student practice till they become competent ▪ Assess the students 	<ul style="list-style-type: none"> ▪ Anvil, swage block, leg vice, forging hammers, hot set, cold set, sets of hammer, punchers, drifts, fillers, top swage, bottom swage, flatter, open tongs, hallow bit
	General Objective: 3.0 Welding Processes		
9-12	3.1 Set up and operate gas or metal arc welding equipment in given situations. Note: Equipment operation should include choice of correct nozzles or electrode. Adjustment for correct gas pressure/flame or voltage 3.2 Prepare joints for welding in given situations 3.3 Weld given components by arc or gas welding methods, and state safety precautions to be observed	<ul style="list-style-type: none"> ▪ List and identify the gas and metal arc welding equipments ▪ Demonstrate the use of both gas and metal arc welding equipment; and all the students to practice ▪ Demonstrate to the students how to prepare joints for welding purposes ▪ Guide students to weld various components using both gas and arc welding processes and state safety precautions to students to practise till competent 	<ul style="list-style-type: none"> ▪ Oxygen and acetylene cylinders with regulations, arc welding equipment, goggles, shield, electrodes, diagrams and charts of various welding joints

Assessment: Practical – 60% of overall assessment

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL METAL WORK II		MODULE CODE: CME 12	CONTACT HOURS: 5 HRS/WK PER WEEK: T2, P3
MODULE SPECIFICATION: KNOWLEDGE REQUIREMENTS			
WEEK	General objective: 1.0 Understand the basic principles and processes of heat treatment of metal in the workshop		
	Specific Learning Outcome	Teacher Activities	Resources
1 - 4	<p>1.1 Explain briefly the structural behaviour of Plain Carbon Steel as it is heated from room temperature to about 1000°C</p> <p>a. Hardening b. Tempering c. Annealing d. Normalising e. Case-hardening</p> <p>1.2 Explain the meaning of hardening metal work. 1.3 Outline safety precautions relating to heat treatments processes and apply them to given situations.</p>	<ul style="list-style-type: none"> ▪ Prepare detail notes that will explain the structural behaviour of Plain Carbon Steel as it is heated from temperature to about 1000°C ▪ Prepare detail notes that will explain the meaning of hardening in metal work ▪ Prepare notes that will outline safety precautions relating to heat treatment processes. ▪ Assess the students. 	Recommended Textbooks and Lesson notes
	General Objective 2.0: understand the technique of producing simple engineering components by forging		
5 - 6	<p>2.1 Explain with outline sketch the main features and working principles of the blacksmith's forge. 2.2 Describe and state the functions of common forging tools, e.g anvil, swage block, leg vice,</p>	<ul style="list-style-type: none"> ▪ Prepare detail notes and diagrams that will explain the main features and working principles of the Blacksmith's forge. 	Diagrams of Forges and Forging tools.

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7 - 8	<p>forging hammers, hot and cold sets, set hammer, punches and drifts, hardie, fullers, top and bottom swages, flatter, tongs (open mouth, closed mouth, hollow bit, etc)</p> <p>Describe with sketches the following forging operations:</p> <ol style="list-style-type: none"> a. Upsetting b. Drawing c. Setting down d. Twisting e. Forge welding (scarf and splice welds) f. Bending g. Forming closed ring h. Forming an eye 	<p>Prepare notes and diagrams that will describe the functions of common forging tools</p> <ul style="list-style-type: none"> ▪ Prepare detail notes that will describe the following forging operations: upsetting, drawing down, setting down, twisting, forge welding, bending, forming closed ring and forming an eye ▪ Assess the students. 	
<p align="center">General Objective 3.0: Understand the basic principles and techniques of gas and metal arc welding and apply them in fabricating simple metal components.</p>			
9 - 12	<ol style="list-style-type: none"> 3.1 Describe the equipment and explain the basic principles and applications of gas and metal arc welding. 3.2 State the safety precautions to be observed and apply them in given welding situations. 3.3 Differentiate between various tool shapes and state their uses e.g round nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool etc. 	<ul style="list-style-type: none"> ▪ Prepare detail notes and diagrams that will describe the equipment and explain the basic principles and applications of gas and metal arc welding. ▪ Prepare diagrams of joints that the students will practice. ▪ Prepare detail notes that will state the safety precautions to be observed during welding. ▪ Assess the students. 	<ol style="list-style-type: none"> a. Oxygen and Acetylene cylinder with regulators. b. Arc welding set, Goggles, Shield, Electrodes c. Diagrams and charts of various welding joints and techniques.

Week 13 Examination – Practical 60%, Theory 40%

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MODULE: CWW 11: GENERAL WOODWORK

DURATION: 84 HOURS (7 HOURS PER WEEK)

GOAL: To introduce the trainee in timbers trades to the basic woodwork processes and materials.

General Objectives: On completion of this module the student will be able to:-

1. Understand and be able to apply general safety precautions in the wood workshop
2. Know common woodwork hand tools, equipment and their uses
3. Understand the basic process of timber preparation and be able to prepare timber to given size by hand
4. Mark out stock to given specifications
5. Understand how common portable electric power hand tools work and be able to use them safely for the preparation of stock for joinery and furniture work.
6. Understand the working principles of and be able to use task wood working machines to produce wood work items of all types.
7. Understand the principles of carcass construction and be able to apply them to produce box-like structure, car-case work in wood work.
8. Understand the principles of frame construction and to apply these to construct various wood work items.
9. Know the various materials used in wood work construction, their characteristics and applications.
10. Know common adhesives used in wood work, their preparation and applications.
11. Select common fittings and fastenings used in wood work and be able to fit them where necessary.
12. Understand the purpose of finishing wood item, the common materials used and their applications.

Student Outcome:

On completion of this module, the student will be able to:-

1. Comply with the general safety precautions in a wood workshop
2. Use wood work hand tools effectively.
3. Prepare timber to given sizes by hand
4. Mark out stock to given specifications
5. Make effective use of portable electric hand tools complying with safety precautions involved
6. Use basic wood working machine to perform some operations in wood work
7. Construct carcass and use them to produce box-like structure in wood work
8. Construct frames applying various principles in wood work projects
9. Prepare and apply common adhesive used in wood work.
10. Fit common fittings and fastenings used in wood work where necessary
11. Apply the appropriate finishing materials used in wood work to any given project.

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE			
Module: GENERAL WOODWORK		Module Code: CMW 11	Contact Hours:7hrs/wk Per week: T2, P3
Module Specification: Theoretical Content			
WEEK	General Objective: 1.0 Understand and be able to apply general safety precautions in the wood workshop		
	Specific Learning Outcome	Teacher's Activities	Resources
	<p>1.1 List sources of hazards in a wood workshop. e.g.</p> <ul style="list-style-type: none"> a Handling and using hand tools, power tools and machines; b Stepping on or striking obstructions left on the floor or bench; c Lifting, moving and storing materials or jobs; d Using inflammable liquids; e Inhaling vapour or fumes. <p>1.2 Identify how accidents can occur through the various items listed in 1.1. above</p> <p>1.3 Explain how accidents listed in 1.2 can be prevented.</p> <p>1.4 Name safety wears and equipment essential in a wood workshop and their application in working situation: shoes, non-flowing gowns, eye goggles, fire extinguishers and sand and water buckets.</p>	<ul style="list-style-type: none"> ▪ Explain the need to be safety conscious in the workshop. ▪ Name the basic provisions in a first aid box. Explain the use of fire extinguishers in the workshop. Introduce students to location of fire extinguishers and first aid box. ▪ students how to use them in case of emergency 	<ul style="list-style-type: none"> ▪ Charts and chalkboard illustrations. ▪ First aid kits ▪ Fire Extinguishers. ▪ Accident pictures/postures ▪ Basic tools obtainable in the wood workshop.
	<p>1.5 Know the safety rules relating to:</p> <ul style="list-style-type: none"> a Clothing and health hazards; b Workshop hygiene c Movement and other behaviour of workers in a workshop; d Materials handling; e Tool handling, storage and use; f Machine operation; g Fire <p>1.6 Understand appropriate procedures in the event of accident or danger in the workshop. Examples of procedures include:</p>	<ul style="list-style-type: none"> ▪ Demonstrate to students how to effect treatment in case of emergencies arising from these hazards. ▪ Give detailed account of appropriate procedures to be followed in the event of accident or danger in the workshop so as to achieve remedial measures. 	

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	<ul style="list-style-type: none"> a Application of first-aid to the victim; b Removal or rectification of the cause of accident; c Reporting the incident to the appropriate authority; <p>1.7 Keeping a record of accidents for use by the appropriate authority of the school or industry</p>		
General Objective 2.0 : Know common woodwork hand-tools, equipment and their uses.			
2	<p>2.1 Identify and state the application in woodwork of the following:</p> <ul style="list-style-type: none"> a Holding and supporting tools b Geometrical/marketing-out tools – try squares, dividers, gauges; c Planning tools – jack, smooth and try planes spoke shelves ,etc. d Cutting tools; <ul style="list-style-type: none"> i. Saws - hand, back, tenon, rip ii. Chisels – firmer, paring and mortice iii. Knives - marking knife iv. Boring - ratchet and wheel brace, bits, drills, and countersinks. d Impelling tools- hammer, mallet, etc. e Pneumatic tools – <p>2.2 State the safety precautions to be observed while using hand tools.</p> <p>2.3 Demonstrate proper procedure for maintenance of the tools by:</p> <ul style="list-style-type: none"> a Sharpening cutters b Cleaning and lubricating all tools before they are stored away. 	<ul style="list-style-type: none"> ▪ Name common woodworking tools ▪ Classify the tools into: Holding and supporting, cutting tools, etc. ▪ Identify the tools in each class. ▪ Sketch and name the parts of the tools. ▪ Give notes for students to copy. ▪ Explain the safety precautions to be observed in using hand tools. ▪ Discuss with examples the proper procedure for maintenance of the tools. 	<ul style="list-style-type: none"> ▪ Hand-tools ▪ Maintenance equipment e.g. Oil, Rags, brush etc. ▪ Lesson notes
3	General Objective 3.0: Understand the basic process of timber preparation and be able to prepare timber to given sizes by Hand		
	<p>3.1 Explain the principles of cutting wood to size using hand saws.</p>	<ul style="list-style-type: none"> ▪ List the tools used for timber preparation. ▪ List the steps involved e.g. marking-out, sawing, planning 	<ul style="list-style-type: none"> ▪ Chalk board ▪ Woodwork tools ▪ Materials (wood)

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		<ul style="list-style-type: none"> etc. ▪ Select tools appropriate to each step of the operations. 	
	General Objective 4.0: Mark-out stock to given specifications		
	<p>4.1 Interpret simple working drawings and sketches of projects in wood.</p> <p>4.2 Identify conventional representation for timber fastings, etc. on a drawing</p>	<ul style="list-style-type: none"> ▪ Teach students to make orthographic drawing of simple objects. ▪ Explain Working drawing and show examples. 	<ul style="list-style-type: none"> ▪ Drawing Equipments ▪ Marking out tools.
	General Objective 5.0: Understand how common portable electric power hand tools work and be able to use them safely for the preparation of stock for joinery and furniture work.		
5	<p>5.1 Describe the common portable electric power hand tools used in woodwork;</p> <ul style="list-style-type: none"> a Portable saw b Portable planer c Portable drill d Portable sander e Jig saw <p>5.2 Explain the operational principles of each of the tools listed in item 5.1 above Carry out various woodwork operations using the above named portable electric tools such as planing, sawing, mitring, drilling holes, sand papering, cutting circles, rebating, etc.</p>	<ul style="list-style-type: none"> ▪ Define Portable electric Power tools ▪ Present samples of Portable electric Power tools and explain the application of each. ▪ Identify the essential parts and demonstrate the machine operation. ▪ List portable electric Power tools 	<ul style="list-style-type: none"> ○ Portable electric Power Tools
6	General Objective 6.0: Understand the working principles of and be able to use basic wood-working machines to produce wood-work items of all types.		
	<p>6.1 Explain the purpose of machinery in wood-work</p> <p>6.2 List the basic woodworking machines</p> <p>6.3 Surface planing and thickening machine</p> <p>6.4 Circular sawing machines</p> <p>6.5 Mortising machine</p> <p>6.6 Drilling machine</p> <p>6.7 Single – ended tenoning machines</p> <p>6.8 Radial arm saw planing Machines</p> <ul style="list-style-type: none"> a Explain the working principles of planing machines using 	<ul style="list-style-type: none"> ▪ Explain the difference between Portable Electric Power tools and Woodwork Machines. ▪ Identify woodwork machines and state their uses. ▪ Identify the main parts of the Planning Machine. ▪ Explain related Safety 	<ul style="list-style-type: none"> ▪ Woodworking Machine Tools and accessories

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	<p>annotated single line diagram.</p> <p>b List the types of basic planning machines and their uses:</p> <p>(i) Surface/overhead planer for surfacing and edging;</p> <p>(ii) Thicknesser for thickening and widening</p>	Precautions	
7	<p>6.4 Drilling Machine (Drill Press)</p> <p>a Explain the working principles of a drilling machine.</p> <p>b Select the correct size of drill and install on chuck.</p> <p>c Explain the use of and be able to make simple jigs for repetitive drilling operation.</p> <p>6.5 Circular Sawing Machine</p> <p>a Explain the working principles of circular sawing machines.</p> <p>b List types of circular sawing machines and their specific uses:</p> <p>i. Cross cut saw</p> <p>ii. Rip saw</p> <p>iii. Dimension saw</p> <p>iv. Install a saw blade in a machine</p> <p>c Carry out the following operations with the circular sawing machines</p> <p>d ripping stock to width</p> <p>e cutting stock to length</p> <p>f mitring</p> <p>g rebating</p> <p>6.6 Mortising Machine</p> <p>a Explain the working principles of a mortising machine</p> <p>b Differentiate between a chain cutter and hollow chisel used in a Sanding Machine</p> <p>c Explain the working principles and uses of belt, disc and bobbing sanders.</p>	<ul style="list-style-type: none"> ▪ Identify the main parts of the specific machines explaining their functions and limitations. ▪ Remind students of the need to adhere to land down safety procedures in operating the machines. 	<ul style="list-style-type: none"> ▪ Machine, tools and accessories
General Objective 7.0: Understand the principles of carcass construction and be able to apply them to produce box-like structure, car-case work in wood-work			
8	<p>7.1 Explain the basic principles of carcass construction work;</p> <p>7.2 Sketch and state the uses of common car-case joints used in wood-work</p> <p>a Welding Joints</p>	<ul style="list-style-type: none"> ▪ Make sketches of angle joints on the chalk board. ▪ Exhibit Models of the common joints. 	<ul style="list-style-type: none"> ▪ Charts ▪ Chalk board ▪ Lesson notes.

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	<ul style="list-style-type: none"> b butt c dowel d tongues and groove e slot-screw joints f Angle Joints g mitre h lap joint i dovetail joint j through dovetail k lap dovetail l Intermediate Joints m housing joint n through housing o stop housing 	<ul style="list-style-type: none"> ▪ State possible areas of application of the joints. 	
General Objective 8.0: Understand the principles of frame construction and to apply these to construct various items of woodwork;			
9	<p>8.1 Explain the principles of frame construction:</p> <p>8.2 List factors that must be considered in frame construction:</p> <ul style="list-style-type: none"> a rigidity b jointing method c squareness of frame in all directions <p>8.3 Explain the principles of triangulation in relation to the rigidity of a square frame carcass;</p> <p>8.4 Explain the following frame joints by hand process:</p> <ul style="list-style-type: none"> a butt and dowel joint b mortice and tenon joints 	<ul style="list-style-type: none"> ▪ Make sketches of Framing joints. ▪ State their possible uses. ▪ Show models of the joints. ▪ . 	<ul style="list-style-type: none"> ▪ Lesson notes ▪ Chalk board ▪ Charts.
General Objective 9.0: Know the various materials used in woodwork construction, their characteristics and application.			
10	<p>9.1 Describe the growth of a tree from which timber is obtained, how it is felled; and cut into logs for sawmills.</p> <p>9.2 Classify timber into two – hardwoods and softwoods and explain the difference between the two classifications.</p> <p>9.3 State the main structural characteristics of hardwoods and softwoods.</p> <p>9.4 Define conversion and state its purposes.</p>	<ul style="list-style-type: none"> ▪ Present specimen of board leaves and spiky leaves e.g. Gmelina and whistling pine leaves. ▪ Present specimen of Hardwood and softwood. ▪ Use chalkboard and charts to 	<ul style="list-style-type: none"> ▪ Samples of materials ▪ Tools ▪ Lesson notes ▪ Chalk board

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	<p>9.5 Describe with annotated sketches how a log is converted to timber by the following methods: a through and through sawing b quarter sawing</p> <p>9.6 State the merits and demerits of each type of conversion method. Seasoning</p> <p>9.7 Explain what is meant by “seasoning”.</p> <p>9.8 State the purposes of seasoning</p> <p>9.9 Explain the difference between kiln seasoning and natural/air seasoning</p> <p>9.10 State the merits and demerits of each type of seasoning</p> <p>9.11 Describe the effect of proper stacking of boards on the seasoning of the timber, Timber Defects</p> <p>9.12 Identify and explain the causes of the following timber defects: Splits, warp, twist, casehardening, collapse, etc.</p> <p>9.13 Identify timber defects - fungus, (dry rot) white ants, wood borers and how they can be prevented.</p> <p>9.14 Identify the following Nigerian timbers – mahogany obeche, cedar, afara, abura, etc and their uses.</p> <p>9.15 Describe the characteristics of the timber listed in 9.14 in relation to their structural properties, grain, figure, colour and density.</p>	<p>illustrate methods of seasoning</p> <ul style="list-style-type: none"> ▪ Take the students to a local timber shade to see how timbers are stacked for air seasoning. ▪ Define defects in Timber. ▪ Illustrate types of defects using chalkboard and charts. ▪ Present sample of timber with defects. 	
	<p>9.16 Identify the types and the structural properties of common manufactured boards: Plywood, lamin-board, block board and chip board.</p> <p>9.17 State where each of the boards listed in 9.16 is used.</p> <p>9.18 State advantage of manufactured Boards over solid wood.</p>	<ul style="list-style-type: none"> ▪ Define: Manufactured boards ▪ Use diagram to ▪ Illustrate the cross section of each manufactured board. ▪ Present samples of: Plywood, Block board, chip board, etc. 	<ul style="list-style-type: none"> ▪ Materials ▪ Chalk board ▪ Lesson note, etc.
General Objective 10.0: Know common adhesives and in woodwork, their preparation and applications.			
	<p>10.1 Explain the principles of adhesion.</p> <p>10.2 Classify adhesives into interior and exterior types Interior: - animal, vegetable and thermoplastic glues (p.v.c.,</p>	<ul style="list-style-type: none"> • Explain some technical terms related to adhesives: e.g. Pot life, shelve life, etc. 	

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	<p>ponal,) Exterior - Phenol-formaldehyde (cascamite) epoxy resin (araldite)</p> <p>10.3 State the composition of the adhesives listed in</p>	<ul style="list-style-type: none"> • Explain the classification of adhesives into interior and exterior types giving examples as well as their different compositions. 	
12	General Objective 11.0: Select common fittings and fastenings used in wood-work and be able to fit them where necessary.		
	<p>11.1 Differentiate between fastening, holding and pulling: Fastenings:- Screws, nails, corrugated fasteners, bolts and nuts; Holding and pulling:- hinges, handles, locks, catches, stays, etc.</p> <p>11.2 Explain how fasteners are used to hold two parts together.</p> <p>11.3 State the properties of materials used for common fittings – brass, mild steel, aluminium, plastics, etc.</p>	<ul style="list-style-type: none"> ▪ Use chalkboard and charts or sketches to illustrate the use of common fittings e.g. Butt hinges etc. and fastenings e.g. locks. ▪ Explain the properties of the materials needed for fittings, brass, mild steel etc. 	<ul style="list-style-type: none"> ▪ Carmated fasteners ▪ Bottles and nails ▪ Hinges ▪ Lacks ▪ Nails ▪ Screws ▪ Lesson note ▪ Chalk board
	General Objectives 12.0: Understand the purpose of finishing wood item, the common materials used and their applications.		
	<p>12.1 Explain the purposes of finishing wood: hygiene, preservation, and aesthetics.</p> <p>12.2 Name and state the composition of common materials used for finishing wood surfaces: Sand paper, varnish, polish, and paint. Examination: Practical - 70% Theory - 30%</p>	<ul style="list-style-type: none"> ▪ Explain some finishing Terms e.g. job in the white, blooming, etc. ▪ Discuss the reasons for applying finishing operations in wood work 	<ul style="list-style-type: none"> ▪ Lesson note ▪ Chart. ▪ Samples of wood finishing materials as listed in learning outcome.

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE			
Module: GENERAL WOOD WORK		Module Code: CMW 10	Contact Hours: 7hrs/wk., Per week: T2:P5
Module Specification: Practical Content			
WEEK	General Objective 1.0: Use common wood working hand tools and machines to produce simple wood items observing necessary safety and operational procedures.		
	Special Learning Outcome	Teachers Activities	Resources
1-2	1.1 Select timber. 1.2 Saw timber to given length and width. 1.3 Plane timber to size following the proper sequence: a Plane the face side and mark. b Plane the face edge and mark. c Gauge to correct width and remove waste d Gauge to correct thickness and remove waste. e Plane one end. f Measure length with 1.3mm allowance; cut and plane to correct length.	<ul style="list-style-type: none"> ▪ Demonstrate to student the sawing and planning operations. ▪ Guide the students to carry out the sawing and planning operations. 	<ul style="list-style-type: none"> ▪ Timber. ▪ Tools. ▪ Drawings, etc.
3	2.1 Select tools for marking out . 2.2 Mark out stock to given specification.	<ul style="list-style-type: none"> ▪ Demonstrate marking out operation 	<ul style="list-style-type: none"> ▪ Marking out tools ▪ Materials
4-5	3.1 Carry out various wood work operations using appropriate electric power tools. 3.2 Apply all safety precautions. 3.3 Maintain the tools as appropriate.	<ul style="list-style-type: none"> ▪ Demonstrate to students the proper use of the respective electric power tools. 	<ul style="list-style-type: none"> ▪ Portable electric power tool. ▪ Timber material
	General Objectives 4.0: Wood working Machines		
	4.1 Produce templates or jigs as appropriate. 4.2 Select the right size of cutter and install as appropriate 4.3 Set up machines correctly and carry out operations as specified. 4.4 Apply relevant safety precautions. 4.5 Maintain machine properly after use by cleaning, greasing, etc.	<ul style="list-style-type: none"> ▪ Guide the students to carry out operations and maintenance on the specified wood working machine. 	<ul style="list-style-type: none"> ▪ Woodworking machine. ▪ Materials. ▪ Templates, etc. ...
	General Objective 5.0: Car-case Construction		
6 - 9	5.1 Use hand process to construct common joints used in carcass construction.	<ul style="list-style-type: none"> ▪ Guide the students to construct simple carcass 	<ul style="list-style-type: none"> • Tools. • Materials (timber).

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	5.2 Make wood –work items involving the use of carcass joints. 5.3 Test carcass for squareness. 5.4 Lip edges of manufactured boards using: veneer ; solid wood. 5.5 Make simple carcass mouldings.	items.	• Working drawing.
	General Objective: 6.0 Framed Construction		
10-12	6.1 Produce the following frame joints by hand process: a butt and dowel joint b mortise and tenon joint c mitre and feather joint 6.2 Prepare and apply adhesives OR 6.3 Select appropriate fasteners and fitting and fix on frame 6.9 Assemble frame. 6.10 Test the frame for squareness.	▪ Guide the students to produce joints assemble frame components and test frame for squareness.	- do -
13	Examination: Practical = 70%; Theory = 30%		

NTE and ANTE Curriculum and Module Specifications in Foundry

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY

MODULE: CFD 10: INTRODUCTION TO FOUNDRY

DURATION: 120 HOURS (10HOURS PER WEEK)

GOAL: This module is designed to introduce the trainee to the fundamental of foundry craft practice.

General Objectives

On completion of this module the trainee should be able to:

1. Understand the safety aspect of foundry work
2. Understand the working principles of common foundry tools and devices
3. Understand the principles, types and techniques of foundry work
4. Know foundry materials, their composition, properties and applications.

Student Outcome:

On completion of this module, the student will be able to

1. Comply with safety rules and regulations in foundry workshop
2. Effectively utilize common foundry tools and devices
3. Apply different principles, types and techniques in foundry operation
4. Identify foundry materials and their composition
5. Use foundry materials effective

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: INTRODUCTION TO FOUNDRY		MODULE CODE: CFD 10	CONTACT HOURS: 10 hrs//wk PER WEEK: T4, P6
MODULE SPECIFICATION: Underpinning knowledge			
WEEK	General Objective 1.0: Understand The General Overview Of Foundry Activities.		
	Specific Learning Objective:	Teacher Activities	Learning Resources
1	1.1 Define foundry 1.2 Differentiate between casting from other shaping methods e.g. forging, machining, welding and fabrication. 1.3 Describe foundry practice. 1.4 Explain the history of foundry development. 1.5 Explain the history of foundry practice.	<ul style="list-style-type: none"> ▪ Give explanation of the meaning of foundry ▪ Emphasis on Benin Bronze casting. ▪ The Nok, Igboukwu and Ife cultures. ▪ Demonstrate the procedure for a casting ▪ Give detailed explanation of the history of foundry development. ▪ Give explanation of the origin and development of foundry practice. 	<ul style="list-style-type: none"> ▪ Relevant literature and video tapes.
General Objective 2.0: Understand The Safety Aspect Of Foundry Work			
2	2.1 Explain the factory safety act as regards foundry practice. <ul style="list-style-type: none"> a the effect of excess noise in the shop. b adequate ventilation c lighting requirement d vision, glare, colour and colour contrast in the shop. 	<ul style="list-style-type: none"> • Ask students to explain the various safety requirement in the foundry. 	
	2.2 Identify the principle hazards in the foundry and associated areas: <ul style="list-style-type: none"> a. storage and handling of corrosive, toxic, silicostic and inflammable materials. b. dangers arising from melting, tapping, transfer and teeming of molten metal. c. Dangers associated with the misuse of mechanical, electrical, 	<ul style="list-style-type: none"> ▪ Ask students to identify the various dangers/areas in the foundry shop. 	

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	metallurgical, pneumatic and hydraulic foundry plants and appliances including conveyers and knockout systems.		
	d) Dangers associated with manual lifting, use of levers and other lifting tackles in the foundry and pattern making shop. e) Dangers associated with shop cleanliness, benches, gangways and the shop floor. f) Dangers of obstruction and disposal of shop refuse.		
	2.3 Use of protective equipment in the foundry shop. a The use of barrier cream and cleaning agents, safety boots, respirators, first aid, goggles, hand gloves, helmets, aluminised aprons and foot sprats etc. b The danger of incorrect clothing at work place.	<ul style="list-style-type: none"> ▪ Demonstrate the effective use of protective safety wears. 	
	General Objective 3.0: Understand The Working Principles Of Common Foundry Tools And Devices.		
3	3.1 Identify the various foundry tools and devices. a Flask b Trowels c Cope d Dowel pin e Drag f Sprue pin g Draw spike h Board i Crucible j Rammers k Riddles l Vent wires m Strickle bar n Pattern o Bellow p Swaps q Brushes, Cleaners and others	<ul style="list-style-type: none"> ▪ Guide the students in identification of various foundry tools and devices listed in 3.1 based on their uses 	<ul style="list-style-type: none"> ▪ Listed tools and devices to be made available.

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	3.2 Understand the application of 3.1 above	<ul style="list-style-type: none"> ▪ Ask the student to describe the application of 3.1 above. 	
General Objective 4.0: Understand The Principles, Types And Techniques Of Foundry Works.			
4	<p>4.1 Explain the principles and techniques of foundry works:</p> <p>a Hand moulding</p> <p>b Machine moulding</p> <p>c Die casting</p> <p>d Centrifugal castings and other casting methods.</p> <p>4.2 State the classes and types of foundry work.</p> <p>4.3 State the advantages and disadvantages of foundry practice in 4.1 above.</p>	<ul style="list-style-type: none"> ▪ Ask student to differentiate between hand moulding and machine moulding. ▪ Die casting and centrifugal casting and other casting methods. ▪ Emphasis on jobbing, repetitive and captive foundries. ▪ Ferrous and non-ferrous foundries. ▪ Ask student to list the advantages and disadvantages of 4.1 above. 	<ul style="list-style-type: none"> ▪ Hand moulding tools, moulding machines and casting equipment. ▪ As in 4.1 above.
General Objective 5.0: Know Foundry Materials, Their Composition, Properties And Applications.			
5	5.1 Describe foundry engineering, materials, their chemical symbols, boiling, melting and pouring points and their relative densities.	<ul style="list-style-type: none"> ▪ Ask students to list out: ▪ Foundry materials and their following properties: ▪ Chemical symbols <ul style="list-style-type: none"> • Boiling, melting and pouring temperatures ▪ Densities of various metals. 	<ul style="list-style-type: none"> ▪ Charts and tables.
	5.3 Identify and describe simple alloy composition of foundry metals., e.g.)	<ul style="list-style-type: none"> ▪ Emphasis on non-ferrous and ferrous metals, alloy composition. ▪ Ask student to identify the areas of application of various alloy metals. 	<ul style="list-style-type: none"> ▪ Charts and tables.
	<p>a Brass and Bronze alloys</p> <p>b Grey cast iron</p> <p>c Bearing steel</p> <p>d Gun metal</p> <p>e Steel</p> <p>f Aluminium</p>		

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	g Phosphor bronze etc.		
	5.3 State the properties of metals used for foundry e.g a Strength b Ductility c Hardness d Malleability e Brittleness f Impact resistance g Creep etc.	<ul style="list-style-type: none"> ▪ Ask student to describe the various properties of metals. ▪ Emphasis on ferrous and non-ferrous metals and areas of application. 	
	5.4 State the advantages and disadvantages of the materials mentioned in 5.2 above.	<ul style="list-style-type: none"> ▪ Student to state the merits and demerits of alloys mentioned in 5.2 above. 	

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MODULE: INTRODUCTION TO FOUNDRY		MODULE CODE: CFD 10	Contact Hours: 10hrs/wk Per week: T4, P6
Module Specification: Practice			
Week	General Objective 1.0: Understand The General Overview Of Foundry Activities.		
	Specific Learning Outcome:	Teacher Activities	Learning Resources
6	1.1 Identify and demonstrate the principle hazards in the foundry and associated areas: a Storage and handling of corrosive, toxic, silicostic and inflammable materials. b Dangers arising from melting, tapping, transfer and teeming of molten metal. c Explain the dangers associated with the misuse of mechanical, electrical, metallurgical, pneumatic and hydraulic foundry plants and appliances including conveyers and knockout systems.	<ul style="list-style-type: none"> ▪ Ask students to identify the various dangerous areas in the foundry shop. 	<ul style="list-style-type: none"> ▪ Foundry workshop. Broken tools, hazards etc.
7-8	1.2 Demonstrate the use of protective equipment in the foundry shop. a The use of barrier cream and cleaning agents, safety boots, respirators, first aid, goggles, hand gloves, helmets, aluminised aprons and foot sprats etc. b The danger of incorrect clothing at work place.	<ul style="list-style-type: none"> ▪ Demonstrate the effective use of protective safety wears. Students to demonstrate awareness in the task below already discussed. 	<ul style="list-style-type: none"> ▪ All items listed in objective
9	1.3 Identify the various foundry tools and devices. a Flask b Trowels c Cope d Dowel pin e Drag f Sprue pin g Draw spike h Board i Crucible j Rammers	<ul style="list-style-type: none"> ▪ Ask students to use the foundry tools and devices listed in objective 1.3 	<ul style="list-style-type: none"> ▪ Tools and devices to be made available.

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	<p>k Riddles l Vent wires m Strickle bar n Pattern o Bellow p Swaps q Brushes, Cleaners and others</p>		
10 - 13	<p>1.4 Demonstrate the use of simple hand tools and devices to produce a simple sand mould,, observing safety rules and regulations.</p>	<ul style="list-style-type: none"> ▪ Ask the students to practice until competent. ▪ All objectives above should be considered in this practical activity ▪ Assess the students 	<ul style="list-style-type: none"> ▪ Foundry raw material, hand tools and devices.

NTC and ANTC Curriculum and Module Specifications in Foundry

Programme: National Technical Certificate in Foundry

Module : CFD11: Pattern making.

Pre-requisite: CME11 & 12 and CMW 11 & 12

Duration: 180 hours (15 hours per week)

Goal: This module is designed to provide the trainees with the competence and underpinning knowledge to enable them to make simple patterns using basic tools and machinery.

Learning objectives: On completion of this module the student will be able to:

1. Understand different types of patterns
2. Understand the working principles of common pattern making tools and apply them to make simple patterns
3. Know and select materials for pattern making
4. Understand the safety aspects of pattern making
5. Know various devices used in pattern making and apply them as appropriate
6. Understand the effect caused by incorrect pattern and mould box equipment
7. Produce pattern to a given specification

Student outcome:

On completion of this module, the student will demonstrate the following practical competencies:

To produce pattern to a given specification using appropriate tools and materials in one piece flat back pattern, split pattern

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: PATTERN MAKING		MODULE CODE: CFD 11	CONTACT HOURS: 15hrs/wk PER WEEK: T6, P9
MODULE SPECIFICATION: Underpinning knowledge			
WEEK	General Objective 1.0: Understand Different Types Of Patterns		
	Specific Learning Outcome	Teacher/Activities	Resources
1	1.1 Explain the principles and techniques of pattern making. 1.2 State the uses of pattern in foundry work. 1.3 State the characteristics of pattern giving examples e.g solid patten, split pattern, loose pattern etc. 1.4 Explain the terms: a Flask, b Cope, c Drag, d Draft, e Taper, f Shrinkage, g Follow-board, h etc. 1.5 Draw a simple pattern.	<ul style="list-style-type: none"> ▪ Ask students to: ▪ Define pattern. ▪ Describe principles and techniques of pattern making. ▪ Illustrate the uses of pattern in the foundry. ▪ Ask students to: ▪ Explain solid pattern, split pattern, loose pattern etc. ▪ Use questions and answers to explain the terms, listed in the objective 1.4 ▪ Ask student to draw simple pattern. 	<ul style="list-style-type: none"> ▪ Relevant texts. ▪ As above. ▪ Ditto ▪ Ditto ▪ Drawing instruments and materials.
	General Objective 2.0: Understand the working principles of common pattern making tools and apply them to make simple patterns.		
2	2.1 Explain the working principles of: a Vernier caliper b Barrel protractor c Set square d Auger timing machine e Timing chisel f Contraction rule g Bandsaw h etc 2.2 State the application of each of the tools in 2.1 above 2.3 Use and maintain the tools listed in 2.1 above to produce simple patterns	<ul style="list-style-type: none"> ▪ Demonstrate the working principles of the items listed in objective 2.1 ▪ Ask students to state characteristics of all the tools. ▪ Ask students to produce simple patterns using the tools. 	<ul style="list-style-type: none"> ▪ Items of equipment, as shown in the list. ▪ Tools to be made available.

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	General Objective 3.0: Know And Select Materials For Pattern Marking.		
3	<p>3.1 Identify pattern making materials e.g</p> <p>A Wood - mahogany</p> <p> i. Obeche</p> <p> ii. Iroko etc</p> <p>B Metal - iron</p> <p> i. Brass</p> <p> ii. Aluminium, etc</p> <p>C Plastics</p> <p>D Plaster of Paris</p> <p>E Wax</p> <p>F Chemical resins etc.</p> <p>3.2 State the characteristics and the properties of pattern making materials in 3.1 above.</p>	<ul style="list-style-type: none"> ▪ Ask students to identify the materials. ▪ Ask students to state the advantages and disadvantages of the pattern making materials. 	<ul style="list-style-type: none"> ▪ Provision of pattern materials.
	General Objective 4.0: Under Stand The Safety Aspects Of Pattern Making.		
4	<p>4.1 Explain the factory safety acts as regards pattern making workshop.</p> <p>4.2 Observe safety regulations:</p> <p>a. See that all the files being used are fitted with handles.</p> <p>b. Use only the tools authorised for pattern making.</p> <p>c. Wear safety goggles when using the grindstone.</p> <p>d. Keep the edge of cutting tools sharp.</p> <p>e. Avoid using hammers with loose heads or split handles.</p> <p>f. Wear an overall or apron.</p> <p>g. Keep the gang ways and floor clear and clean.</p> <p>h. Wear appropriate safety boot in the workshop.</p> <p>i. Avoid using cold chisels or punches that have mushroom heads,</p> <p>j. Grind and clean them before use.</p>	<ul style="list-style-type: none"> ▪ Use question and answer to test students on the factory safety acts. ▪ Ask students to explain the importance of safety in the pattern shop. 	<ul style="list-style-type: none"> ▪ Factory safety acts. ▪ Safety regulations and safety wears.
	General Objective. 5.0: Know Various Devices Used In Pattern Making And Apply Them As Appropriate.		
5	<p>5.1 Identify various devices used in pattern making e.g</p> <p>a Bench vice</p> <p>b Wood clamp</p> <p>c Template</p>	<ul style="list-style-type: none"> ▪ Ask students to identify various devices and differentiate them between tools. ▪ Ask students to state the 	<ul style="list-style-type: none"> ▪ Workshop devices. ▪ As above.

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	<p>d Marking out table e Rapping and lifting plate f Slings g Dowel pins h Numbering punch.</p> <p>5.2 List the advantages and disadvantages of the devices in 5.1 above.</p>	<p>advantages and disadvantages of the devices in 5.1 above.</p>	
General Objective 6.0: Understand The Defects Caused By Incorrect Pattern And Mould Box Equipment			
6	<p>6.1 Explain the defects caused by:</p> <p>a Pattern e.g. i. mismatch, ii. fins, iii. strain etc. a Mould box i. mismatch ii. crush.</p>	<ul style="list-style-type: none"> ▪ Ask student to identify and differentiate the different defects caused by: ▪ Pattern ▪ Mould box 	<ul style="list-style-type: none"> ▪ Available relevant text.
General Objective 7.0: Produce Pattern To A Given Specification.			
7	<p>7.1 Recognise tools, select suitable materials and produce different types of patterns e.g. a One piece flat back b Split pattern and c Produce a good finished surfaces.</p> <p>7.2 Carry out pattern arrangement and layout on plates for moulding.</p> <p>7.3 Carry out calculations relating to pattern and casting weights estimation and cost, contraction allowances etc, using simple mathematical symbols.</p>	<ul style="list-style-type: none"> ▪ Ask students to produce different patterns using suitable tools and materials e.g one piece flat black split pattern ▪ Ask students to perform pattern arrangement and layout on plates for moulding. ▪ Guide students in carrying out relevant calculations. 	<ul style="list-style-type: none"> ▪ Pattern making tools equipment and materials. ▪ Pattern plates and moulding machines.

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: PATTERN MAKING		MODULE CODE: CFD 11	CONTACT HOURS: 15hrs/wk PER WEEK: T6, P9
MODULE SPECIFICATION: Practice			
WEEK	General Objective 1.0: Demonstrate Competence In Pattern Making		
	Specific Learning Objective	Teacher/Activities	Resources
8-12	<p>Draw a simple pattern Know and select materials for pattern making. Make simple patterns. Use and maintain the tools listed to produce simple patterns Observe safety regulation:</p> <ol style="list-style-type: none"> See that all the files being used are fitted with handles. Use only the tools authorised for pattern making. Wear safety goggles when using the grindstone. Keep the edge of cutting tools sharp. Avoid using hammers with loose heads or split handles. Wear an overall or apron. <p>Carry out pattern arrangement and layout on plates for moulding.</p>	<ul style="list-style-type: none"> ▪ Ask the students to draw simple pattern. ▪ Identify and select materials for pattern making. ▪ Ask students to produce simple patterns using the tools. ▪ Teacher to set up workshop with hazards and students to identify hazards. ▪ Teacher to demonstrate correct use of tools ▪ Teacher to demonstrate and students to perform pattern arrangement and layout on plates. 	<ul style="list-style-type: none"> ▪ Drawing instruments and materials. ▪ Provide appropriate drawing materials ▪ Provide materials for pattern making ▪ Tools to be made available. ▪ Safety regulation and safety wears. ▪ Faulty tools. Workshop set out with hazards ▪ Pattern plates and moulding machines.

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Programme: National certificate in foundry:
Module CFD12 :Core making
Duration 168 hrs (14 hours per week)

Goal: This module is intended to provide the trainee with the competence and underpinning knowledge to operate and maintain different types of core making tools and equipment and be able to produce good cores for foundry work.

General objectives:

On completion of this module, the trainee will be able to

1. Understand the types of cores, methods of production and techniques of producing good cores.
2. Understand various processes of core making including bonding materials
3. Understand the essential features and working principles of core making machines (equipment) for mixing sand, drying and manipulation of cores.
4. Be able to use simple calculations involving core sand preparation and compaction.

Student outcome:

On completion of this module the student will demonstrate the following practical competencies:

To produce cores using

1. Core box process
2. Extrusion process
3. Core blowing process

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: CORE MAKING		MODULE CODE: CFD 12	CONTACT HOURS: 14 HRS/WK PER WEEK, T6:P8
MODULE SPECIFICATION: Underpinning knowledge			
WEEK	General Objective 1.0: Understand the types of cores, methods of production and the techniques of producing good cores.		
	Specific Learning Outcome	Teacher/Activities	Learning Resources
1	1.1 Explain the types of cores a Air-set b Shell c CO ₂ d Oil sand (use of Linseed oil) 1.2 Recognise designs for core production.	<ul style="list-style-type: none"> ▪ Ask students to define and explain different types of cores. ▪ Ask students to recognise core designs. 	<ul style="list-style-type: none"> • Materials for core making.
General Objective 2.0: Understand various processes of core-making including bonding of materials.			
2-3	2.1 Describe the types of core-making processes e.g: a Core box system b Extrusion system c Core blowing system d Core shooting system e Shell moulding core system etc.	<ul style="list-style-type: none"> ▪ Ask the students to describe core-making processes. 	<ul style="list-style-type: none"> ▪ Core boxes, ▪ Core-making ▪ Machines and ▪ Core materials.
	2.2 Describe materials for core bonding: a Sodium silicate b CO ₂ c Linseed oil d Cereal e Resin f Clay g Molasses h Cement i Starch 2.3 Take precautions against Linseed oil and the fast drying agent.	<ul style="list-style-type: none"> ▪ Ask students to differentiate the various core binders. ▪ Emphasize curing temperature range. ▪ Demonstrate the basic reactions arising from these processes. 	<ul style="list-style-type: none"> ▪ Core binders. ▪ Core materials and equipment.

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	2.4 Explain the basic chemistry of core making: a CO ₂ process b Air-set processes.		
	General Objective. 3.0: Understand the essential features and working principles of core-making machines (equipment) for mixing sand, drying and manipulation of cores.		
4	3.1 Explain the essential features and working principles of: a Mixing machines b Extrusion machines c Core blowing machines d Shell core machines e Continuous mixer machine dispenser.	<ul style="list-style-type: none"> ▪ Ask students to explain the working principles of core making machines. 	<ul style="list-style-type: none"> ▪ Core making machines.
	3.2 Explain general properties of sand used in core-making: a Porosity b Adhesiveness or bonding c Refractoriness d Moisture contents e Fineness etc.	<ul style="list-style-type: none"> ▪ Ask students to describe various properties of core sand. 	-Ditto-
	General Objective 4.0: Understand simple calculations involving core sand preparation.		
	4.1 Carry out simple calculations involving ingredients for mixing volumes used for moulding, test results, losses etc.	<ul style="list-style-type: none"> ▪ Ask students to perform simple calculations involving sand composition e.g base sand, additions, binders etc. 	-Ditto-

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: CORE MAKING		MODULE CODE: CFD 12	CONTACT HOURS: 14hrs/wk PER WEEK: T6,P8
MODULE SPECIFICATION: Practice			
WEEK	General Objective 1.0: Understand the types of cores, methods of production and the techniques of producing good cores.		
	Specific Learning Outcome	Teacher/Activities	Learning Resources
6-7	1.1 Carry out tests such as: a. Moisture content, b. Silica and clay content c. Shatter index d. Dry strength e. Permeability f. Green strength g. Sieve tests for build up of fineness.	<ul style="list-style-type: none"> ▪ Teacher to demonstrate and students to perform various tests using relevant equipment. 	<ul style="list-style-type: none"> ▪ Sand testing equipment.
8-9	1.2 Explain various types of cores e.g a. Cover cores b. Blind cores c. Wing cores d. Hanging cores e. Self cores f. Core assembly 1.3 Carry out core-making using any of the processes in above.	<ul style="list-style-type: none"> ▪ Demonstrate the use of corebox equipment. ▪ Ask students to identify various types of cores. ▪ Ask students to produce cores of any of the type above. 	<ul style="list-style-type: none"> ▪ Corebox. ▪ Materials for core making and coreboxes. ▪ As above.
10-11	1.4 Carry out tests on finished cores: a Permeability b Green and Dry compressive strength c Green and Dry hot deformation d Shatter index.	<ul style="list-style-type: none"> ▪ Teacher to demonstrate the procedures/ students to perform the tests using the relevant equipment. 	<ul style="list-style-type: none"> ▪ Permeability tester, green and dry compression equipment, shatter index machine.
12	1.5 Operate core making machines mentioned in 3.1 above and observe safety precautions.	<ul style="list-style-type: none"> ▪ Demonstrate the operation of these machines. ▪ Emphasize on maintenance and safety precautions. 	<ul style="list-style-type: none"> ▪ Relevant core making machines see 3.1

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Programme: National technical certificate in foundry

Module: CFD13 Moulding process.

Duration: 180 hours (15 Hours per week)

Goal: This module is designed to provide the trainee with the competence to produce good moulds under specified condition.

General objectives:

On completion of this module, the trainee will be able to:

1. Understand the use and method of production of moulds using various types of moulding equipment.
2. Understand and operate essential equipment and machines used in moulding
3. Understand the importance of facing and dressing of moulds and carry out facing and dressing of moulds using appropriate materials for the various metals.
4. Understand and apply the principle of post-casting knocking including cleaning and fettling.
5. Understand the various defects caused by incorrect moulding, core making and gating.

Student outcomes:

On completion of this module the trainee will demonstrate the following practical competence

1. Carry out sand tests and use moulding tools and features to provide moulds in
2. Open cast moulds
3. Cope and drag moulds
4. Pit moulds

Produce moulds using the following moulding machines:

1. Hand moulding machines
2. Jolt moulding machines
3. Squeeze moulding machine
4. Jolt and squeeze moulding machine.
5. Sand slinger moulding machine

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: MOULDING PROCESS		MODULE CODE: CFD 13	CONTACT HOURS: 15HRS/WK Per week: T6, P9
MODULE SPECIFICATION: Underpinning knowledge			
WEEK	General Objective: 1.0 Understand various types of moulds, the uses various techniques and methods of production.		
	Specific Learning Outcome:	Teacher's Activities	Learning Resources
1	1.1 Explain the types, the techniques and the methods of moulding. 1.2 Explain general properties of sand used in moulding: a Moisture content b Green and dry compressive strength c permeability d Shatter index e Refractoriness f Grain size etc. 1.3 Explain the use of moulding fixtures: a Springs b Studs c Chaplets d Gagers e Reinforce wires etc.	<ul style="list-style-type: none"> ▪ Ask students to explain techniques and method of moulding. ▪ Ask students to describe the properties of sand used in moulding and the use of testing equipment. ▪ Ask students to describe and apply the use of moulding fixtures. 	<ul style="list-style-type: none"> ▪ Relevant texts. ▪ Sand testing equipment. ▪ Moulding fixtures.
	1.4 Carry out simple calculations relating to liquid and metal static pressure and force. 1.5 Explain the needs for good clamping and weighting of moulds before casting.	<ul style="list-style-type: none"> ▪ Demonstrate simple calculations involving upward force, downward force, and side forces on moulds. ▪ Emphasise the importance of clamping and weighting of moulds. 	<ul style="list-style-type: none"> ▪ Relevant texts.
	General Objective 2.0: Understand and operate essential equipment and machines used in moulding		
2	2.1 Make simple sketches of essential moulding machines. 2.2 Explain the working principles of: a Hand moulding machines	<ul style="list-style-type: none"> ▪ Ask students to describe the moulding machines by the use of sketches. ▪ Ask the students to distinguish between the moulding machines. 	<ul style="list-style-type: none"> ▪ Moulding machines. ▪ As above.

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	<ul style="list-style-type: none"> b Jolt moulding machines c Squeeze moulding machine d Jolt and squeeze moulding machines e Sand slinger. 		
General Objective 3.0: Understand the importance of facing and dressing the mould, carry out facing and dressing of moulds using appropriate materials for various metals.			
3	<p>3.1 Explain the importance of facing and dressing of moulds.</p> <p>3.2 Explain and apply the knowledge of the following properties of sand in the selection of dressing materials.</p> <ul style="list-style-type: none"> a Roughness b Fineness c Moisture content d Viscosity e Penetration f Suspension etc <p>3.3 Assess finished surfaces.</p>	<ul style="list-style-type: none"> ▪ Ask the students to describe the importance of facing and dressing of moulds. ▪ Ask students to explain the effect and implication of these properties on mould facing and dressing. ▪ Emphasise the need for good mould surface finish. 	<ul style="list-style-type: none"> ▪ Facing and dressing materials. ▪ As above.
General Objective 4.0 Understand and apply the principle of post-casting knocking including cleaning and fettling.			
4-5	<p>4.1 Carry out knock-out operations by manual and mechanical means (use of intermittent and vibrating grits).</p> <p>4.2 Recognise and avoid the dangers of premature knock-out.</p> <p>4.3 Observe all safety measures involved in knock-out, cleaning and fettling operations.</p>	<ul style="list-style-type: none"> ▪ Ask student to perform knock-out operations by manual and mechanical means. ▪ Emphasise on the effects of premature knock-out. ▪ Ask students to adopt safety measures applicable to knock-out, cleaning and fettling operations. 	<ul style="list-style-type: none"> ▪ Knock-out grits. ▪ Safety wears.
General Objective 5.0 Understand the defects caused by incorrect moulding, core making and gating.			
	<p>5.1 Explain the defects caused by incorrect:</p> <ul style="list-style-type: none"> a Moulding <ul style="list-style-type: none"> i. mismatch ii. crush iii. swelling etc. 	<ul style="list-style-type: none"> ▪ Ask student to identify, describe and differentiate between various defects caused by 5.1 (a),(b) & (c). 	

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	<ul style="list-style-type: none">b Core making<ul style="list-style-type: none">i. variation in wall thickness of castingii. blows.iii. scabbing etc.c Gating<ul style="list-style-type: none">i. slag inclusionii. short runiii. sand inclusioniv. misrun, etc.		
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NTC and ANTC Curriculum and Module Specifications in Foundry

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: MOULDING PROCESS		MODULE CODE: CFD 13	CONTACT HOURS: 15HOURS/WK PER WEEK, T6, P9
MODULE SPECIFICATION: Practice			
WEEK	General Objective 1.0: Understand various types of moulds, the uses of various techniques and methods of production.		
	Specific Learning Outcome:	Teacher/Activities	Learning Resources
6-7	1.1 Make open and closed moulds. 1.2 Make pouring cups, bushes basins, down sprues and sumps, simple slag arrester and simple runners and gates e.g - Connor block - Horn horse shoe - Pencil and knife - Bottom gating - Top gating etc. 1.3 Make simple sketches of moulding arrangement.	<ul style="list-style-type: none"> ▪ Demonstrate the production of: ▪ open mould ▪ cope and drag mould ▪ pit mould. ▪ Demonstrate the application of these to mould production. ▪ Illustrate moulding arrangement by use of sketches: ▪ two parts moulds ▪ three parts moulds etc. 	<ul style="list-style-type: none"> ▪ Moulding tools. ▪ Availability of simple mould devices and materials. ▪ Drawing materials and instruments.
8-9	General Objective 2.0 Understand and operate essential equipment and machines used in moulding..		
	2.1 Operate moulding machines of all types as in 2.2 above. 2.2 Maintain and take care of all moulding equipment in use.	<ul style="list-style-type: none"> ▪ Teacher to demonstrate use of equipment. Students to practice till competent ▪ Demonstrate the operation of moulding machines. ▪ Emphasise the importance of maintaining the moulding equipment. 	<ul style="list-style-type: none"> ▪ Moulding machines ▪ As above.
	General Objective 3.0: Produce moulds using any of the moulding machines taking care of the facing and dressing of the moulds.		
10	3.1 Apply plumbago, blacking, lampblack, talc, refractory materials Aluminium and Telurium paint, resinous coatings and inhibitors as facing materials.	<ul style="list-style-type: none"> ▪ Ask students to carry out facing and dressing application using appropriate materials of the prepared moulds. 	<ul style="list-style-type: none"> ▪ As above, as well as the appropriate facing and dressing materials.

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General Objective 4.0 Remove gates, feeders, risers and fins from ferrous and non-ferrous castings			
11-12	<p>4.1 Use tumble barrels, shot blast cabinet and hydro blasts.</p> <p>4.2 Employ cranes, hoists, skips, pallets folk-lifts and conveyors for conveying finished products.</p>	<ul style="list-style-type: none"> ▪ Ask students to describe and perform fettling operation using appropriate tools. ▪ Ask students to differentiate the use of tumble barrel shot blast cabinet and hydro blasts ▪ Ask students to describe the various methods of handling finished products. 	<ul style="list-style-type: none"> ▪ Fettling tools and equipment ▪ Tumble barrel shot blasting machine and hydro blasts. ▪ Handling equipment.

NTC and ANTC Curriculum and Module Specifications in Foundry

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY
MODUE: CFD 14: MELTING, MOLTEN METAL HANDLING AND TREATMENT
DURATION: 240 HRS (120 HOURS PER TERM AT 10 HOURS/WEEK)
GOAL: The module is intended to provide the trainee with the knowledge and skill to operate all type of furnaces during melting of metals.

General Objectives

On completion of this module, the trainee should be able to:

1. Maintain and operate common foundry melting furnaces
2. Understand the principles of heat treatment and the effect of heat on materials
3. Understand defects caused by molten metal

Student Outcome

On completion of this module, the student will be able to:

1. Describe, use and maintain common foundry melting furnaces
2. Explain the principles of heat treatment and the effect of heat on materials
3. Explain the various defect caused by molten metal.

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: MELTING MOLTEN METAL HANDLING AND TREATMENT		MODULE CODE: CFD 14	CONTACT HOURS: 10 HRS/WK PER WEEK: T4, P6 (YR 3, TERM 2)
Module Specification: Underpinning Knowledge and practical			
Week	General Objective 1.0: Maintain and operate common foundry melting furnaces.		
	Specific Learning Outcome	Teacher's Activities	Resources
1-3	1.1 Describe the construction and function of different furnaces mentioned in 1.1 of CFD 14 practical and their operational sequence. 1.2 Distinguish melting losses and gains and be able to effect them by adding and removing during charge preparations.	<ul style="list-style-type: none"> ▪ Ask students to describe the construction and functions of different furnaces. ▪ Ask students to list the operational sequence of each of the furnaces. ▪ Emphasise the losses and gains in charge make up. 	<ul style="list-style-type: none"> ▪ See 1.1 of CFD 14 practical.
	General Objective 2.0: Understand the principles of heat treatment and the effect of the heat on materials		
4 - 8	2.1 Carry out basic mathematical calculations involving:- a Expansion of metals b Contraction of metals c Specific heat d Melting point e Freezing point f Latent heat. 2.2 Apply heat transfer process, temperature gradient and heat diffusibility, its application to solidification and furnaces. 2.3 Explain thermal efficiency and its application in foundry work. 2.4 Describe the effect of metallostatic pressure on casting process e.g a Bursting b Leakage (run out)	<ul style="list-style-type: none"> ▪ Ask student to perform simple calculation involving the effect of heat on metals. ▪ Ask student to describe the major methods of heat transfer, (conduction, convection and radiation). ▪ Temperature gradient. ▪ Diffusion and diffusibility. ▪ Emphasis on the effect of thermal efficiency in melting. ▪ Emphasis on the effect of forces of molten metal on moulds during casting. 	<ul style="list-style-type: none"> ▪ Relevant text. ▪ Relevant texts. <p align="center">- Ditto -</p>

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	2.6 Explain the effect of heat treatment on castings: a Normalising b Annealing c Tempering etc.	<ul style="list-style-type: none"> ▪ Ask student to differentiate between the heat treatment methods. 	<ul style="list-style-type: none"> ▪ Heat treatment and temperature measuring instruments.
General Objective 3.0: Understand defects caused by molten metal.			
9 - 12	3.1 Student to know the various defects resulting from molten metal: a A mismatch b A misrun c Cold laps d A crush e Gas-holes (porosity). 3.2 Describe the various defects caused by molten metal in 3.1 above by use of sketches.	<ul style="list-style-type: none"> ▪ Ask student to list the defects associated or caused by molten metal. ▪ Ask student to identify and describe the defects in 3.1 above by the use of sketches. 	

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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: MOLTEN METAL HANDLING AND TREATMENT		MODULE CODE: CFD 14	CONTACT HOURS: 10HRS/WK PER WEEK: T4, P6 (YR 3, TERM 3)
Module Specification: Theoretical and Practical Contents			
Week	General Objective 1.0: Maintain and operate common foundry melting furnaces.		
1 - 7	<p>1.1 Recognise different types of furnaces:</p> <ul style="list-style-type: none"> a Cupola b Crucible c Reverberatory d Rotary e Electric arc f Induction g Resistance, etc <p>1.2 Carry out furnace linings, repair furnace linings, fire different types of furnaces and charge different types of furnaces available.</p> <p>1.3 Operate furnaces to ensure fuel efficiency.</p> <p>1.4 Make up charges including fluxes and covers.</p> <p>1.5 Carry out tapping operations</p>	<ul style="list-style-type: none"> ▪ Students to explain the differences between the furnaces. ▪ Students to know and carry out furnace linings, repair furnace linings, fire different types of furnaces and charge different types of furnaces available. ▪ Students to operate the furnaces. ▪ Students to describe make-up furnace charges e.g scraps, ingots, returns, fluxes, covers etc. ▪ Students to perform tapping operations. 	<ul style="list-style-type: none"> ▪ Furnaces (either life or sketches). ▪ Furnaces and furnace lining materials. ▪ Furnaces. ▪ Furnace charge including fluxes and covers. ▪ Tapping tools and devices.
8 - 12	<p>1.6 Carry out molten metal treatment such as:</p> <ul style="list-style-type: none"> a Desulphurisation; b Inoculation; c Treatment to form spheroidal graphite; d Grain refining using grain refiners; e Deoxidation and degassing. <p>1.7 Operate and maintain Thermocouples, Optical and Total Radiation Pyrometers.</p>	<ul style="list-style-type: none"> ▪ Students to perform molten metal treatment as indicated. ▪ Students to distinguish between different temperature measurement devices. 	<ul style="list-style-type: none"> ▪ Treating agents. ▪ Thermocouples ▪ Optical and Total Radiation Pyrometers.

NTC and ANTC Curriculum and Module Specifications in Foundry

ADVANCED NATIONAL TECHNICAL CERTIFICATE IN

FOUNDRY CRAFT PRACTICES

NTC and ANTC Curriculum and Module Specifications in Foundry

PROGRAMME: **ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY**

MODULE: **CFE 21 PATTERN MAKING**

DURATION: **144 HOURS (12 HOURS PER WEEK)**

PRE-REQUISITE: **CME 11, 12 AND CMW 10**

GOAL: This module is intended to provide the trainee with advanced knowledge and skill to read and interpret engineering drawing of casting and translate blueprints into patterns.

GENERAL OBJECTIVES:

On completion of this module the trainee will demonstrate the following practical competencies to a standard expected in industry.

1. Understand trade science of pattern making
2. Acquire special skills in pattern making
3. Carry out simple engineering drawings for pattern making

STUDENT OUTCOME:

On completion of this module the student will demonstrate the following competencies.

1. Making working drawings and interpret engineering drawings of patterns
2. Select correct materials for pattern construction.
3. Produce patterns using appropriate tools and equipment
4. Carry out various finishing operations on patterns
5. Make expendable pattern using appropriate materials
6. Carry out casting with appropriate calculations from a given drawing and pattern equipment

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PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: PATTERN MAKING		COURSE CODE: CFD 21	CONTACT HOURS: 12 HRS/WK PER WEEK: T4, P8
Course Specification: Theoretical and Practical Contents			
WEEK	General Objective 1.0 Understand the Art of Pattern Making		
	Special Learning Outcome	Teachers Activities	Resources
1-4	1.1 Design patten from blue-print 1.2 Carry out cost analysis of a given job 1.3 Select common and special materials for pattern making a Wood b Wax c Plaster of Paris (P.O.P) d Plastics e Metals f etc. 1.4 Explain inspection and quality control operations involved in pattern making 1.5 Carry out various finishing operations in pattern making a Sand papering b Vanishing c Painting and colour coding d Pattern fixtures e etc	<ul style="list-style-type: none"> ▪ Guide student to design pattern from Blue-print ▪ Emphasis on importance of cost analysis of a given job ▪ Ask students to: ▪ Distinguish and identify the various pattern making materials. ▪ State the advantages and ▪ Disadvantages of various pattern making materials ▪ Ask students to carry out inspection and quality control through ▪ Measurement ▪ Gauging ▪ Sampling ▪ etc ▪ Emphasis on the need for good finish ▪ Perform finishing operations 	<ul style="list-style-type: none"> ▪ Drawing materials and instruments ▪ Casting Design ▪ Writing materials, calculator ▪ Pattern making materials ▪ Quality control tools and devices ▪ Tape Ruler, Venier Calipers ▪ Micrometer screw gauge etc ▪ Sand papers, paint ▪ Vanisher dowels, lifting strips etc.
	General Objective: 2.0 Acquire special skill in pattern making		
5.8	2.1 Carry out simple carving and tooling operations 2.2 Carry out wood milling and turning operations using common and special machines and tools, example: a Woodturning lathe b Wood milling machine c Bobbling sander d Thicknessing machine	<ul style="list-style-type: none"> ▪ Ask students to carry out simple carving operations in pattern shapes ▪ Guide students to operate both the common and special machines in pattern production ▪ Ask students to distinguish the differences between the various 	<ul style="list-style-type: none"> ▪ Carving tools ▪ Machines and Tools as listed in objective 2.2 ▪ Availability of expendable materials. ▪ Relevant standard pattern workshop

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	<p>e Circular saw machine f Band saw machine g etc</p> <p>2.3 Make expendable pattern using materials such as: a Wax b Plaster of Paris c Polystyrene</p> <p>2.4 Explain the general layout of a pattern shop example: a Arrangement of machines and equipment b Tools storage c Gangways</p>	<p>expendable materials</p> <ul style="list-style-type: none"> ▪ State the advantages over the wood and metal patterns ▪ Emphasis on good pattern workshop layout 	
General Object: 3.0 Carry out simple Engineering drawing for pattern making			
9-12	<p>3.1 Make working drawings isometric, autographic (oblique and sectioning) for pattern production; Consider the following: - a Mould joints b Slip joint c Core prints d Loose pieces e Running and feeding systems f Mould and core reinforcements g Draw backs h False (self cores) i Cover cores and Core assemblies</p> <p>3.2 Interpret engineering drawing of patterns</p> <p>3.3 Estimate casting weights from given drawing and prepared</p>	<ul style="list-style-type: none"> ▪ Ask student to produce working drawings for pattern production ▪ Considerations and emphasis on the relevance of a-i in 3.1 ▪ Emphasis on the importance of allowances and provisions to be made on patterns e.g. ▪ Shrinkage ▪ Taper ▪ Machining ▪ Core prints ▪ Fillets etc ▪ Ask students to carry out casting weight calculations using ▪ Drawings ▪ Prepared pattern 	<ul style="list-style-type: none"> ▪ Drawing materials and instruments ▪ Shrinkage (contraction) and fillets provisions ▪ Appropriate Formulae from Texts for calculations of volumes and weights ▪ Samples of already made patterns

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PROGRAMME: **ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY**

MODULE: **CFD 22 MOULDING AND CORE-MAKING**

DURATION: **180 HOURS (15 HOURS PER WEEK)**

GOAL: The module is intended to provide the trainee with further knowledge in moulding, core-making and to make good cores and moulds.

GENERAL OBJECTIVES:

On completion of this module the trainee will demonstrate the following practical competencies to a standard expected in industry.

1. Understand the properties of materials used in moulding processes.
2. Understand sand casting process and other special mould castings
3. Understand the basic approach to solidification of metals and alloys
4. Understand the methods used to minimize shrinkage and inclusions in castings
5. Understand the causes of faulty castings, and their preventive measures

Student outcome: On completion of this module the student will demonstrate the following competencies.

1. Carry out sand routine tests
2. Carry out calculations on gating system i.e gating ratio's
3. Use correct gating system
4. Prepare sand moulds
5. Melt and remove slag and dross in molten metal
6. Carry out fluidity tests using spiral testing device.
7. Measure casting temperature
8. Pour the molten metal with correct pouring technique
9. Knock-out casting and carry out salvaging of defective castings as the need arises
10. Carry out inspection control on finished casting

Produce castings using other special casting processes.

1. Centrifugal casting

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2. Investment casting
3. Gravity or permanent mould casting
4. Pressure die casting
5. Plaster casting

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PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: MOULDING AND CORE-MAKING		COURSE NO CFD 22	CONTACT HOURS: 15 HRS?WK PER WEEK: T6, P9
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL CONTENTS			
WEEK	General Objective Understand the properties of materials in moulding processes		
	Special Learning Outcome	Teachers/Student Activities	Learning Resources
	1.1 Identify and describe the properties of materials used in moulding and core-making: a Green compressive strength b Refractoriness c Dry strength d Hot strength	<ul style="list-style-type: none"> ▪ Ask students to identify and describe the properties of various types of foundry sands. ▪ Emphasis on different types of sand materials and their composition, viz; ▪ Natural sand ▪ Silicate sand ▪ Zircon sand ▪ Chromite sand ▪ Olivine sand ▪ Ask students to list the advantages and disadvantages of the use of the sands in 2 above 	<ul style="list-style-type: none"> ▪ Sand samples
	1.2 State the simple properties of metallic materials used in moulding and core making practice a Strength b Ductility c Hardness d Corrosion e Malleability f Roughness g Brittleness h Annealing and Normalizing	<ul style="list-style-type: none"> ▪ Emphasis on the use of appropriate metallic material for specific job. ▪ Ask student to use the properties in selecting metallic materials 	<ul style="list-style-type: none"> ▪ Samples of metallic material for mould making e.g Mild Steel, Aluminum etc.
	General Objective 2.0: Understand Different Casting Processes		
2	2.1 Carry out the following casting processes: a gravity or permanent mould casting b sand casting	<ul style="list-style-type: none"> ▪ Ask student to differentiate between sand casting and other casting processes ▪ Ask student to make related sketches 	<ul style="list-style-type: none"> ▪ Casting Equipment and special materials

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	<ul style="list-style-type: none"> c Low and high pressure die casting d Investment casting i. Shell casting ii. Lost wax casting iii. Frozen mercury casting e Centrifugal casting f Plaster casting 		
General Objective 3.0: Understand the basic approach to solidification of metals and alloys			
3-5	<ul style="list-style-type: none"> 3.1 Explain solidification and its influence on solid/liquid interface 3.2 Explain shrinkage and its effect. 3.3 State the implications of shrinkage in the provision of sound casting 3.4 Explain fluidity of metals, its necessity, influencing factors and assessment tests 	<ul style="list-style-type: none"> ▪ Understand the basic approach to solidification of metals and alloys ▪ Ask students to describe solidification rate as it affects structure of cast metals, with particular emphasis on grain size and dendrites etc. ▪ Ask students to explain volume changes as it relates to: <ul style="list-style-type: none"> ▪ Liquid contraction ▪ Solidification contraction ▪ Solid contraction ▪ Emphasis on shrinkage allowances with reference to <ul style="list-style-type: none"> ▪ Pattern maker allowance ▪ Feeding provision (feeders) ▪ Ask students to perform fluidity test (assessment tests) 	<ul style="list-style-type: none"> ▪ Texts, slides, microscope Reagents ▪ Phase diagram ▪ Shrinkage Rule ▪ Spiral testing device
General Objective 4.0: Understand the methods used to minimize shrinkages and inclusions in castings			
6-7	<ul style="list-style-type: none"> 4.1 Explain the effects of cooling stages on the casting of different metals 4.2 Know the effects of grain refiners such as <ul style="list-style-type: none"> a. Silicon b. Aluminum c. Copper 4.3 Employ special gating methods such as <ul style="list-style-type: none"> a. Pencil runner 	<ul style="list-style-type: none"> ▪ Ask students to: <ul style="list-style-type: none"> ▪ Differentiate between rate of cooling on different metals i.e slow and rapid ▪ Explain effect of cooling rate on grain structure on different metals ▪ Ask students to explain the effect of additions of grain refiners on casting 	<ul style="list-style-type: none"> ▪ Text, lesson notes ▪ Grain Refiners ▪ Special gating samples in prepared mould or sketches as listed in 4-3 ▪ Materials and Devices in 4.4 ▪ Slagging device

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	<p>b. Whirl gate c. Strainer runner 4.4 Employ the use of a) Chills b) Insulators c) Exothermic compound d) Tie bars e) Ribs f) Knock off feeders 4.5 Remove slag and dross such as non-metallic inclusions 4.6 Carry out elementary calculations on gating systems 4.7 Make simple sketches of gating systems</p>	<p>structures.</p> <ul style="list-style-type: none"> ▪ Emphasis on the correct additions (percentage) ▪ Ask studentst to apply the use of the gating methods in a-c in 4.3 to minimize shrinkage in castings ▪ Ask students to explain the use of different method of minimizing shrinkage in castings following the list in 4.4 ▪ Ask students to identify and remove non-metallic inclusions in melts by the use of slagging bars ▪ Ask studens to perform calculations of gating systems with particular emphasis on gating ratios for: <ul style="list-style-type: none"> ▪ Pressurized gating system 	<ul style="list-style-type: none"> ▪ Gating Ratio Formula from Texts ▪ Relevant Text ▪ Prepared sketches ▪ Drawing materials
General Objective 5.0: Understand the causes and of faulty casting and their preventive measures			
10-12	<p>5.1 Recognise sand mould defects a. Blow holes b. Slag or non-metallic inclusions c. Shrinkage cavity and mismatch d. Swelling e. Scabbing f. Pin holes g. Porosity h. Fins and flashes i. Misrun and Cold shot j. Hot tearing k. Cracking l. Distortion m. Segregation n. Poor surface finish o. Orange peel</p>	<ul style="list-style-type: none"> ▪ Understand the causes of faulty castings and their preventive measures ▪ Ask students to describe and recognise the various sand mould defects. ▪ Ask students to describe the casting defects emanating from a-g in 5-2 ▪ Emphasis on casting temperatures and pouring techniques ▪ Guide students to perform inspection ▪ Ask students to distinguish the three inspection methods ▪ Emphasize the limitation of each of three inspection methods ▪ Ask students to reclaim defective casting using any of the three methods mentioned in5.4 (a-c) 	<ul style="list-style-type: none"> ▪ Relevant Texts ▪ Sketches of the sand mould defects ▪ Samples of the sand mould defects in cast components ▪ Temperature measuring instrument and devices ▪ Casting designs ▪ Mould designs & Assembly ▪ Core designs ▪ Relevant tools and equipment as listed in 5.3 ▪ Relevant tools and equipment as listed in 5.4 ▪ Sand Testing equipment as listed in 5.5

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	<p>p. Drooped cod q. Incorrect section thickness r. Warping 5.2 Recognise defects emanating from: a. Casting design b. Melting and Moulding equipment c. Molten metal d. Pouring systems e. Gating systems f. Mould and Cores g. Metal mould reaction and incorrect mould assembly and handling.</p>	<ul style="list-style-type: none"> ▪ Ask students to perform the sand routine test using the appropriate sand testing equipment. 	
	<p>5.3 Carry out sand routine tests such as: a Moisture content b Silica and Clay content c Permeability d Shatter index e Green and Dry compressive strength f Sieve analysis for the sand grain sizes</p>		

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PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY

MODULE: CFD 23: MELTING AND CASTING PROCESSES

DURATION: 180 HOURS (TERM 2, 5HRS/WK AND TERM 3, 10HRS/WK)

GOAL: The Module is intended to provide the trainee with the knowledge and skill to melt various metals using all types of furnaces.

General Objective:

On Completion of this module, the trainee should be able to:

1. Maintain and operate common foundry melting furnaces
2. Understand the structure, properties and uses of special metals.
3. Understand the casting processes including quality control of raw and finished products.
4. Design and make suitable pouring, gating and feeding systems to prevent common pouring defects.
5. Relate metallurgical aspects of metal solidification characteristics to the objectives of casting and pouring, gating and feeding systems designs.
6. Produce sound casting using any of the modern processes

Student Outcome

On completion of this module, the student will demonstrate the following competencies:

1. Use and maintain common foundry melting furnaces
2. Explain the structure, properties and use of special metal
3. Explain all casting processes including quality control of raw and finished products
4. Produce suitable pouring, gating and feeding systems to prevent common pouring defects.
5. Explain the relationship of metallurgical aspect of metal solidification characteristic to the objectives of casting and pouring, gating and feeding systems designs.

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PROGRAMME: ADVANCE NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: MOULDING AND CASTING PROCESSES		MODULE CODE: CFD 23	CONTACT HOURS: 15 HRS/WK PER WEEK: T2, P3 (TERM 2)
MODULE SPECIFICATION: THEORY AND PRACTICAL CONTENT			
General Objective: Maintain and operate common foundry melting facilities			
Week	Specific Learning Outcome	Teacher/Student Activities	Learning Resources
Term 2 1- 5	1.1 Recognise different types of furnaces a Cupola furnace b Crucible furnace c Reverbatory furnace d Rotary furnace e Electric arc furnace f Induction furnace g Resistance furnace	<ul style="list-style-type: none"> ▪ Ask students to recognize different types of furnaces ▪ Emphasis on the choice furnace considering the factors used in selecting the types of melting units ▪ Ask students to state the uses and limitations of each of the furnaces. ▪ Students should be guided to carry out furnace lining and repairs ▪ Ask students to charge and operate furnaces ▪ Ask students to perform charge calculations to avoid losses of elements during melting ▪ Emphasis on correct metal temperature required for tapping ▪ Ask students to follow tapping procedures before tapping ▪ Students to operate appropriate tapping devices observing safety precautions. 	<ul style="list-style-type: none"> ▪ Any of the melting furnaces ▪ Furnace lining materials ▪ Charge make up ▪ Texts and literature
	1.2 Explain the uses and limitations of the Furnaces in 1.1 above		
	1.3 Construct Furnace linings and repair damaged Furnace linings		
	1.4 Operate Furnaces, make up charges, use fluxes and covers.		
	1.5 Distinguish between melting losses and gain and be able to compensate them during charge preparation.		
	1.6 Carry out tapping operations		
General Objective 2.0: Understand the structure, properties and uses of special metals			
6 - 8	2.1 Outline the composition and properties of the following: a Special and alloy cast iron b Alloy steel and non-ferrous metals c Inoculated and Spheroidal Graphite cast irons d Heat, Wear and Corrosion resistance alloys	<ul style="list-style-type: none"> ▪ Ask students to state the composition and properties of metals and their alloys ▪ Emphasis to be made on the treatment given to special alloys e.g 	<ul style="list-style-type: none"> ▪ Alloying materials

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	<p>e Non-ferrous alloys</p> <p>i) Brasses</p> <p>ii) Aluminum</p> <p>iii) Bronze</p> <p>iv) Magnesium alloys etc.</p> <p>2.2 Describe the application of the alloys listed in 2.1 above</p>	<p>Spheroidal Graphite Iron</p> <ul style="list-style-type: none"> ▪ Ask students to identify and explain the ▪ Uses of alloys 	
General Objective 3.0: Understand all casting processes including quality control of raw and finished products			
9 - 12	<p>3.1 Recognise the effect of raw materials, casting processes, quality of material and design factors on production procedure.</p> <p>3.2 Carry out the following quality control test on molten metal</p> <p>a Fluidity</p> <p>b Gas content</p> <p>c Temperature</p> <p>d Spectrometer (metal analysis)</p> <p>e Wedge test</p> <p>3.3 Carry out investigation and remedial procedure for defective castings</p>	<ul style="list-style-type: none"> ▪ Ask students to recognise and explain the effects of: <ul style="list-style-type: none"> ▪ Raw material ▪ Casting processes ▪ Quality of materials ▪ Design factors on production procedures ▪ Ask students to perform the various test on molten metal ▪ Ask students to perform investigation, and remedial procedures for defective castings ▪ Emphasize on <ul style="list-style-type: none"> ▪ Burning on ▪ Welding ▪ Pressure impregnation 	<ul style="list-style-type: none"> ▪ Relevant Texts ▪ Test Equipment
General Objective 4.0: Design and make suitable pouring, gating and feeding systems to prevent common pouring defects			
Term 3 1- 4	<p>4.1 Design and make suitable gates to prevent:</p> <p>a) Aspiration</p> <p>b) Turbulence</p> <p>c) Sand erosion</p> <p>d) Oxide formation</p> <p>e) Slag and Dross from molten metal</p> <p>4.2 Use feeding aids, chills and denseners to assist directional solidification and freezing rate.</p>	<ul style="list-style-type: none"> • Guide students in designing suitable gating systems • Emphasize on correct methods of casting procedures and providing the right aid. • Emphasize on the importance of directional solidification by the use of chills and denseners 	<ul style="list-style-type: none"> • Chills and Denseners
	4.3 List the effects of the properties of metals and	<ul style="list-style-type: none"> • Ask student to list the 	<ul style="list-style-type: none"> • Mould coat, Boric Acid and

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	4.4	moulds on directional solidification and freezing rate Use mould facing and dressings to prevent sand erosion, metal mould reaction and promote chilling and refractoriness	<ul style="list-style-type: none"> • Effects of properties of metals on directional solidification and freezing rate • Effects of properties of moulds on directional solidification and freezing rate • Ask students to list materials used in mould facing and dressings • Emphasize on the effect of the use of mould coat such as: <ul style="list-style-type: none"> • Inhibitors • Tellurium paints • Refractory paints • On mould erosion, metal mould reaction and chilling. 	<ul style="list-style-type: none"> • refractory chills. • Etc.
General Objective 5.0: Relate the metallurgical aspect of metal solidification characteristics to the objectives of casting and pouring gating and feeding systems design.				
5 - 9	5.1 5.2 5.3 5.4 5.5 5.6	<p>5.1 Explain all aspect of solidification of metals and alloys, nucleation and growth Mechanism, equiaxed and chilled equiaxed, grain structure, dendritic growth, degree of contraction in the various phases</p> <p>5.2 Interpret phase diagram for various alloys a) Iron carbon b) Copper alloys c) Aluminum alloys</p> <p>5.3 Explain the influence of casting temperatures on the microstructure</p> <p>5.4 Explain the influence of cooling rate on microstructure</p> <p>5.5 Identity hot tear, residual stress, cold cracking and shrinkage cavity, porosity and their causes</p> <p>5.6 List the effects of contraction hindrance, casting design and alloy composition on solidification</p>	<ul style="list-style-type: none"> • Ask students to describe solidification processes of metal and alloys at all stages using phase diagram and appropriate sketches. • Ask students to explain the use of phase diagram for different alloys. • Ask students to state the effect of casting temperature on microstructure. • Ask student to describe <ul style="list-style-type: none"> • Hot tears • Residual stress • Cold crack • Shrinkage cavity • Porosity causes and prevention • Ask students to differentiate between 	<ul style="list-style-type: none"> • Phase Diagram • Microscope • Microscope • Relevant text • Phase diagram • Slider • Microscope • Relevant text • Phase diagram • Slides • Microscope • Relevant text • Ditto • Text

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	5.7	Prevent and/or remove gas solubility in molten metals by degassing methods e.g a) Vacuum b) Lancing c) Plunging d) Others	<p>the various effects on solidification.</p> <ul style="list-style-type: none"> Ask students to identify and explain the use of various degassers A Chlorine tablets B Cuprex degassers C Aluminum degasser D Nitrogen etc Ask students to perform the Micro analysis Macro analysis 	<ul style="list-style-type: none"> Pattern samples Cast samples Degassing Devices and agents as in teacher's activities of 5.7 Metallurgical microscope, Hydropress, Grinding and polishing machines and Re-agents
	5.8	Examine casts by micro and macro techniques for grain size, cell and nodularity counts, shrinkage, porosity, slag and sand inclusions		
General Objective 6.0: Produce sound casting using any of the modern processes				
10 - 12	6.1	Produce sound casting by any of the following methods a) Sand casting b) Die-casting c) Centrifugal casting d) Investment casting etc	<ul style="list-style-type: none"> Ask student to produce sound casting using any of the method State the advantages of the use of each method (process) Emphasis on cost analysis 	<ul style="list-style-type: none"> Casting Equipment Relevant Text
	6.2	Use the following factors to choose the most suitable casting method: a) Plant cost b) Material cost c) Reclaiming system d) Production rate e) Dimensional tolerance f) Quality required		

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PROGRAMME: **ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY**

MODULE: **CFD 24: FINISHING AND QUALITY CONTROL**

DURATION: **120 HOURS (10 HOURS PER WEEK)**

GOAL: **The module is intended to equip the student with the knowledge and skill to carry out post casting operations.**

GENERAL OBJECTIVES

On completion of this module the trainee should be to:

1. Understand the use of all equipment in the finishing shop.
2. Understand the basic principles of some metallurgical applications
3. Understand and apply the principles of post casting knock-out including cleaning and fettling
4. Carry out all post-casting treatment to a finished product conditions.
5. Carry out inspection and quality control of finished products
6. Carry out preliminary processing of casting

Student outcomes:

On completion of this module the student will demonstrate the following competencies.

- Carry out knock-out operations on castings
- Use appropriate tools and equipment to fettle and clean castings
- Carry out necessary quality control tests on castings
- Carry out metallographic examinations of casting
- Apply appropriate device in conveying completed castings from one section to another
- Salvage defective castings if required
- Keep inspection records
- Carry out necessary preliminary processing of castings

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PROGRAMME: ADVANCE NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY			
MODULE: FINISHING AND QUALITY CONTROL		MODE CODE: CFD 24	CONTACT HOURS: 10 HOURS PER WEEK T6: P4
Module Specification: Theory and Practical content			
WEEK	General Objective 1.0: Understand the use of all Equipment in the finishing shop		
	Special Learning Outcome	Teachers/Student Activities	Learning Resources
1	1.1 Apply all safety requirements for machines usage 1.2 Carry out dust and noise control 1.3 Take precaution against X-ray and general material handling such as chemical usage	<ul style="list-style-type: none"> • Ask students to apply safety precautions and use of safety wears • Emphasis on the use of Respirators, Dust extractors and Ear plug • Emphasis on danger associated with X-rays and chemicals 	<ul style="list-style-type: none"> • Safety wears • Respirators • Dust extractors • Ear plugs • Safety wear and Devices • First Aid Box
	General Objective 2.0: Understand the basis principles of some metallurgical applications		
2 - 3	2.1 Carry out metallographic examinations on metals 2.2 Carry out tests with ultrasonic radiography and micro-hardness testing equipment 2.3 Use thermocouple types of furnaces, time temperature recorders for drying of moulds and cores 2.4 Analyse metals and alloys 2.5 Explain the importance of phase diagrams	<ul style="list-style-type: none"> • Ask students to perform • Micro analysis • Macro analysis • Produce micrograph • Ask students to differentiate between these non-destructive method • Ask students to apply the use of temperature measuring devices • Guide students to analyse metal and alloys using • Spectrometer • Wet analysis • Carbon-Silicon analysis • Ask studens to draw and interpret simple phase diagram e.g Iron-Carbon phase diagram 	<ul style="list-style-type: none"> • Metallurgical Microscope • Hydropress, • Grinding & Polishing machines and Etchants • Ultrasonic Radiograph • Hardness equipment. • Temperature measurement Devices • Spectrometer , Carbon-Silicon analyser and chemical reagent and apparatus • Phase Diagram
	General Objective 3. 0: Understand and apply the principles of post casting including cleaning and fettling.		

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4.6	<p>3.1 Carry out knock-out operations using manual and mechanical means</p> <p>3.2 Recognise and avoid the dangers of premature knock out that will lead to:</p> <p>a) Damage of casting</p> <p>b) Hot tears</p> <p>c) Warpage and distortion</p> <p>d) Fast cooling etc.</p> <p>3.3 Use tumble barrels, shot blast chamber and hydroblasts</p> <p>3.4 Remove gates, feeder, risers and fins from ferrous and non ferrous castings</p> <p>3.5 Employ cranes, hoists, skips, palettes, fork-lifts and conveyor for conveying finished products.</p> <p>3.6 Observe all safety measures involved in knock-outs, cleaning and fettling operations</p> <p>3.7 Carry out cleaning operation involving chemical treatment of castings</p>	<ul style="list-style-type: none"> • Ask student to perform the knock out operations using • Manual means • Mechanical means • Emphasis on the use of intermittent and vibrating grits • Emphasis on the effect of premature knock-out • Ask student to distinguish the use of different cleaning equipment • Tumble barrel • Shot blast chamber • hydroblast • Ask student to perform fettling operations such as • Knocking/flogging • Cutting • Chipping • Grinding • etc. • Ask students to use the various conveying devices • Emphasize on safety rules and regulations • Emphasize on the use of prickling bath in cleaning operation 	<ul style="list-style-type: none"> • knockout equipment and devices • Cleaning equipments listed in 3.3 • Tools and equipment fettling • Conveying Devices • Safety wears • Bath and chemicals for prickling treatment
General Objective 4.0: Carry out all post casting treatment to a finished product condition.			
	<p>4.1 Salvage defective castings by welding</p> <p>4.2 Carry out the following heat treatment:</p> <p>a) Stress relieving</p> <p>b) Annealing</p> <p>c) Normalizing</p> <p>d) Quenching</p>	<ul style="list-style-type: none"> • Ask students to perform the reclaiming of defective casting by: • Arc welding • Chermite welding • Oxy-acetylene etc • Impregnation 	<ul style="list-style-type: none"> • Welding equipment • Heat-treatment furnaces • Materials for solution treatment • Electricity • Heat treatment furnaces • Treatment materials e.g Carbon,

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	<ul style="list-style-type: none"> e) Tempering f) Solution treatment g) Aging Etc <p>4.3 Carry out the following case-hardening operations</p> <ul style="list-style-type: none"> a) Carbonizing b) Cyaniding c) Nitriding d) Flame hardening e) Induction hardening Etc 	<ul style="list-style-type: none"> • Ask students to perform the heat treatment operations as itemized in 4. 2 • Emphasize on the effects of the different processes • Ask students to describe and perform the case hardening operations • Emphasize on the effects of the different processes 	<ul style="list-style-type: none"> • Nitrogen and Cyanide • Flame (for construction components) • Electricity
General Objective 5.0: Carry out inspection and quality control of finished products.			
8-9	<p>5.1 Carry out routine inspection by:</p> <ul style="list-style-type: none"> a. Visual b. Jigs and Gauges c. Pressure testing 	<ul style="list-style-type: none"> • Ask students to perform routine inspection on castings using different methods. 	<ul style="list-style-type: none"> • Relevant testing equipment
	<p>5.2 Carry out a destructive testing (mechanical) of casting, example:</p> <ul style="list-style-type: none"> a. Hardness b. Tensile strength c. Impact test d. Transverse test Etc 	<ul style="list-style-type: none"> • Ask students to perform mechanical testing on castings using different methods. • Emphasize on Rockwell, Brinell and Vickers hardness testers. 	<ul style="list-style-type: none"> • Relevant testing equipment.
	<p>5.3 Carry out non-destructive tests example:</p> <ul style="list-style-type: none"> a) Use of penetrants b) Magnetic particle c) Ultrasonic testing d) Radiographic testing e) Spectrometric testing 	<ul style="list-style-type: none"> • Guide students to perform the various non-destructive tests. 	<ul style="list-style-type: none"> • Relevant testing equipment.
	<p>5.4 Carry out quality control for sand mixtures, routine sand testing, compact tests on finished moulds, high temperature tests, and fluidity tests on molten metals.</p>	<ul style="list-style-type: none"> • Ask students to perform • Various sand routine tests • Various molten metal tests. 	<ul style="list-style-type: none"> • Testing instrument appropriate for the specified tests.

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	5.5 Keep inspection records and give information or feedback on daily basis.	<ul style="list-style-type: none"> • Ask students to keep proper and accurate quality control records of inspections. 	<ul style="list-style-type: none"> • Record book.
General Objective 6.0: Carry out preliminary processing of casting			
	<p>6.1 Carry out</p> <p>a) Machining of castings</p> <p>b) Setting up of tools and jobs</p> <p>c) Turning operation</p> <p>d) Milling operations</p> <p>e) Shaping operations</p> <p>f) Drilling operations</p> <p>Etc.</p> <p>6.2 Explain the relevance of the following to machinable castings:</p> <p>a) Feed rates</p> <p>b) Cutting action</p> <p>c) Hard spots</p> <p>d) Location point</p> <p>e) Influence of casting features</p> <p>f) Joints</p> <p>g) Gate location</p> <p>h) Taper</p> <p>i) Chip formation</p> <p>Etc.</p> <p>6.3 Identify machining allowance form working drawing</p> <p>6.4 Use core or boring for holes</p> <p>6.5 Carry out batch, slow and transfer machining operations</p> <p>6.6 Identify types of wheel-grinding and cutting machine</p> <p>6.7 Apply all safety requirement for machining and grinding</p>	<ul style="list-style-type: none"> • Ask students to perform the various operation • Emphasize on • Correct use of tools and equipment • Safety measures • Ask students to state the relevance of (a - i) on machinable castings • Emphasize the specific areas to be machined from working drawing • Guide students in making cores to dimension • Emphasize the minimum hole diameter to be cored or bored • Ask students to perform batch, slow and transfer machining operations • Emphasize the use of jigs and fixtures for machining • Ask student to differentiate between the different types of wheel grinding and cutting machines • Emphasis on the following points: - • Speed • Dressing • Balancing • Maintaining of the wheels • Emphasize on the safety requirement for performing machining and grinding 	<ul style="list-style-type: none"> • Machines and Tools appropriate for each operation • Safety wears • Relevant Texts • Cast samples • Working drawing • Boring tools • Coring equipment • Machining tools jigs and Fixtures • Grinding and Cutting Machines, examples; • Hand Grinder • Table Grinder • Power Saw • Guillotine • Etc. • Safety wears and safety measures.

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PROGRAM:	ADVANCED NATIONAL TECHNICAL CERTIFICATE IN FOUNDRY
MODULE:	CFD 25: PROJECT
PRE-REQUISITE:	CFD 21, CFD 22, CFD 23 and CFD 24
GOAL:	On completion of this module the trainee should be able to carry out a detailed study on his own and present an extended essay on a suitable topic.

Project

The Following are examples of suitable projects:

1. Investigate a Foundry layout and describes the production steps
2. Investigate the production of quality casting noting the causes and prevention of various defects in castings.
3. Carryout market survey of trends in foundry development
4. Forecast manpower requirement in relation to Foundry owners
5. Investigate the treatment and finishing operations in metal castings
6. Investigate the properties and use of various Engineering materials obtainable in foundry workshop.
7. Investigate methods of production of Engineering components examples, casting, forging, welding & fabrication etc.
8. Investigate the various methods of casting processes
9. Investigate the production of good pattern using various materials.

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NATIONAL TECHNICAL CERTIFICATE AND ADVANCED NATIONAL TECHNICAL CERTIFICATE

Guidelines for textbook writers

The following guidelines are suggestions from the Engineering Committees to the writers of the textbooks for the new curricula. They are intended to supplement the detailed syllabuses which have been produced, and which define the content and level of the courses.

Authors should bear in mind that the curriculum has been designed to give the students a broad understanding of applications in industry and commerce, and this is reflected in the curriculum objectives.

- One book should be produced for each syllabus
- Page size should be A4
- The front size should be 12 point for normal text and 14 point where emphasis is needed
- Line spacing should be set to 1.5 lines
- Headings and subheadings should be emboldened
- Photographs, diagrams and charts should be used extensively throughout the book, and these items must be up-to-date
- In all cases the material must be related to industry and commerce, using real life examples wherever possible so that the book is not just a theory book. It must help the students to see the subject in the context of the 'real world'.
- The philosophy of the courses is one of an integrated approach to theory and practice, and as such the books should reflect this by not making an artificial division between theory and practice.
- Illustration should be labelled and numbered
- Examples should be drawn from Nigeria wherever possible, so that the information is set in a country context.
- Each chapter should end with student self-assessment question (SAG) so that students can check their own master of the subject
- Accurate instructions should be given for any practical work having first conducted the practical to check that the instructions do indeed work
- The books must have a proper index or table of contents, a list of references and an introduction based on the overall course philosophy and aims of the syllabus.
- In case of queries regarding the contents of the books and the depth of information the author must contact the relevant curriculum committee via the National Board for Technical Education.
- The final draft version of the books should be submitted to Nigerian members of the curriculum working groups for their comments regarding the content in relation to the desired syllabus.

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RECOMMENDED TEXT BOOKS

1. Principles of Metal casting by: F.W Heine & P.C Rosenthal - Pub. McGraw-Hill
2. Non-ferrous foundry metallurgy by: A. J. Wurfy - Pub. Pergamon Press
3. A manual of foundry practice by: J. Leing & R. T Roife Pub. Chapman & Hill
4. Cores and core-making by: F.D Ropers - Pub Allen & Union.
5. Material Science for Engineers by Van Ulack - Pub. Addison-Wesley, Pub. Co.
6. Foundry Technology by: C.O. Nwajagu - Pub
7. Foundry Engineering by: Howard F. Taylor, Merton C. Flemings, John Wulff.
8. Foundry sand practice by: Clyde A. Sanders

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LIST OF WORKSHOPS AND LABORATORIES

A) WORKSHOPS

1. Pattern Making shop
2. Moulding shop
3. Core-making shop
4. Furnace shop
5. Finishing shop

B) METALLURGICAL LABORATORIES

1. Sand testing laboratory
2. Metal testing laboratory (Destructive and Non-destruction tests)

C) SCIENCE LABORATORIES

1. Physics Laboratory
2. Chemistry Laboratory

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LIST OF EQUIPMENT

Tools, materials and equipment for use in pattern making, moulding, core making, casting and metallurgical laboratories

S/NO.	DESCRIPTION OF ITEMS	MINIMUM QUANTITY REQUIRED	QUANT. AVAIL.	REMARKS
	<u>Pattern Making Shop</u>			
1.	Jack planes	6		Add circular surface m/c cross cutting m/c thicknesser pedestal grinder surface plainer buot welder.
2.	Jack planes smooth	6		
3.	Cross cut saws	4		
4.	Rip cut saws	4		
5.	Tenon saws	10		
6.	Try squares	10		
7.	Mitre squares	6		
8.	Wood work benches	4		
9.	Wood work vices	16		
10.	Mortise gauge	6		
11.	Mortise chisels	6 sets		
12.	Marking gauge	10		
13.	Marking knife	10 sets		
14.	Firmer chisels	6		
15.	Spork shape	6		
16.	Hammer	10		
17.	Nails	5 kg		
18.	Glue	1 gallon		
	<u>Machines</u>			
	Hand drills	4		
	Wood tuning lathe	1		
	Band saw with accessories	1		
	Moulding shop	1		
1.	Red sand	1/4 ton		
2.	Silica sand	1 ton		
3.	Moulding bench	10		

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4.	Bottom board	30		
5.	Moulding flasks	30		
6.	shovel	10		
7.	Moulding sand	30		
8.	Watering can	5		
9.	Wheel barrow	4		
10.	Parting dust	30		
11.	Rammers 1	30		
12.	Moulding trowels	10		
13.	Stake off bars	10		
14.	Gate cutter or spoon	10		
15.	Sprue pins			
16.	Vent rods	30 pks		
17.	Wet brush	30 pks		
18.	Draw pins	10		
19.	Bellowers	100 pks		
		6		
20.	Lifter	2		
21.	Bulb sponges	6		
22.	Riddle (sleeves)	10		
	<u>Machines</u>			
1.	Sand mixing machine	1		
2.	Continous mixer machine/dispenser	1		
	Moulding machines			
3.	Laboratory equipment for sand routine testing	5		
4.	<u>Core Making shop</u>	2 sets		
1.	Core boxes			
2.	C-clamps			
3.	Linseed oil			
4.	Fast drying agents	10		
5.	Core dried	20		
	<u>Machines</u>	5 gallons		
1.	Core blowing machine with accessories	5 pks		
2.	Shell core machines	2		

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1.	<u>Furnace Shop</u> Crucible furnace	2		
2.	Crucible pots			
3.	Crucible test or tool			
4.	Crucible lifting tongs	2		
5.	Metal pick-up tongs			
6.	Combined slag lifter and skimming ladle	1		
7.	Combined portable thermocouple and pyrometer	2		
8.	Chemical additives	3		
9.	Degassing plunger			
10.	Hammers	2		
11.	Face shields			
12.	Heat resistant gloves	6		
13.	Knee leggings	2		
14.	Big type aprons (leather)			
15.	Heavy shoes			
16.	Refractory clays	2		
2.	Outside caliper	8		
3.	Inside caliper	8		
4.	Steel measuring tapes	4		
	Measuring rules			
5.	<u>Vices/Pliers</u>	10		
	Bench vice			
1.	Hand vice	4		
2.	Combination pliers	6		
3.	<u>Files</u>	4		
	Flat file			
1.	Half round file	10		
2.	Round file	10		
3.	Triangular file	5		
4.	Rasp file half-round	10		
				Knock out equipment safety wears. Tumbling barrel shot blasting hydroblasting

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5.	<u>Machines</u> Pillar drilling machine	5		
1.	Straight shank drill bits Tapered shank drill bits	1		
2.	Drill drift Pedestal grinder	2 sets		
3.	Wire brush Goggle	1 set		
4.	Hand hacksaw with blade	1		
5.	Metallurgical laboratory:	2		
6.	- grinders	10		
7.	- polishers	10		
8.	- metallurgical microscope	6		
	- etchants	2		
9.	- metal analysers etc.	2		

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