

Mechanical Engineering Craft - National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC)

National Board for Technical Education, Kaduna

Curriculum and Module Specification – 2001



Fabrication/craft practice

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General Information

Entry Qualifications

Craft Programme

Candidates must not be less than 14 years of age and should have successfully completed three years of 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

- a. The Curriculum of each programme is broadly divided into three components:
- b. General Education which accounts for 30% of the total hours required for the programme.
- c. Trade Theory, Trade Practice and Related Studies which account for 65% and
- d. 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 compulsory for the full-time students.

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 in the curriculum. They are:

- a. General Objectives
- b. Specific Objectives

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 of

- 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/Performance Objectives are concise statements of the specific behaviour expressed in units of discrete practical tasks and related knowledge the student 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, 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 training and general education may be able to compete with their secondary school counterparts for direct entry 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 studies.

National Award

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

CERTIFICATE OF ATTENDANCE

The institution can award a certificate of attendance to a trainee who successfully complete one or more modules

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 goal objectives of each module is 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 66 hours in the 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.

INTEGRATED APPROACH IN THE TEACHING OR TRADE

Theory, Trade Science and Trade Calculate

The traditional approach of teaching trade science and trade calculation as separate and distinct subject 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 as the same as in trade calculation and trade science. In the new scheme therefore, mathematics and physical science will be taught by qualified persons in these fields 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/Modules

For the programme to achieve its objectives, any course started at the beginning of term must terminate at the end of the term. Instructors should therefore device methods of accurately assessing the trainees to enable them given the students 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 course work and the national examination.

Curriculum Table (NTC)

COURSE: MECHANICAL ENGINEERING CRAFT PRACTICE

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE

SUBJECT CODE	MODULE	YEAR I						YEAR 2						YEAR 3						TOTAL HRS FOR EACH		
		Term 1		Term 2		Term 3		Term 1		Term 2		Term3		Term 1		Term 2		Term 3				
		T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P			
CPH 12-15	Math	2		2		2		2		2		2		2		2		2		2		216
CCH 10-12	Physics	2		2		2		2	1	2	1	2	1	2	1	2	1	2	1	2	1	288
CPH 11-12	Chemistry	2		2		2		2	1	2	1	2	1	2	1	2	1	2	1	2	1	285
CEN 11-17	Eng.Lang & Com.	2		2		2		3		3		3		3		3		3		3		288
CEC 11-13	Economics	2		2		2		2		2		2		2		2						216
ICT 10	Intro. Comp	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	36
ICT 12	Comp. Appl. I-4	-	-	-	-	-	-	-	-	1	2	-	-	-	3	-	-	-	-	-	-	36
ICT 13	Comp. Appl. II	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	3	-	-	-	-	36
ICT 14	AutoCAD I	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	36
ICT 15	AutoCAD II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	36
CMS 10	Entrepreneurial		-		-		-		-		-	2	-	2	-	-	-	-	-	-	-	48
CEI 11	Basic Electricity	2	1	0.4	1.6	0.4	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	84
CTD 11-13	Tech. Drawing	-	3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	108
	Plane & D. Geo.	-	-	-	-	-	-	-	3	-	3	-	3	-	-	-	-	-	-	-	-	108
CME 11	Gen.Metal Wk. I	2	5	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168
CME 12	Gen.Metal Wk. II	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60
CME 13	Gen. Fitting	4	2	-	-	-	6	2	3	-	-	-	-	-	-	-	-	-	-	-	-	216
CME 14	Turning	-	-	-	-	-	-	2	6	2	4	-	4	-	-	-	-	-	-	-	-	216
CME 15	Milling	-	-	-	-	-	-	-	-	-	-	4	4	2	9	-	3	-	-	-	-	216
CME 16	Shaping/PLN/SLT	-	-	-	-	-	-	-	-	2	5	-	-	-	-	-	-	-	-	-	-	84
CME 17	Drilling	-	-	2	6	-	-	-	-	-	-	-	-	-	-	2	6	-	-	-	-	96
CME 18	Grinding	-	-	-	-	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	192

GRAND - TOTAL = 3160 HOURS

Curriculum Table (ANTC)

COURSE: MECHANICAL ENGINEERING CRAFT PRACTICE
PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE (ANTC)
OPTION: TOOL AND DIE MAKING

SUBJECT CODE	MODULE	ONE YEAR						TOTAL HRS FOR EACH
		Term 1		Term 2		Term 3		
		T	P	T	P	T	P	
CMA 21-22	Mathematics	2		2				48
CEN 21-22	English language & Communication	2		2				48
CEC 21-23	Economics					2		24
CEM 21	Entrepreneurial	2		2		2		72
CME 21	Mechanical Engineering Science			3	4			84
CTD 21	Mechanical Engineering Design	3	2			2	2	108
CME 23	Boring					3	8	132
CME 26	Project						7	84
CME 27	Inspection and Measurement	3	4					84
CME 28	Press Tool Manufacture			3	8			132
CME 29	Jig. And Fix Design					2	4	72
CME 30	Die Manufacture	1	3					48
ICT 21	AD. AutoCAD I		3					36
ICT 32	AD. AutoCAD II				3			36
CEN 21	Technical Writing	2						24
	GRAND TOTAL							984

COURSE: MECHANICAL ENGINEERING CRAFT PRACTICE
PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE (ANTC)
OPTION: MACHINE SHOP PRODUCTION AND MAINTENANCE

SUBJECT CODE	MODULE	ONE YEAR						TOTAL HRS FOR EACH
		Term 1		Term 2		Term 3		
		T	P	T	P	T	P	
CMA 20	Mathematics	2		2				48
CEN 20	English language & Communication	2		2				48
CSS 21	Economics					2		24
CME 21	Mechanical Engineering Science	2	4					72
CMC 21	Entrepreneurial Studies					4		48
CTD 21	Engineering Drawing Design	4	2					72
CME 23	Boring			2	6			96
CME 26	Project						6	72
CME 27	Inspection and Measurement			4	4			120
CME 22	Presses, JIGS. & Fixtures	4	4					108
CME 24	Fitting (Mill Wright)	2	6					288
CME 25	Valves, Pumps and Drive			3	6	2	12	120
CEN 21	Technical Report Writing			2				24
ICT 41	Advanced AutoCAD I		3					36
ICT 42	Advanced AutoCAD II				3			36
	GRAND TOTAL	16	19	15	18	8	18	1212

General Metal Work I

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ENGINEERING CRAFT PRACTICE

Course: General Metal Work I

Course Code: CME 11

Contact Hours 7hrs/wk

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

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 use
3. Select and use common measuring, marking out, cutting and striking tools.
4. Understand the basic working principles of drilling machine.
5. Understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand.
5. Understand the ISO system of tolerances and fits and their application in engineering production.
6. Produce simple engineering components on the bench.
7. Understand the essential features and working principles of the center 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:

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 time
3. Use and select handtools for carrying out various bench fitting and assembly tasks
4. Tools: hacksaws, taps, reamers, drills, dividers, surface gauge
5. Produce threads using taps and dies
6. Correctly grind drill point angles: Drills: Twist and flat drills
7. Select and set drilling machine speeds to carryout a range of operations i.e drilling, reaming, counter sinking, and counterboring using the appropriate coolants.
8. Perform metal joining by a range of processes. Cut through the joints and investigate the depth of penetration of the metals at the interface. The processes Include. 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.

PRACTICAL TASKS

	General Objective: On completion of the following practical task, the trainee will demonstrate the following abilities:		
Week	Specific Learning Objective:	Teachers Activities	Resources
	General Objective 1.0: Safety and Practice		
1-3	<p>1.1 Using and handling hand tools, portable power tools and machine</p> <p>1.2 Lifting, moving and storing materials or job</p> <p>1.3 Demonstrate first aid application in cases of minor cuts, electric shock, burns.</p>	<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 e.g files, hacksaw • Television, Video machines • Posters on artificial respiration
	General Objective: 2.0: Measuring, Marking, Cutting and Striking Tools		
Week	Specific Learning Objective:	Teachers Activities	Resources
4-6	<p>2.1 Describe the essential features and use of the following</p> <p style="padding-left: 20px;">a. Micrometer screw gauge</p> <p style="padding-left: 20px;">b. vernier calliper</p> <p style="padding-left: 20px;">c. Venier height gauge</p> <p style="padding-left: 20px;">d. combination set</p> <p>2.2 Maintain and care for the instruments listed above</p> <p>2.3 Perform marking out exercise on plane surfaces including profiles</p> <p>2.4 File a piece of metal to a given specifications using any of the following: Cross filing, draw filing, filing square and flat surfaces</p> <p>2.5 Test surface for flatness using surface plate and try square and state precautions to be taken to avoid pinning</p> <p>2.6 Maintain files in good working conditions</p> <p>2.7 Apply various hammers and mallets e.g ball pein, rubber mallets, etc for engineering purposes</p>	<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 	<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, Hack saw frame

General Objective: 2.0: Measuring, Marking, Cutting and Striking Tools			
Week	Specific Learning Objective:	Teachers Activities	Resources
4-6	<p>2.8 Select and insert hacksaw blade correctly</p> <p>2.9 Cut metal and other engineering materials to a given specification using the adjustable hacksaws, junior hacksaws, piercing saw, etc drills and Drilling./ Assess the students</p>	<ul style="list-style-type: none"> • Demonstrate how a hacksaw blade can be inserted correctly • Demonstrate how to use adjustable hacksaw, junior hacksaw piercing • Students should be allowed to practice till competent • Assess the students 	
General Objective 3.0: Machine Tools			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-9	<p>3.1 Setting up and operate a drilling machine in a 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 up the drill bit in chuck <p>3.2 Sharpen a twist drill correctly to manufactures' specification</p> <p>3.3 Perform with facilities the following operations:</p> <ol style="list-style-type: none"> a. drilling blind holes b. drilling round stock c. counterboring and counter-sinking d drilling large diameter holes 	<ul style="list-style-type: none"> • Demonstrate how to set up and operate a drilling machine. • Students to practice till competent • Demonstrate how a twist drill can be sharpened correctly • Demonstrate with the appropriate facilities 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 	<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

General Objective 3.0: Machine Tools			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-9	<p>3.4 List the operation square and cut internal (through and blind) and external threads by hand method and state precautions to taken when taping 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 the marking out procedures on bench work using datum lines datum faces, etc • Students to practice till they become competent • Assess the student. 	
General Objective 3.0: Machine Tools			
Week	Specific Learning Objective:	Week	Specific Learning Objective:
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) • 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
Assessment profile: Practical to take 60% of the overall assessment			

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: General Metal Work I **Course Code: CME 11** **Contact Hours 7hrs/wk**

Course Specification: Knowledge Requirement

Week	General Objective 1.0: Understand Workshop Safety Rules And Application In Machine Shop		
	Specific Learning Outcome:	Teachers Activities	Resources
1	<p>1.1 State sources of hazards in the workshop and how to prevent them. e.g</p> <ul style="list-style-type: none"> a. handling and using hand tools, portable power tools and machines; b. stepping on or striking obstructions left on floors or benches; c. lifting, moving and storing materials or jobs; d. using inflammable or corrosive liquids and gases; e. inhaling vapours or fumes; <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 answer, determine whether the students grasped the topic • Show a film on industrial safety. • Through question and answer 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-g. • Use questions and answers to determine comprehension. • Assess the students 	<ul style="list-style-type: none"> • Safety posters, common hard tools like files hacksaw • Television, Video machine. • Overall, goggles, gloves, hardshoes, head shield, fire extinguishers.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: General Metal Work I **Course Code: CME 11** **Contact Hours 7hrs/wk**

Course Specification: Knowledge Requirement

	<p>1.4 Outline safety rules and regulations 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 the workshops; d. materials handling; e. tool handling, storage and usage; f. machine operation; g. fire protection. <p>1.5 Understand appropriate procedures in the events of a workshop accident Examples of procedures may include:</p> <ul style="list-style-type: none"> a. application of first aid to the victim; b. removal or rectification of the accident; c. reporting the accident to the appropriate authority; d. keeping a record of accidents for management use. 	<ul style="list-style-type: none"> • Give detail notes and explanation on appropriate. • Procedures to be taken in the event of workshop accident • Give detail notes and explanations to explain the meaning of the following general physical properties of metals: 	
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General Objective 2.0: Know The Physical Properties, Manufacturing Process And Application Of Ferrous And Non-Ferrous Metals In Common Use

Week	Specific Learning Objective:	Teachers Activities	Resources
2	<p>Ferrous and Non-Ferrous Metals</p> <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 detailed notes and explanations for the topics in 2.1 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: General Metal Work I

Course Code: CME 11

Contact Hours 7hrs/wk

Course Specification: Knowledge Requirement

<p>2.2 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.</p> <p>Cast Irons - gray cast iron malleable cast iron, alloy cast irons (spheroidal and acicular)</p> <p>Alloy Steels - High speed steels, high tensile steels, tungsten, carbide, stainless steels, stellite</p> <p>2.3 Outline:</p> <p>a. the cupola process of manufacture of cast iron; b. the blast furnace process of manufacture of pig iron; c. the direct reduction process of manufacture of steel.</p> <p>Note: A visit to a steel manufacturing plant is recommended.</p> <p>2.4 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 bronze tunmetal, bell metal, aluminium bronze, phosphor bronze and lead.</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, gray cast iron, malleable cast iron, alloy cast iron high speed steels, high tensile steels tungsten, carbide, stainless steels • Give notes and explanation on the cupola process, the blast furnace and the direct reduction process of manufacture of steel. • 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. <p>Assess the students</p>	<ul style="list-style-type: none"> • Video and television including cassettes on production processes.
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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

Course Specification: Knowledge Requirement

General Objective 3.0: Select And Use Common Measuring, Marking Out, Cutting And Striking Tools.

Week	Specific Learning Objective:	Teachers Activities	Resources
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 poller, 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 and demonstrate the technique of holding work in the vise 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 it, such as filing, tapping sawing etc.</p> <p>3.10 Describe and use the following tools:</p> <ol style="list-style-type: none"> cold chisels (flat, cross, cut half round, diamond-point) centre punch and dot punch scrapers (flat, triangular, half round) power hack saw 	<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 and 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 halfround, three square, warding, mill and rasp. • Prepare detail notes that will classify the common files used in the metal work as well as the composition of materials used for their manufacture. 	<ul style="list-style-type: none"> • Steel rule, dividers calipers, trammel, scribe, and angle plate vee block, Centre Square.1 • 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, handfile engineers square. • Surface plate try square (engineers square) • File card • Flat file • Bench vice.

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Course: General Metal Work I

Course Code: CME 11

Contact Hours 7hrs/wk

Course Specification: Knowledge Requirement

4	<p>3.11 Describe the various parts of a hack saw and their function.</p> <p>3.12 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 desiging operations.</p> <p>3.12 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 operations • Prepare detail notes that will describe the functions of the various parts of a bench vice, its holding power while performing various operations • Prepare detail 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, stating the safety precautions to be observed when using a hand hacksaw. • Prepare notes that will describe the uses of various hacksaws. • Assess the students 	<ul style="list-style-type: none"> • Bench vice. • Ball pein hammers mallets. • Cold chisels, centre punches, dot punch, scrapers Hacksaw blade • Hacksaw frame • Adjustable hacksaw junior hacksaw piercing saw. • Bench drill • Pillar drill. • Twist drill, flat drill counter sink drill, counter bore drill combination centre drill.
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Course: General Metal Work I **Course Code: CME 11** **Contact Hours 7hrs/wk**

Course Specification: Knowledge Requirement

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.

Week	Specific Learning Objective:	Teachers Activities	Resources
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"> point angle too acute; point angle too obtuse; cutting edges at unusual angles; insufficient lip clearance; excessive lip clearance. <p>4.6 Calculate spindle revolution or cutting speed for specified size of drill using the formulae:</p> $N = \frac{1000S}{\pi d}$ $S = \pi dN/1000$ <p>Where S = cutting speed (m/min) N = revolution/minute D = diameter of drill (mm) $\pi = 3.142$</p> <p>4.8 State the cause and remedy of drilling faults such as:- a. drill breaking; b. drill coloured blue; c. walls of drilled hole left rough; d. chipped cutting lips.</p>	<ul style="list-style-type: none"> Give students to produce simple engineering components like open ended spanner, engineers square, tool makers clamp, center square, etc. 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. Show different types of drilling machines Make notes and drawings that will identify the various types of drilling m/cs. Prepare detail 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 	<ul style="list-style-type: none"> Ball peen hammers, mallet, cold chisels, dot/center punches, hacksaw and hacksaw blades Drilling machines and its accessories.

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5-6	4.9 State the safety precautions to be observed when using a drilling machine. 4.10 Explain the purpose of reaming and describe different types of hand and machine reamers. 4.11 Ream to given specification by hand and machine method.	<ul style="list-style-type: none"> • Twist drill (taper shank, parallel shank, jobber drill and their relative merits), flat drill, counterbore drill and combination center drill. • Assess the students. 	
General Objective 5.0: Understand The Applications Of Various Types Of Screw Threads, Rivet And Cut Screws By Hand.			
Week	Specific Learning Objective:	Teachers Activities	Resources
7	5.1 Sketch the thread forms below and state their applications:- <ol style="list-style-type: none"> a. the ISO metric thread b. the unified thread c. Whitworth and British fine threads d. British Association (BA) thread e. British Standard pipe f. Square thread g. Acme thread h. Buttress thread. 5.2 Sketch and state the functions of:- <ol style="list-style-type: none"> a. taps (taper tap, second tap, plug) b. tap wrench c. die and die stock. 5.3 Explain the meaning of tapping size or tapping drill and estimate its value in given situations using formulae such as:- $T = D - P$ Where T = tapping diameter D = thread top diameter P = pitch	<ul style="list-style-type: none"> • Give detailed notes with diagrams that will show the various forms of trade and their uses. • Prepare notes that will state the functions of taps, tap wrench, die and die stock. • Give detailed notes that will explain the meaning of tapping size or tapping drill and estimate its values using the formula: <ul style="list-style-type: none"> • $T = D - P$ • Where T = tapping diameter • D = thread top diameter and • P = Pitch 	<ul style="list-style-type: none"> • Diagrams/charts of thread forms • Parallel reamers taper reamers twist drills.

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	5.4 State precautions to be taken when tapping on the bench. 5.5 Describe and differentiate types of rivets. e.g. Snap and pan head, mushroom and counter-sunk head, flat head, dod rivet, etc. 5.6 Sketch the rivet set and state its use. 5.7 Calculate the diameter of rivet and riveting allowance in given situations.	<ul style="list-style-type: none"> • Prepare notes that will state precautions to be taken when tapping on bench. • 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 riveting allowance. • Assess the students. 	Rivet sets, drills.
General Objective 6.0: Understand The ISO Tolerances And Fits And Its Application In Engineering Production.			
Week	Specific Learning Objective:	Teachers Activities	Resources
8	6.1 Differentiate between the following:- a. nominal siz b. limits (upper and lower) c. tolerance (unilateral and bilateral) d. fit (clearance, transition interference). 6.2 Explain the importance of tolerance and fit in engineering production and describe briefly the ISO system of limits and fits. 6.3 Determine by calculation the amount of tolerance and types of fit in given situations.	<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. 	• Charts on tolerances, limits and fits.

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General Objective 7.0: Produce Simple Engineering Components On The Bench.

Week	Specific Learning Objective:	Teachers Activities	Resources
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.

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

Week	Specific Learning Objective:	Teachers Activities	Resources
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>	<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. 	<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.

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10	<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.</p> <p>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"> • 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 use 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 making 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"> • 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 cutting tool: e.g vibration and chatter, tool rubbing against or digging into the job. Define cutting speed and feed with respect to lathe Operation.</p> <p>8.11 Calculate the cutting speed and feed for given turning operation.</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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8.12 Estimate the rate of metal removal and time required for carrying out specified turning operations

8.14 State precautions to be observed when turning between centres.

8.14 Set up the lathe for and carry out basic turning operations between centres.

8.15 Compute required taper dimensions from given data using taper ratio angle formulae i.e.

$$\text{TaperRatio} = \frac{d_2 - d_1}{L}$$

OR

$$\frac{\tan \theta}{2} = \frac{d_2 - d_1}{L}$$

where θ = taper angle

d_1 - small end diameter

d_2 = large end diameter

L = length of taper

General Metal Work II

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: GENERAL METAL WORK II

MODULE CODE: CME 12

CONTACT HOURS: 5hrs/wk

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

PRACTICAL TASKS

Week	General Objective 1.0: On completion of the following practical task, the trainee will demonstrate the following abilities:		
	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			
Week	Specific Learning Objective:	Teachers Activities	Resources
3-4 5-8	2.1 Select appropriate forging tools and produce to specification given engineering components by forging processes <ul style="list-style-type: none"> a. upsetting - drawing down b. setting down - twisting c. forge welding (scarf and spice welds) d. bending, turning closed ring 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			
Week	Specific Learning Objective:	Teachers Activities	Resources
9-12	<p>3.1 Set up and operate gas or metal arc welding equipment in given situations.</p> <p>Note: Equipment operation should include choice of correct nozzles or electrode. Adjustment for correct gas pressure/flame or voltage</p> <p>3.2 Prepare joints for welding in given situations</p> <p>3.3 Weld given components by arc or gas welding methods, and state safety precautions to be observed</p>	<ul style="list-style-type: none"> • List and identify gas and metal arc welding equipment. • Demonstrate the use of both gas and metal 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, acetylene regulators, cylinders, arc, welding equipment goggles, shield, electrodes, diagrams and charts of various welding joints
Assessment: Practical - 60% of overall assessment			

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MODULE: GENERAL METAL WORK II		MODULE CODE: CME 12	CONTACT HOURS: 5hrs/wk
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	Learning Resources
1-4	<p>On completion of this module, the trainee should be able to:</p> <p>1.1 Explain briefly the structural behaviour of plain carbon steel as it is heated from room temperature to about 1000°C for the purposes of:</p> <ol style="list-style-type: none"> hardening tempering annealing normalising case-hardening. <p>1.2 Explain the meaning of hardening metal work.</p> <p>1.3 Outline safety precautions relating to heat treatment processes apply them in 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 room temperature to about 1000°C. Prepare detail notes that will explain the meaning of hardening in metalwork. Prepare notes that will outline safety precautions relating to heat treatment processes. Assess the students 	<ul style="list-style-type: none"> Recommended Text books Lesson notes, etc
General Objective 2.0: Understand The Techniques Of Producing Simple Engineering Components By Forging.			
Week	Specific Learning Objective:	Teachers Activities	Resources
5-6 7-8	<p>2.1 Explain with outline sketch the main features and working principles of the black smith's forge.</p> <p>2.2 Describe and state the functions of common forging tools. e.g anvil, swage block, leg vice, 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>	<ul style="list-style-type: none"> Prepare detail notes and diagrams that will explain the main features and working principles of the black smith's forge. Prepare notes and diagrams that will describe the functions of common forging tools. 	<ul style="list-style-type: none"> Charts etc.

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MODULE: GENERAL METAL WORK II		MODULE CODE: CME 12	CONTACT HOURS: 5hrs/wk
MODULE SPECIFICATION: KNOWLEDGE REQUIREMENTS			
5-6 7-8	<p>2.3 Describe with sketches the following forging operations:</p> <ul style="list-style-type: none"> a. upsetting b. drawing down c. setting down d. twisting e. forge welding (scarf and splice welds) f. bending g. forming closed ring h. forming an eye. 	<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, forming an eye. • Assess the students. 	
General Objective 3.0: Understand The Basic Principles And Techniques Of Gas And Metal Arc Welding And Apply Them In Fabricating Simple Metal Components.			
Week	Specific Learning Objective:	Teachers Activities	Resources
	<p>3.1 Describe the equipment and explain the basic principles and application of gas and metal arc welding.</p> <p>3.2 State the safety precautions to be observed and apply them in given welding situations.</p> <p>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.</p>	<ul style="list-style-type: none"> • Prepare detail notes and diagrams that will describe the equipment and explain the basic principles and application 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. 	<ul style="list-style-type: none"> • Oxygen cylinder acetylene cylinder regulations arc welding set goggles, shield electrode. • Diagrams and charts of various welding joints, and techniques.

General Fitting

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: GENERAL FITTING

MODULE CODE: CME 13

CONTACT HOURS: 6hrs/wk

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

1. Understand the basic principles and methods of shaping metal to given specifications.
2. Know the various clamping devices used in metal work and apply them as appropriate.
3. Grind metals of various shapes and sizes to given specifications.
4. Understand the working principles of common drilling machines and accessories and apply them to drill holes on various engineering material.
5. Understand the purposes of reaming and ream a hole
6. Lap engineering component to good surface finish and accuracy
7. Change the mechanical properties of metal using heat.
8. Understand the principles of measuring tools and apply the same to measure and align components.
9. Understand the alignment of components/machines.
10. Solder metal together.
11. Assemble machine components and equipment.

Practical Competence:

On the completion of this module, the trainee will demonstrate the following competences to the standard expected in the industry

1. Shape metals to size by methods of shearing, sawing and filing
2. Operate off-hand, and angle grinders to sharpen cutting tools; e.g chisels, flat and twist drills, scrapers. etc
3. Drill different sizes of holes precisely on location and perform specialized operations such as reaming, counter sinking and counter boring on the drilling machine.
4. Lap a given component to a high degree of surface finish and tolerance.
5. Perform heat treatment processes on metals to impart the desired qualities such as annealing, hardening, normalizing and tempering.
6. Measure with precision measuring instruments and transfer dimensions with them. Compare work piece shapes and size with gauges.
7. Perform alignment checks for flatness, concentricity, axial alignment and correct anomalies detected.
8. Carry out simple heat-methods of making joints such as soft and hard soldering.
9. Carry out simple tests to demonstrate the properties of materials; after hardness, malleability, ductility, toughness and shear strength.

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MODULE: GENERAL FITTING

MODULE CODE: CME 13

CONTACT HOURS: 6hrs/wk

10. Use co-ordinate and polar methods to locate boarders lines and features such as holes during marking-out process.

11. Select and use hand tools for carrying out a variety of bench fitting and assembly tasks. Tools; hammer, metal stamps, centre punches, scriber, hacksaw, pipe wrench, pliers and the combination set.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
Week	General Objective 1.0: Understand The Basic Principles And Methods Of Shaping Metals To Given Specifications.		
	Specific Learning Outcome:	Teacher Activities:	Learning Resources:
1-3	1.1 Describe bench operations of shaping metals to size and the layout of work-bench for fitting process. 1.2 Introduce common fitting tools, their cutting actions and use. 1.3 Explain the basic action of cutting metals by sawing. 1.4 Describe the types and parts of a hack saw and explain its cutting principles. 1.5 Select and be able to install saw blades in frame. 1.6 State the conditions for the use of hacksaws. 1.7 State the types of shearing equipment in common use. 1.8 Explain the basic principles of shearing metals to size using sriper, hand shear and bench shearing machine.	<ul style="list-style-type: none"> • Explain the layout of work-bench to enhance assessibility of tools and equipment. • Involves the students in identification of the various bench cutting tools. • Explain the cutting of metals using appropriate types of bench saws. • Explain the types and parts of hacksaw and its cutting principles • Select appropriate saw blades for specific blades for specific cutting purposes in relation to: <ul style="list-style-type: none"> • Type of material • Number of teeth of blade • Thickness of materials. • Involve the student in the selection of suitable types of shears for various purposes. • Explain the use of shears for marking straight and curved cuts on sheet metals. 	<ul style="list-style-type: none"> • The work-bench • The tool rack • Bench cutting tools: <ul style="list-style-type: none"> • Files • Hacksaw • Shears/snips • Chisels. • Various types of hand saws: <ul style="list-style-type: none"> • Hack saw • Bench vice • Junior saw. • Bench shears • Straight srips • Curved srips • Bench champ(s) • Marking-out tools.

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MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
4-6	<p>1.9 Classify files used in bench work:</p> <p>a. Fitters/machinist files.</p> <p>b. Swiss files.</p> <p>1.10 Explain the principles of filing and filing actions.</p> <p>1.11 Describe the various types of bench chisels in common use.</p> <p>1.12 State the principles of shaping metals by chiseling process.</p> <p>1.13 State the safety precautions in the use of chisels.</p> <p>1.14 Highlight the importance types and use of hammers in metal fitting.</p>	<ul style="list-style-type: none"> • Explain to the students on the selection of bench files for various purposes. • Explain the "forward" and "draw" filing operations with different types of files. • Explain the filing processes of plain, concave and convex surfaces. • Explain the use of flat, diamond, round nose and cross-cut chisels for producing the required shapes on metals. • Explain appropriate hammers for various fitting operation. • Assess the students. 	<ul style="list-style-type: none"> • Types of Files: • Flat • Half round • Triangular • Warding files. • A set of chisels. • Cross pein hammers • Straight pein • Soft hammers • Slage hammers.
General Objective 2.0: Know The Various Clamping Devices Used In Bench Fitting.			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-9	<p>2.1 Highlight the principles and operations of bench clamping devices. e.g</p> <p>a. Bench vice</p> <p>b. Leg vice</p> <p>c. Hand clamps/vice</p> <p>d. Quick release vice.</p> <p>2.2 State the methods of controlling clamping pressure and protecting the work piece from damage.</p> <p>2.3 Mention appropriate methods of clamping regular and irregular shapes.</p>	<ul style="list-style-type: none"> • Explain the use of bench, leg, quick-release and hand vices and demonstrate the application of "hard" and "soft" jaw vices in protecting the finish products for further fitting operations. • Explain the use of formers and vee blocks in clamping of irregular work piece. • Assess the students 	<ul style="list-style-type: none"> • Bench vices • Leg vices • Quick release vices • Bench clamps • Parallel strips • Angle plates • Vee Blocks • Soft • Cylindrical • Cup wheels etc.

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MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
	<p>3.1 Identify and describe the types of grinders:-</p> <p style="padding-left: 40px;">a. bench grinders</p> <p style="padding-left: 40px;">b. pedestal grinders</p> <p style="padding-left: 40px;">c. hand grinders</p> <p>3.2 State the characteristics of a good grinding stone: fine, medium, rough.</p>	<ul style="list-style-type: none"> • Explain to the students the operation and care of grinding machine. • Describe "off hand" grinding methods and use of workrest in grinding process. • Discuss different types of grinding wheels and state their works. • Assess the students 	
10	<p>3.3 Apply safety precautions as necessary when performing grinding operations e.g wearing protective goggles or face shield; holding work and tools at correct angle, etc.</p>	<ul style="list-style-type: none"> • Explain to the students the various safety precautions and prepare notes accordingly. • Assess the students. 	
General Objective 4.0: Understand The Working Principles Of Common Drilling Machines And Accessories And Apply Them To Drill Holes On Various Engineering Materials.			
Week	Specific Learning Objective:	Teachers Activities	Resources
11-12	<p>4.1 Differentiate between the following types of drilling machines; sensitives, pillar and the radial drilling machines and state the principles of operation, construction and care of common types of drilling machines.</p> <p>4.2 Describe the various types of drills and their applications.</p> <p>4.3 Describe the type of materials used for twist drills.</p>	<ul style="list-style-type: none"> • Explain to the student the operations and working principles of sensitive (bench), pillar and radial drilling machines, and prepare notes accordingly • Describe the setting and drilling processes with the various types and sizes of drills and work pieces. • Explain to the students the various types of drills and their applications, prepare notes accordingly • Assess the students 	<ul style="list-style-type: none"> • Drilling Machines • Bench • Hand • Pillar • Radial • Assorted • Shapes of work pieces.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
General Objective 5.0: Understand The Principles And Purposes Of Reaming.			
Week	Specific Learning Objective:	Teachers Activities	Resources
13	5.1 Explain the operation of reaming and boring a hole. 5.2 State the purposes of reaming.	<ul style="list-style-type: none"> • Explain the reaming of holes using various types and sizes of reamers. • Explain the application and adjustment of expanding reamers, and make notes • Assess the students 	<ul style="list-style-type: none"> • Solid Reamers • Parall • Taper • Adjustable or expanding reamers. • Drilling machines and various sizes of drills.
General Objective 6.0: Lap engineering component to good surface finish and accuracy.			
Week	Specific Learning Objective:	Teachers Activities	Resources
14	6.1 Explain the working principles and operations of lapping machine. 6.2 Select appropriate tools and paste for lapping flat surfaces, curved surfaces, diameters (internal, external), e.g valve seating.	<ul style="list-style-type: none"> • Explain the operation of lapping machine. • Involve the students in selecting the appropriate speed and paste for various jobs, and make notes 	
15	6.3 State the composition of lapping paste used for lapping various surfaces.	<ul style="list-style-type: none"> • Explain the lapping of surfaces to the required finish and accuracy, and make notes • Assess the students 	<ul style="list-style-type: none"> • Lapping machines • Lapping pastes • Honing machine with tools.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
General Objective 7.0: Change The Mechanical Properties Of Metals Using Heat			
Week	Specific Learning Objective:	Teachers Activities	Resources
16-17	7.1 Explain the effect of carbon on heat treatment of metals. 7.2 Describe the following in relation to heat treatment: a. relation between temperature and colour b. correct quenching media c. techniques of quenching. 7.3 State the types and functions of heat treatment furnaces.	<ul style="list-style-type: none"> • Explain to the students the heat treatment processes of: • Hardening • Annealing • Tempering • Normalising, and make notes 	<ul style="list-style-type: none"> • Various types of work materials. • The tong • Containers of quenching liquids.
18-19	7.4 Identify hardening materials and state their composition. 7.5 Define and carry out the following processes:- a. hardening; b. annealing; c. normalizing; d. tempering; e. stress relieving processes. 7.6 Explain the purpose and methods of case-hardening.	<ul style="list-style-type: none"> • Make adequate explanations on notes on 7.4 and 7.5 • Assess the students 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
General Objective 8.0: Understand The Principles Of Measuring Tools And Apply Them To Measure Component.			
Week	Specific Learning Objective:	Teachers Activities	Resources
20-24	8.1 Outline the importance of measurement. 8.2 Explain the difference between the English and metric system of measurement. 8.3 Describe the kinds, and parts of micrometers e.g: a. Outside micrometer b. Inside micrometer c. Depth micrometer d. Screw-thread micrometer etc. 8.4 Describe the functions of parts of micrometers. 8.5 Describe how the micrometer work. 8.6 Describe how a micrometer can measure to one hundredth a milimetre. 8.7 Explain why a caliper should be held lightly with the fingertips when measuring a part. 8.8 Explain the difference between gauging and measuring. 8.9 Describe an electronic gauge. 8.10 List the parts of a combination set. 8.11 Describe the difference between a 25-division vernier caliper and a 50-division vernier caliper. 8.12 Describe the common lengths of a sinebar.	<ul style="list-style-type: none"> • Explain the students on the operation and care of measuring instruments, and make adequate notes • Assess the students. • Explain how to carry out external and internal measurement with micrometers and vernier calipers. • Explain to the students on the use of protractors spirit levels and dial indicator and accessories, make notes and assess the students • Explain the application of gauges to determine the accuracy of jobs, make notes and assess the students • Make adequate explanation and notes for 8.7 to 8.9 • Assess the students. • Make adequate explanation and notes for 8.10 to 8.12 	<ul style="list-style-type: none"> • Micrometers • Plain • Vernier • Internal • Vernier Calipers • External • Internal • Metric. • Protractors • Limit of standard • gauges • rulers • tapes. • Dial indicators • comparators • surface testers.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
26-27	8.13 Describe the difference between a sinebar and a sine plate. 8.14 Describe the difference between a "Go" and No-Go gauge. 8.15 Explain the principles of vernier micrometer.	• Make adequate explanation and notes for 8.13 to 8.15	
28-29	8.17 Inspect finish components, machinery and equipment using gauges. 8.18 Select the following gauges for particular inspections:- a. telescopic gauge, spirit level; b. plug gauges; c. ring gauges; d. slip gauges; e. thread gauges; f. feeler gauges; g. calliper gauges; h. engineer square, straight edge; i. radius gauge; j. dial test indicator.	• Make adequate explanation and notes for 8.17 to 8.18	
30	8.19 State the limits and accuracies of the gauges in 8.4 above. 8.20 Set and use each of the gauges listed in 8.4 above.	• Make adequate explanation and notes for 8.19 to 8.20 • Assess the students.	
General Objective 9.0: Understand The Alignment Of Components/Machines.			
Week	Specific Learning Objective:	Teachers Activities	Resources
31	9.1 State the purposes of alignment in engineering. 9.2 Describe the methods of checking alignment.	• Explain to the students the alignment and checking of machines and components by the use of spirit levels, dial indicators and accessories.	• Recommended equipment as in 8.0 above.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GENERAL FITTING		MODULE CODE: CME 13	CONTACT HOURS: 6hrs/wk
MODULE SPECIFICATION: Knowledge Requirement			
33	9.7 Select appropriate tools and align the centres of a lathe. 9.8 Test for straightness, roundness, surface finish and centre distance.	• Make adequate explanations and notes for 9.7 to 9.8	
General Objective 10.0: Understand The Methods Of Soldering For Metal Jointing Process.			
Week	Specific Learning Objective:	Teachers Activities	Resources
34	10.1 State the composition of soft solders and explain the principles of soldering and the factors that determine if a job should be soldered.	• Explain the heating and application of soldering iron or bits in joining sheet metal pieces, and make notes accordingly. • Assess the students	• Soft solders • Soldering bit • Heating furnace • Fluxes.
	10.2 Describe soldering equipment and their functions and state the purposes of fluxes. 10.3 Differentiate between the melting points of solder and metal. 10.4 Describe the lead-tin equilibrium diagram for soft solders. 10.5 Test soldered joints for rigidity and leakage.	• Make adequate explanations and notes for 10.2 to 10.5 • Assess the students	
General Objective 11.0: State The Basic Procedure Of Assembling Simple Mechanical Devices.			
Week	Specific Learning Objective:	Teachers Activities	Resources
35	11.1 Read machine blue print, the working drawing and identify the components.	• Explain to the student the assembly of simple machine and equipment and use of assembly tools, and make notes accordingly.	• Spanners • Screw drivers • Assembly benches.
36	11.2 Describe the functions of the components. 11.3 Explain how to select appropriate devices for assembling. 11.4 Explain the procedure for testing for efficiency of the assembled machine.	• Explain how to test for the efficiency of the assembly, and make notes accordingly. Assess the students	

Module: General Fitting		Module Code: CME 13	Contact Hours 52
Module Specification: Practical Tasks			
Week	General Objective 1.0: On completion of the following practical task, the trainee will demonstrate the following abilities:		
	Specific Learning Outcome:	Teachers Activities	Resources
1-10	<p>13. Select and be able to install saw blades in frame.</p> <p>14. Cut metal to specification using hacksaw or power saw</p> <p>15. Cut metals to size using any of the following: snipp/ hand shear, bench shear and power shear.</p> <p>16. File flat and curved surfaces</p> <p>17. Frost the surface</p> <p>18. Select the correct shapers for shipping job</p> <p>19. Shape metal to shape using chisels</p> <p>20. Select and use appropriate clamping device in a metal angle plate, strap clamp</p> <p>21. Protect finished surfaces when applying clamps.</p> <p>22. Select appropriate grinding wheel for a job</p> <p>23. Carry out grinding operation with facility</p> <p>24. Dress and true the off-hand grinding wheel with a star dresser</p>	<ul style="list-style-type: none"> • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students 	<ul style="list-style-type: none"> • Work bench, Tool rack • Hacksaw and hacksaw blade • Shears/snips • Files. • Chisels and workpiece • Clamps and workpiece • Grinding machines • (Bench, pedostal, hand) cylindrical and plane workpieces • set of grinding wheels (hard, soft, cylindrical, cup wheel, etc

Module: General Fitting		Module Code: CME 13	Contact Hours 52
Module Specification: Practical Tasks			
12-24	<p>13. Install drill/drilling accessories on the check of a drilling machine.</p> <p>14. Select feed and cutting speeds to suit the diameter of drill.</p> <p>15. Drill a clean hole with drilling machines to given specifications on a flat workpiece and a round workpiece.</p> <p>16. Adjust expansion reamer to correct size of hole</p> <p>17. Ream hole using hand and machine tools observing safety precaution.</p> <p>18. Select correct lapping speed</p> <p>19. Set and lap the surface to the required finish and accuracy.</p> <p>20. Carry out the heat treatment processes of: Hardening, Annealing, Normalizing, Tempering, stress relieving, Case hardening</p> <p>21. Take accurate measurements using: Vernier gauges, vernier protractor, dial indicators, optical instrument, micrometer.</p> <p>22. Inspect finish component, machinery and equipment using gauges</p>	<ul style="list-style-type: none"> • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students 	<ul style="list-style-type: none"> • Drilling machines • (bench, hand, pillar, radial, assorted) and accessories • Workpieces • Solid reamers (parall, taper) • Lapping machines, lapping paste, honing machine. • Furnace and tongs • Micrometers (plane, vernier internal) • Vernier calipers (external, internal and metric) • Gauges
25-27	<p>23. Check the alignment of centers by observing if the point of the dead center touches the point of the live center</p> <p>24. Check the alignment with a steel test bar and dial indicator.</p> <p>Note: The dial indicator must stay at zero as the carriage is moved back and forth</p> <p>25. Check the alignment after machining a bar and determine if the cut is straight or tapered by taking a light cut at both ends of a piece of scrap stock and measuring with micrometer</p>	<ul style="list-style-type: none"> • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students 	<ul style="list-style-type: none"> • Dial indicators, comparators, surface testers. • Recommended equipment

Module: General Fitting		Module Code: CME 13	Contact Hours 52
Module Specification: Practical Tasks			
28-36	<p>26. Locate and align components by using dowel e.g mark out dowel "box" the drill hole with correct reaming allowance</p> <p>27. Test for straightness, roundness, surface finish and center distance</p> <p>28. Carry out alignment for: shaft, pulley, couplings, belts, chains, sprocket, horizontal, vertical or angular planes</p> <p>29. Solder joints</p> <p>30. Test soldered joints for rigidity and leakage</p> <p>31. Select appropriate devices for assembling</p> <p>32. Test for efficiency of the assembled machine</p>	<ul style="list-style-type: none"> • Demonstrate for students to practise till they become competent. • Assess the student • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practise till they become competent. • Assess the students • Demonstrate for students to practice till they become competent. • Assess the students 	<ul style="list-style-type: none"> • Recommended equipment • Recommended equipment • Recommended equipment • Soft solders, soldering bits, heating furnace, fluxes. • Recommended equipment • Recommended equipment • Recommended equipment
NTC Assessment Profile: Practical to take 60% of overall assessment.			

Turning

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Turning

Module Code: CME 14 - Turning

Contact Hours 6hrs/wk

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

1. Understand the essential features and the working principles of lathe machines and use the lathes to produce various engineering components to given specifications.
2. Calculate speed and gear train for screw cutting
3. Understand the basic principles and methods of taper turning and apply them in the production of engineering components. Know the four basic work holding methods and the use of the various work holding equipment for turning jobs on the lathe
4. Understand the working principles of turret, automatic and capstan lathes and operate them to produce work pieces to specification

Practical Competence:

On completion of this module the trainee will demonstrate the following practical competences to a standard expected in industry safety in the work place:

1. Comply with the general rules for safe practice in the working environment at all times and use all tools correctly ensuring that machinery guards and protective eye shields are used at all times.
2. Select, grind and mount lathe tools to turn a variety of metals and plastic materials. Tools: Straight nose, facing, knife, parting and chamfer tools; Materials: low and high carbon steels, bronze, polymetric materials.
3. Mount workpiece on a center lathe using appropriate methods: Concentric (3-jaw), independent and collect chucks, driving plate and centers
4. Select appropriate speeds and feeds on center lathe to carry out a range of machine processes on both metals and plastic materials using appropriate coolants where necessary; Machining Process: facing, center drill, drill through workpiece and drill to a given depth, ream, cut threads using tap, dies and screw cutting on the machine, knurl, turn external diameter bore through workpiece and part-off solid bar, turn to shoulder and turn tapers compound slide and tail stock set over.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Turning

Module Code: CME 14 - Turning

Contact Hours 6hrs/wk

5. Select appropriate cutting tools, speeds and feeds on a turret and capstan lathes to carry out a range of machining processes. Machining Process: face work to center, turn up to an external shoulder, turn external diameter, center drill, drill through a workpiece and drill to a given length. Perform taper turning, grind using the tool post grinder, bore and recess while holding job; in chuck, on face plate, on the saddle and on fixed steady; perform screw cutting using the methods of: Single point tool to execute plunge and angular cuts, solid and collapsible chaser, die head and thread rolling
6. Copy as sample workpiece using the copying attachment on turret/capstan or center lathe

PRACTICAL TASKS

Week	General Objective: 1.0: On completion of the following practical task, the trainee will demonstrate the following abilities:		
	Specific Learning Outcome:	Teachers Activities	Resources
1-2	1.1 Use all tools correctly ensuring machinery guide and protective eye shields are used at all times and wear the correct clothing include safety boots, overalls and helmet were appropriate	<ul style="list-style-type: none"> • Demonstrate the operations of safety devices and safety procedure during accident • Assess the students 	<ul style="list-style-type: none"> • Safety gadgets
	General Objective 2.0: Set The Lathe Machine For Various Turning Operations, Using The Appropriate Speed And Feeds, E.G Align Centres Of The Lathe, Etc		
Week	Specific Learning Objective:	Teachers Activities	Resources
3-4	Select and grind to the correct angles lathe tool cutters/bits for different materials/operations	<ul style="list-style-type: none"> • Demonstrate operations of lathe machine • Demonstrate the act of tool grinding for various operations. Task students to do same • Assess the students 	<ul style="list-style-type: none"> • Lathe machines and its accessories
	General Objective 3.0: Mount Work With Various Work Holding Devices: Equipment: 3-Jaw, 4-Jaw, Coolant, Chucks, Face Plate, Mandrels, Centres Etc		
Week	Specific Learning Objective:	Teachers Activities	Resources
5-6	3.1 Operate the lathe to produce a piece of job to specification	<ul style="list-style-type: none"> • Demonstrate the mounting and set up of various work holding devices and task students to do same • Demonstrate for the students to practise • Assess the students 	<ul style="list-style-type: none"> • Coolant, chucks, face plates, mandrels, centers, etc
	General Objective 4.0: Maintain the lathe machine:		
Week	Specific Learning Objective:	Teachers Activities	Resources
7-8	4.1 Cleaning and lubricating the machine <ul style="list-style-type: none"> a. topping up oil levels b. greasing parts c. adjusting slides and belt 	<ul style="list-style-type: none"> • Carry out procedure in machine maintenance and task students to do likewise • Assess the students 	

General Objective 5.0: Interpret Working Drawing From Orthographic And Isometric Drawings			
Week	Specific Learning Objective:	Teachers Activities	Resources
9-12		<ul style="list-style-type: none"> • Provide working drawings and interpret them for production purposes • And allow the students to do the same • Assess the students 	<ul style="list-style-type: none"> • The working drawings
General Objective: 6.0: Perform The Following Operations On The Lathe And Observe Safely			
Week	Specific Learning Objective:	Teachers Activities	Resources
13-14	<ul style="list-style-type: none"> a. drilling b. reaming c. tapping d. knurling e. cutting screw threads f. vi taper turning g. vii Parallel turning 	<ul style="list-style-type: none"> • Demonstrate each of the listed lathe operations and instruct student to follow suit. • Assess the students 	<ul style="list-style-type: none"> • Centre lathes and accessories
General Objective 7.0: Determine The Work Plan For A Turning Job			
Week	Specific Learning Objective:	Teachers Activities	Resources
15-17	<ul style="list-style-type: none"> a. interpret working drawings; b. select work holding devices; c. determine the sequence of operation; d. calculate cutting speed e. select feed f. carry out related calculation g. button boring h. eccentric turning 	<ul style="list-style-type: none"> • Demonstrate the activities in 7.0 for the students to practise and become competent. • Assess the students 	
General Objective 8.0: Carry Out Preventive Maintenance			
Week	Specific Learning Objective:	Teachers Activities	Resources
18 - 20	<ul style="list-style-type: none"> a. clean the machine b. oil the machine c. adjust slides d. replace components due for replacement instruction. 	<ul style="list-style-type: none"> • Demonstrate the activities in 8.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • Complete tool box for maintenance

General Objective 9.0: Mount And Use Face Plate, Angle Plates, Chucks, Collets, Soft Jaw, Solid Mandrel, Steadies, (Fixed And Traveling)			
Week	Specific Learning Objective:	Teachers Activities	Resources
21		<ul style="list-style-type: none"> • Demonstrate the activities in 9.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • Chucks, collet, soft jaw, mandrels, steadies, etc
General Objective 10.0: Bore/Recess While Holding The Job:			
Week	Specific Learning Objective:	Teachers Activities	Resources
22-24	<ul style="list-style-type: none"> a. in the chuck; b. on the face plate; c. on the saddle d. on fix steady 	<ul style="list-style-type: none"> • Demonstrate the activities in 10.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • -do-
General Objective 11.0: Grind On The Lathe Using The Tool Post Grinder And Observe All Necessary Safety Precautions			
Week	Specific Learning Objective:	Teachers Activities	Resources
25-26		<ul style="list-style-type: none"> • Demonstrate the activities in 11.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • Tool post grinder.
General Objective 12.0: Cut Screw Threads Using The Following Methods:			
Week	Specific Learning Objective:	Teachers Activities	Resources
27-29	<ul style="list-style-type: none"> a. single point tool (plung method, angular method) b. chasers, solid chasers, collapse chaser c. die head d. thread rolling 	<ul style="list-style-type: none"> • Demonstrate the activities in 12.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • Threading tools

General Objective 13.0: Carry Out Relieve Turning Using The Appropriate Attachment			
Week	Specific Learning Objective:	Teachers Activities	Resources
30-33		<ul style="list-style-type: none"> • Demonstrate the activities in 13.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • Lathe machine and accessories
General Objective 14.0: Carry Out Form Turning Operation Including The Use Of Coping Attachment And Form Feels			
Week	Specific Learning Objective:	Teachers Activities	Resources
34-36		<ul style="list-style-type: none"> • Demonstrate the activities in 14.0 for the students to practise and become competent. • Assess the students 	<ul style="list-style-type: none"> • Lathe machine and accessories

KNOWLEDGE REQUIREMENTS

General Objective 1.0: Understand Essential Features And The Working Principles Of Lathe Machines And Use The Lathe To Produce Various Engineering Components To Given Specifications			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-5	<p>1.1 Identify the types of lathes, centre lathe, capstan lathe, turret lathe and screen lathe</p> <p>1.2. Explain the working principles of a lathe turning machine</p> <p>1.2 Describe the functions and constructional details of the component parts of each lathe and its accessories - such as 3-jaws chuck, 4-jaw chucks, collect chuck, magnetic chuck, air or pneumatic chuck hydraulic chuck, post grinder, turret, fixed and traveling steadies, face plate, etc</p> <p>1.3 Explain and check by using gauges the function of the various angles on a lathe tool.</p> <p>1.4 State the problems associated with the machining of plastics and the speeds and feeds necessary</p>	<ul style="list-style-type: none"> • Highlight distinguishing features of different lathe and make notes where necessary • Explain working principles of the lathe and ask student to produce their diagrammatic illustration of the principles • Put stress on uses and care of parts mentioned in 1.3 • Illustrate various angles at tool point • Discuss properties of plastic and the effect on them • Assess the students 	<ul style="list-style-type: none"> • Pictures of different types of lathe from textbooks, catalogue, etc • Charts -do- • Wooden model of various kinds of lathe tools with detachable point from shank • Table of plastic materials and their properties
General Objective 2.0 Calculate Speed And Gear Train For Screw Cutting			
Week	Specific Learning Objective:	Teachers Activities	Resources
6-12	<p>2.1 Calculate the cutting speed of a lathe:</p> $S = Nd/1000$ $\pi = 3.142$ <p>d = Diameter of work N = Revolution per minute S = Surface speed of material in m/minute</p> <p>2.2 Calculate simple and compound gear trains for screw cutting where</p> $\frac{\text{Driver (Gear)}}{\text{Driven (Gear)}} = \frac{\text{Pitch to cut}}{\text{Pitch of leadscrew}}$	<ul style="list-style-type: none"> • Solve many problems for the students to practise • Assess the students 	<ul style="list-style-type: none"> • Notes of solve problems.

General Objectives 3.0: Understand The Basic Principles And Methods Of Taper Turning And Apply Them In The Production Of Engineering Components With Tapered Surfaces.			
Week	Specific Learning Objective:	Teachers Activities	Resources
13-15	3.1 Identify different methods of taper turning, tail stock set over, compound slide, form tools taper attachment, copying attachment 3.2 Explain the various methods of taper turning a. form tool; b. use of compound slide c. setting over the tail stock d. use of compound feeds (simultaneous e. taper turning attachment 3.3 Calculate the angle for taper turning 3.4 Calculate the angular error in taper turning derived from tool setting	<ul style="list-style-type: none"> • Illustrate methods of turning taper in 3.1 • Describe methods given in 3.2 and make notes where necessary • Explain worked examples and give assignment to students 	<ul style="list-style-type: none"> • Recommended textbooks, lesson note, chalkboard, and chalk
General Objective 4.0: Know The Four Basic Working Holding Methods And The Use Of The Various Work Holding Equipments For Turning Jobs On The Lathe.			
Week	Specific Learning Objective:	Teachers Activities	Resources
16-24	4.1 Describe the various types of work holding equipment used on the centre lathe: a. Chuck - collet, three jaw, four-jaw and face plate b. Catch plates c. Mandrels - plain, parallel, expanding, and spine d. Centres	<ul style="list-style-type: none"> • Ask student to match different configuration of work pieces with their appropriate work holding device • Assess the students 	<ul style="list-style-type: none"> • Film strip, slide, pictures from textbooks

3 rd term	General Objectives 5.0: Understand The Working Principles Of Turret, Automatic And Capstan Lathes And Operate Them To Produce Work Pieces To Specifications.		
Week	Specific Learning Objective:	Teachers Activities	Resources
25-36	<p>5.1 Explain the working principles and the main functions of the capstan, automatic and turret lathes and their accessories</p> <p>5.2 Determine the work plan for a turning job</p> <ol style="list-style-type: none"> a. interpret working drawings b. select work holding devices c. determine the sequence of operation; d. select appropriate tools and materials e. calculate cutting speed f. select feed g. carry out related calculation 	<ul style="list-style-type: none"> • Explain working principles of listed lathes and contrast with each other • Develop sequence of operations with time frame for each and tools for each scheme • Assess the students. 	<ul style="list-style-type: none"> • Video show, film strip, diagrammatic illustrations
	<p>Assessment Profile:</p> <p>Assessment of this module should be based 60% practical, and 40% theory. Theory should be assessed by the use of multiple choice and true/false questions, which should cover the underpinning knowledge across the range of the curriculum. Theory questions should be designed to assess knowledge and understanding. Where possible the underpinning knowledge should relate to the practical task assessed the under pinning knowledge should relate to the practical tasks assessed. Practical content should be assessed by the use of practical tasks which reflect the competence outlined at the beginning of each module.</p>		

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Mechanical Engineering Craft Practice	Module Code: CME 15 - Milling	Contact Hours 8hrs/wk 1st term 11hrs/wk 3hrs/wk
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Course Specification: The module is designed to provide the trainee with the knowledge and skills to enable him produce engineering components

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

1. Understand the working principle of a milling machine and operate the same machine to produce engineering components
2. Determine the correct work holding devices and use them for mounting work piece for milling operations
3. Understanding the working principles of a plane milling machine and operate the same machine to produce engineering components.

PRACTICAL COMPETENCE

On completion of this module the trainees will demonstrate the following competences to a standard expected in trade

1. Identify common milling cutters; slab, side and face, slotting, angular, etc. Select and mount appropriate cutters onto milling.
2. Machine arbours, adaptors and collar chucks for the horizontal and vertical milling machines.
3. Select and mount work holding devices on milling machine. Work holding devices: milling Vice, plate clamps, dividing head, rotary table
4. Select and set milling speeds and feeds to carry out a range of milling operations using appropriate cutting fluids. Milling operations: Square right angled faces, mill horizontal and vertical faces, mill stepped faces, mill open-ended and enclosed slots, mill single angle and vees, mill square ended shaft.
5. Maintenance Operations: Trouble shoot and remedy mechanical faults

Typical Items To Manufacture:

- Parallel Strip
- Stepped faces block
- Key way cutting within and end of shaft
- Jacob chuck key
- Helical gear
- Worm wheel.

Milling

Module: Milling		Module Code: CME 15	Contact Hours 52
Module Specification: Practical Tasks			
Week	General Objective 1.0: On completion of the following practical task, the trainee will demonstrate the following abilities:		
	Specific Learning Outcome:	Teachers Activities	Resources
1-7	<p>a. Select appropriate cutters e.g helical side and face cutter, shell and mill, splitting saw, profile cutter high and heavy duty plain cutters, angular milling cutter.</p> <p>b. Set the machine for milling operation.</p> <p>c. Sharpen milling cutters.</p> <p>d. Mill parallel and square surface with a milling machine.</p> <p>e. Mill angular surfaces.</p> <p>f. Select indexing plate - hexagonal, pentagonal, etc.</p> <p>g. Set the sector arm.</p> <p>h. Produce large range of circular division by using indexing head.</p> <p>i. Mount and align the cutters.</p>	<ul style="list-style-type: none"> • Show, describe and explain to students the functions of different types of cutters e.g helical side and face cutter, shell and mill, splitting saw, profile cutter high and heavy duty plain cutters, angular milling cutters. • Demonstrate to the students the setting of different types of milling machines for various types of milling operations with special emphasis on table alignments. • Explain and demonstrate the sharpening of different milling cutters. • Demonstrate practically milling of parallel and square surfaces. • Demonstrate practically milling of angular surfaces. • Guide students to select indexing plate-hexagonal, pentagonal, etc. • Guide students to set the sector arm. • Guide students to produce • Guide students to mount and align the cutters. • Assess the students 	<ul style="list-style-type: none"> • Videotapes of different milling operations, maintenance activities and safety issues preferably from the manufacturers of equipment or tapes developed locally. • Milling machines and its accessories.

Module: Milling	Module Code: CME 15	Contact Hours 52	
Module Specification: Practical Tasks			
	<p>j. Produce a seat for flat surfaces.</p> <p>k. Mill two surface parallel at one setting.</p> <p>l. Demonstrate the working principle of stradle milling at one setting.</p> <p>m. Produce multiple surfaces at one passage of the cutter.</p> <p>n. Mount the cutters desired to produce the required</p> <p>o. profile ensuring the elimination of end thrust.</p> <p>p. Maintain the milling machine:</p> <p style="padding-left: 20px;">a. clean the machine;</p> <p style="padding-left: 20px;">b. grease nipples;</p> <p style="padding-left: 20px;">c. top up oil level;</p> <p style="padding-left: 20px;">d. service coolant pump;</p> <p style="padding-left: 20px;">e. adjust slides.</p> <p style="padding-left: 20px;">f. Mount jobs on these devices for milling operations.</p>	<ul style="list-style-type: none"> • Guide students to produce a seat for flat surfaces. • Guide to milling two surfaces parallel at one setting. • Explain the working principle of stradle milling at one setting. • Guide students in the production of multiple surfaces at one passage of the cutter. • Guide students to mount the cutters desired to produce the required profile ensuring the elimination of end thrust. • Demonstrate the maintenance of the milling machine as detailed in the instruction manual (see 1-2). Particular attention should be paid to:- <ul style="list-style-type: none"> • cleaning of the machine • greasing of the nipples • topping up oil level • servicing of coolanut pump • adjustment of slides. • Assess the students 	
13-14	<p>v. Set up the machine for milling operation.</p>	<ul style="list-style-type: none"> • Guide students to mount jobs on the work holding devices shown and demonstrated in 2.1 above for milling operations. 	

Module: Milling		Module Code: CME 15	Contact Hours 52
Module Specification: Practical Tasks			
15-24	<p>w. Perform the following milling operations using the appropriate machine, attachments, work holding devices, milling fixtures and cutters to produce a job to specification:</p> <ul style="list-style-type: none"> a. dog teeth; b. cerration; c. spliner; d. profile milling; e. dovetail & tee slot; f. gears helical spur; g. worm wheel bevel; h. helical milling; i. rotary table; j. differential indexing; k. milling cam. 	<ul style="list-style-type: none"> • Guide and monitor, students perform the following milling operations using the appropriate machine, attachments, work holding devices, milling fixtures and cutters: <ul style="list-style-type: none"> • dog teeth • cerration • spliner • profile milling • dovetail and tee slot • gears helical spur • worm wheel bevel • helical milling • rotary table • differential indexing • milling cam. • Assess the students 	<ul style="list-style-type: none"> • Milling machines and accessories
25-26	<p>x. Demonstrate maintenance of the plain milling machine identify critical safety measures.</p> <p>y. Mount tools and cutters on the machines.</p> <p>z. Identify and select the appropriate attachment for a milling operation;</p> <ul style="list-style-type: none"> i. vertical head; ii. slotting attachment; iii. milling cam. 	<ul style="list-style-type: none"> • Explain and demonstrate the maintenance of a plain milling machine using the instruction manual as a guide. Explain safety aspect also. • Show appropriate attachment for a milling operation viz; <ul style="list-style-type: none"> • vertical head; • slotting attachment; • milling cam. • Assess the students 	<ul style="list-style-type: none"> • Complete tool box for maintenance

Module: Milling	Module Code: CME 15	Contact Hours 52
Module Specification: Practical Tasks		
27-36	<ul style="list-style-type: none"> a. Mount tools and cutters on the machine. b. Set up for various milling operations. c. Perform the required milling operation on work piece to given specifications. d. Clean and oil the machine. carry out other maintenance due. e. Adjust the slide of the plain machine. 	<ul style="list-style-type: none"> • Guide students to set up for various milling operations. • Guide students to set up for various milling operations. • Explain expected milling operation on work piece as specified. • Guide students to clean and oil the machine. Guide also to carry out other due maintenance activities. • Demonstrate practically the adjustment of the slide of the plain machine. • Assess the students
NTC Assessment profile - practical to take 60% of overall assessments.		

PROGRAMME: NATIONAL TECHNICAL CERTIFICATES IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: MILLING

MODULE CODE: CME 15

CONTACT HOURS: 300

MODULE SPECIFICATION: Knowledge Requirements

Week	General Objective: 1.0: Understand The Working Principle Of A Milling, Operate And Maintain The Same Machine To Produce Engineering Components.		
	Specific Learning Outcome	Teacher's Activities	Learning Resources
	<p>1 Identify types of milling machines: a vertical milling b horizontal spindle milling machine (plain milling machine and universal milling machine).</p> <p>1.2 Explain the working principles of a milling machine. Explain basic maintenance activities on a milling machine, mention necessary safety precautions.</p> <p>1.3 Describe the function and constructional details of the component parts of each milling machine and its accessories, e.g vertical attachment collars, rotary table, parallel strips, etc.</p> <p>1.5 Select appropriate cutters e.g helical side and face cutter, shell, end mill, splitting saw, profile cutter high and heavy duty plain cutters, angular milling cutter.</p>	<ul style="list-style-type: none"> • Show students different types of milling machines including vertical, horizontal spindle milling machine (plain milling machine and universal milling machine). • Show and discuss with the students the instruction and maintenance manuals to acquaint them with various aspects of the machines (working principles and maintenance). • Demonstrate the function and constructional details of the component parts of each milling machine and its accessories by dismantling and coupling back in a step by step fashion (e.g vertical attachment collars, rotary table, parallel strips, etc. 	<ul style="list-style-type: none"> • Milling Cutters • Milling Machines and Accessories. • Milling machine • Component part, drilling machine • Videotapes of different milling operations, maintenance activities and safety issues preferably from the manufacturers of equipment or tapes developed locally. Drilling head, indexing palte - do -

PROGRAMME: NATIONAL TECHNICAL CERTIFICATES IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: MILLING		MODULE CODE: CME 15	CONTACT HOURS: 300
MODULE SPECIFICATION: Knowledge Requirements			
GENERAL OBJECTIVE 2.0			
7-12	<p>1.8 Identify, select and use the appropriate work holding devices on the milling machine:</p> <ul style="list-style-type: none"> a. vices; b. plain & universal; c. auxiliary tables; d. soft jaws; e. dividing head f. rotary table; g. clamps; h. chuck and collets; i. fixtures. 	<ul style="list-style-type: none"> • Show and demonstrate the use of appropriate work holding devices on the milling machine. Particularly the following among others should be shown and demonstrated: • vices; • plain and universal; • auxiliary tables; • soft jaws; • dividing head; • rotary table; • clamps; • chuck and collets; • fixtures. • Assess the students 	
General Objective 3.0: Understand The Working Principle Of A Plain Milling Machine And Operate The Same Machine To Produce Engineering Components.			
Week	Specific Learning Objective:	Teachers Activities	Resources
13-24	<p>2.1 Demonstrate the understanding of the working principles of plain milling machine.</p> <p>2.2 List out types of plain milling machines.</p> <p>2.3 List out major differences between the types.</p> <p>2.4 Describe the function and constructional details of the component parts of the plain miller and its accessories.</p>	<ul style="list-style-type: none"> • Define and explain the working principles of plane milling machine. Describe the way it works with the aid of the instruction manual. • Assess the students • Identify types of plain milling machines. Explain the differences between the types and use(s) of each type. • With the aid of sketches and the instruction manual, describe and demonstrate the function and constructional details of the component parts of the plain miller and its accessories. • Assess the students. 	<ul style="list-style-type: none"> • Plain milling machine • Chart of plain milling machine

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Mechanical Engineering Craft Practice

Module Code: CME 16 Shaping Planning and slotting

**Contact Hours
6hrs/wk**

Course Specification: PRACTICAL/THEORETICAL CONTENTS

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

1. Understand the working principle of a shaping machine and operate it to produce component parts of machine.
2. Calculate cutting speed and feed.
3. Understand the working principles of the planning machining and apply them in producing machine parts.
4. Calculate speed and feed.
5. Know the various types of slotting machines, their essential parts, the working principles and use them safely to produce component parts of machine.

PRACTICAL COMPETENCE

1. Sketch the drive mechanism of the crank-type shaping machine
2. Demonstrate methods of work holding
3. Work holding devices: Machine vice, shaping dividing head, angle iron, clamps.
4. Adjust cutting/return stroke, feed rate, ram and table flat slides
5. Grind and mount appropriate shaping tool to carry out appropriate machining on a given work piece machining process: Squaring flat surfaces, stepped faces. Internal and external keyway, slotting spline on end of shaft.
6. Sketch the drive mechanism of the planning machine
7. Demonstrate methods of work holding. Work holding devices: Machine vice, spoke, clamps, fixtures. Shaping, planning and slotting
8. Adjust table travel and feed rate and align work
9. Grind and mount appropriate planning tools to carry out appropriate machining on a given work piece machining processes: Production of flat and angular surfaces.
10. Sketch the drive mechanism of the "with worth" slotting machine
11. Demonstrate methods of work holding
12. Work holding devices: Machine vice, angle plate clamps.
13. Adjust cutting/return stroke, feed rate and trace work piece profile.
14. Grind and mount slotting tool for machining a given work piece
15. Machining processes: Internal keyway, spline, circular slot, spur gear.

Shaping, Planning and Slotting

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: SHAPING, PLANNING AND SLOTTING		MODULE CODE: CME 16	CONTACT HOURS: 7hrs/week
MODULE SPECIFICATION: PRACTICAL TASKS			
Week	General Objective 1.0: Understand The Working Principles Of Shaping Machines And To Operate The Machine To Produce Components Parts Of Machine.		
	Specific Learning Outcome:	Teacher's Activities	Learning Resources:
1-4	1.1 Identify the types of shaping machine and set up tools including:- <ul style="list-style-type: none"> i. adjustment of tool height, ii. the length of strokes, iii. feed rate, etc. 1.2 Set and operate the shaper to produce various components applying safety precautions. 1.3 Clean, oil and grease the shaping machine and adjust the slides.	<ul style="list-style-type: none"> • Demonstrate to the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Shaping machine and accessories
General Objective 2.0: Understand The Working Principles Of Planning Machine And Apply Them In Producing Machine Parts			
Week	Specific Learning Objective:	Teachers Activities	Resources
5-8	2.1 Adjust the length of stroke and mount work and tool correctly 2.1 Carry out the planning operations observing safety precautions 2.2 Clean, oil, grease and adjust the slides of the panning machine.	<ul style="list-style-type: none"> • Demonstrate to the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Planning machine and its accessories
General Objective 3.0: Know The Various Types Of Slotting Machines And Use Safely To Produce Component Parts Of Machine			
NTC Assessment profile: Practical to take 60% of overall assessment			

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: SHAPING, PLANNING AND SLOTTING	MODULE CODE: CME 16	CONTACT HOURS:
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MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT

General Objective 1.0: Understand The Working Principles Of Shaping Machines And Operate The Machines To Produce Component Parts Of The Machine

Week	Specific Learning Outcome:	Teacher's Activities	Learning Resources:
1-3	1.1 Safety in the work place. 1.2 Identify the types of shaping machine. a. crank-type shaper b. hydraulic shaper 1.3 Describe the types of operations performed on the shaping machine: 1.4 Explain the principles of operation of a shaper 1.5 Describe the functions and constructional details of the main component of the machine.	<ul style="list-style-type: none"> • Describes the general requirements for the observance of safe practice. • General requirements: protecting self and other, alertness to danger, maintaining personal hygiene, safety to be observed when working with hazardous substances. Knowledge of emergency and hazard reporting. • Illustrate with good examples and make notes where necessary. • Assess the students 	<ul style="list-style-type: none"> • Manuals on general safety practice, and accident reporting sheets. Safety campaign charts. • Pictorial diagrams of component parts on machine parts list. Video clip of running machine. • Observing and practicing operations demonstrated. • Exercises from recommended textbook.

General Objective: 2.0: Calculate Cutting Speed And Feed

Week	Specific Learning Objective:	Teachers Activities	Resources
4	2.1 Explain the geometry of quick return motion 2.2 Calculate the working speed of a shaper $\text{cutting speed} = \frac{\text{length of stroke in meters}}{\text{time in minutes taking by the cutting speed}}$ or $\text{double stroke/mm} = \frac{S}{2 \times \text{length of job}}$ where S = surface speed Feed = distance the moves after each cutting stroke	<ul style="list-style-type: none"> • Solves problems for student to practise • Assess the students 	<ul style="list-style-type: none"> • Notes of solved problems

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: SHAPING, PLANNING AND SLOTING	MODULE CODE: CME 16	CONTACT HOURS:
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MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT

General Objective 3.0: Understand The Working Principles Of Planning Machine And Apply Them In Producing Machine Parts

Week	Specific Learning Objective:	Teachers Activities	Resources
5-7	3.1 Identify the types and sizes of planners 3.2 State the functions of essential parts of the planning machine example, planner head, table, forward and reverse switches, etc 3.3 Explain the working principles of planning machine 3.4 List the tools and accessories used for planning	<ul style="list-style-type: none"> • Illustrate with good examples and make notes where necessary. • Assess the students 	<ul style="list-style-type: none"> • Recommended textbook, chalkboard, lesson notes etc.

General Objective 4.0: Calculate Speed And Feed

Week	Specific Learning Objective:	Teachers Activities	Resources
8	4.1 Calculate the working speed $\text{Average cutting} = \frac{\text{length of stroke in meters}}{\text{Time in minutes taken by the cutting stroke}}$ Or $\frac{S}{LL}$ where S = surface speed L = length of stroke in meters.	<ul style="list-style-type: none"> • Solve examples for the student to practise. • Assess the students 	<ul style="list-style-type: none"> • Notes of solved problems.

General Objective 5.0: Know The Various Types Of Slotting Machine Their Essential Parts And The Working Principles

Week	Specific Learning Objective:	Teachers Activities	Resources
9-12	5.1 Explain types and uses of slotting machine 5.2 Explain the essential component parts and accessories of slotting machine such as rotary table, ram, tool box. 5.3 Describe the functions and the constructional details of the components parts of the machine 5.4 Explain the geometry of "whitworth" quick return motion. 5.5 Calculate the working speed of slotting machine average cutting speed. 5.6 $\text{Average cutting speed} = \frac{\text{length of stroke in meters}}{\text{Time in minutes by the cutting stroke}}$	<ul style="list-style-type: none"> • Illustrate with good examples and make notes where necessary. • Assess the students • Solve many problems for the students to practise and give assignment. • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, lesson notes etc.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: SHAPING, PLANNING AND SLOTTING

MODULE CODE: CME 16

**CONTACT
HOURS:**

MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT

9-12	Or Double stroke/mm = $\frac{S}{2 \times \text{length of job}}$ 5.6 Determine feed rate $F = f \times T \times N$ Where F = feed rate f = feed per tooth T = number of teeth and N = rpm of cutter		
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PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Mechanical Engineering Craft Practice

Module Code: CME 17 - DRILLING

Contact Hours: 8hr/wk

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

1. Understand the working principles of a drilling machine and use it to drill holes on metals and other engineering materials
2. Understand the principles of seating and machine a seating on a hole.
3. Understand the principle of reaming and ream a hole on a drilling machine.
4. Understand the construction of radial or pillar drilling machines and their uses in drilling holes.
5. Determine the speed of drilling operation.

Practical competence: On completion of this module the trainee will demonstrate the following competences to a standard expected in industry.

1. Identify in the workshop different types of drills and describe their typical use common drills; taper and parallel shank twist drill, flat drill, centre drill, core drill, multi-fluted drill.
2. Demonstrate methods of work holding on drilling machine. Work holding devices: Machine vice, angle plate, indexing fixture (dividing head, dividing chuck) clamps
3. Select appropriate speeds and feeds on drilling machine suitable for various materials to perform, centre drill, drill through work piece and drill to a given depth, ream through work piece, using solid and expanding reamer, counter bore a hole, counter sink a hole, spot face round surface and rough surface. Drilling machines: Sensitive, pillar, radial, and portable drilling machines, turret drilling machine gang drilling machine.

Module: Drilling		Module Code: CME 17	Contact Hours 8hrs/wk
Module Specification: Practical Tasks			
Week	General Objective 1.0: Understand The Working Principles Of Drilling Machine And Use It To Drill Holes On Metals And Other Engineering Materials		
	Specific Learning Outcome:	Teachers Activities	Resources
1-3	<p>1.1 Practical safety in the work place.</p> <p>1.2 Drill to specification applying the correct lubricant and observing the safety precautions:-</p> <p style="padding-left: 40px;">a. blind hole</p> <p style="padding-left: 40px;">b. holes on round work piece</p> <p style="padding-left: 40px;">c. locating and drilling center holes</p> <p>1.3 Grind drills to the correct angles.</p>	<ul style="list-style-type: none"> • Describe general requirements for safe practical: self and others protection, use of machinery guards, clothing, etc • Demonstrate skills of drilling and allow students to practise till they become competent. • Assess the students • Demonstrate to the students to practise till they become competent. • Assess the students 	<ul style="list-style-type: none"> • Film show on safety, safety wears. • Drilling machine and its accessories • Real object in static and running positions.
General Objective 2.0: Understand the principle of seating and machine a seating on a hole.			
Week	Specific Learning Objective:	Teachers Activities	Resources
4-6	<p>2.1 Seating</p> <p>2.2 Set up tools for counter boring, counter sinking and facing operations</p> <p>2.3 Machine the seating as required for cheese head bolts or screw, counter sunk head screw etc (observe safety precautions)</p>	<ul style="list-style-type: none"> • Demonstrate skills in using the appropriate tools for counter sinking, counter boring etc and allow the students to practice till they become competent. • Assess the students • Explains the functions and constructional details of main component parts. • Demonstration of the operation of the slotted link • mechanism. 	<ul style="list-style-type: none"> • Counter boring tools, counter sinking tools • Spot facing tools. • Observation of moving and static component parts on shaping machine. • Simulation of slotted link mechanism on model.

Module: Drilling		Module Code: CME 17	Contact Hours 8hrs/wk
Module Specification: Practical Tasks			
General Objective 3.0: Understand The Principles Of Reaming And Ream The Hole On Drilling Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-9	3.1 Reamers and Reaming 3.2 Select a reamer and appropriate speed for reaming 3.3 Mount a reamer on a drill chuck 3.4 Ream a hole observing safety precautions 3.5 Clean, oil, grease and adjust slide on slotting machine.	<ul style="list-style-type: none"> • Demonstrate activities and allow the students to practise till they become competent • Assess the students. 	<ul style="list-style-type: none"> • Reamers, paralle strips, chuck and key, set of twist drill, center drill, center punch and hammer.
General Objective 5.0: Understand The Construction Of Radial Or Pillar Drilling Machine And Their Uses In Drilling Hole			
Week	Specific Learning Objective:	Teachers Activities	Resources
9-12	5.1 Pillar and Radial Drilling machine 5.2 Set the machine for drilling operation using the correct speed and feed 5.3 Drill, counter bore, spot face and tap in one setting using and radial drill machine.	<ul style="list-style-type: none"> • Demonstrate and allow the students to practice till they become competent • Assess the students 	<ul style="list-style-type: none"> • Pillar and radial drilling machines and its accessories
NTC Assessment Profile: Practical take 60% of overall assessment			

Drilling

KNOWLEDGE REQUIREMENTS

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE	Drilling	MODULE CODE: CME 17 - Drilling	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION:			
Week	General Objective 1.0: Understand The Working Principles Of Drilling Machine And Drill Holes On Metals And Other Engineering Materials.		
	Specific Learning Outcome	Teacher Activities	Learning Resources
1-3	<p>1.1 Identify types of drilling machines</p> <ul style="list-style-type: none"> a. Sensitive, pillar and portable drilling machines. b. Vertical drilling machine c. Gang drilling machine d. Multiple drill head machine e. Radial drilling machine f. Turret drilling machine. <p>1.2 Describe the constructional details of the drilling machine, their essential parts and functions.</p> <p>1.3 Describe the applications of each type of drilling machine and its accessories.</p> <p>1.4 Identify different types of drills e.g:-</p> <ul style="list-style-type: none"> a. Twist drill (taper, parallel shank) b. Flat drill c. Multi-fluted drills d. Centre drills e. Tipped drills - carbide and ceramic diamond. 	<ul style="list-style-type: none"> • Identifies and demonstrate skills in using drilling machine with appropriate type of drills. • Describe the constructional details, application and use of drilling machine accessories. • Give note on the application of each type of drilling machine. • Identify the different types of drills. • Assess the students • To show a typical dull drill and state the effect on the accuracy of the hole such drill is used for. • To state the cutting angles for the different materials used in the workshop and the importance of using the angles. • Assess the students 	<ul style="list-style-type: none"> • Radial drilling machine. • Pillar drilling machine • Sensitive drilling machine, etc • Machine vice Jacobs chucks and keys reduction sleeves. • Chart • Sets of twist drills centre drills carbide tipped drills. • Dull drill • Drill chart

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE	Drilling	MODULE CODE: CME 17 - Drilling	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION:			
Week	General Objective 1.0: Understand The Working Principles Of Drilling Machine And Drill Holes On Metals And Other Engineering Materials.		
	Specific Learning Outcome	Teacher Activities	Learning Resources
1-3	1.5 Identify dull drills. 1.6 Explain the need for different cutting angles when using a drill.		
General Objective 2.0: Understand The Principles Of Seating And Machine A Seating On A Hole.			
Week	Specific Learning Objective:	Teachers Activities	Resources
4-6	2.1 Differentiate between counter-boring, counter-sinking, and spot-facing tools. 2.2 Set up tools for counter-boring, counter-sinking and spot facing operation. 2.2 Machine the seating as required for cheese- head bolts or screw, counter-sunk head screw etc. observe safety precautions.	<ul style="list-style-type: none"> To compare and contrast the difference between counter-boring, counter-sinking and spot-facing tool. Demonstrate how to set each tool. Demonstrate skills in using the appropriate tools for counter-sinking, counter-boring etc and the identification of necessary safety precautions. Assess the students 	<ul style="list-style-type: none"> Counter-boring tools. Counter-sinking tools. Spot-facing tools. - do - Counter-boring tools. Counter-sinking tools. Spot-facing tools.
General Objective 3.0: Understand The Principle Of Reaming And Ream A Hole On A Drilling Machine.			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-8	3.1 Identify and describe types of reamers and their specific uses: <ul style="list-style-type: none"> a. jobber's reamers; b. sheel reamers; c. fluted chucking reamers; d. rose chucking reamers; e. expansion chucking reamers; f. step reamers; g. morse taper reamers. 	<ul style="list-style-type: none"> Identify and describe the various types of reamers and their appropriate uses. Show a typical reamed hole, compare and contrast with un-reamed hole. State the reasons why holes are reamed. Show how the speed and feed for reaming operation are calculated. 	<ul style="list-style-type: none"> Parallel shunk reamers Taper reamers Expansion chucking reamers. - do - - do - Reamers Paraller strips Chuck and key

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE	Drilling	MODULE CODE: CME 17 - Drilling	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION:			
7-8	3.2 Explain the purpose of reaming a hole. 3.3 Select a reamer and the appropriate speed for reaming. 3.4 Mount a reamer on a drill chunk. 3.5 Ream a hole observing safety precaution.	<ul style="list-style-type: none"> • Demonstrate the skill in using the reamer in reaming a hole with appropriate use of coolant/lubricant and observing safety precautions. • Assess the students 	<ul style="list-style-type: none"> • Set of twist drill • Centre drill • Centre punch • Hammer.
General Objective 4.0: Understand The Construction Of Radial Or Pillar Drilling Machine And Their Uses In Drilling Holes.			
Week	Specific Learning Objective:	Teachers Activities	Resources
9	4.1 Describe the construction of a pillar drill machine. 4.2 Explain the difference in technique when drilling holes using: <ul style="list-style-type: none"> a. a pillar drilling machine b. a radial drilling machine 4.3 Explain why a hole is drilled, counter bored spot faced and tapped in one setting of the work on a radial drilling machine.	<ul style="list-style-type: none"> • Identify and explain the main difference between a radial drilling machine and the pillar drilling machine. • Explain to the students and prepare notes accordingly • Explain why holes are drilled, counter-bored, spot-faced and tapped in one setting of the work on a radial drilling machine. 	<ul style="list-style-type: none"> • Radial drilling machine • Pillar drilling machine. - do - - do -

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE	Drilling	MODULE CODE: CME 17 - Drilling	CONTACT HOURS: 8hrs/wk
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MODULE SPECIFICATION:

General Objective 5.0: Determine The Speed Of Drilling Operation.

Week	Specific Learning Objective:	Teachers Activities	Resources
10-12	<p>5.1 Calculate surface speed</p> $S = \frac{\pi DN}{1000}$ <p>where S = Surface speed (cutting speed) M/Min D = Drill diameter (mm) $\pi = 3.142$ N = Number of revolution per minute = spindle speed rev/min)</p> <p>The spindle speed</p> $N = \frac{1000S}{\pi D}$ <p>Revolution required = length of hole feed (mm/rev.) Time taken = Revolutions required spindle speed (rev/min)</p> <p>5.2 Identify the various lubrication points on the drilling machine.</p>	<ul style="list-style-type: none"> • Explain the formulae $S = \frac{\pi DN}{1000}$ <p>where S = surface speed or cutting speed (m/min) D = drill diameter (mm) $\pi = 22/7$ N = Number of revolution per minute.</p> <ul style="list-style-type: none"> • Assess the students • Solve many problems for the students to practise and give them assignments • Identify oil nipples on the machine and demonstrate how oil-gun/grease-gun are used. • Identify oil levels on machines with all-gear headstock and explain why oil level should be maintained. 	<ul style="list-style-type: none"> • Oil gun, grease gun

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Mechanical Engineering Craft Practice

Module Code: CME 18 - GRINDING

Contact Hours: 8hrs/wk

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

1. Apply safety precaution in the use of grinding machines.
2. Know the various types of grinding machines and the importance in modern engineering production.
3. Understand how grinding machines and their accessories work.
4. Know the composition of grinding wheels, their classification and uses.
5. Understand the principles and constructional details of grinding machine and operate the machine to produce a job to given specification.
6. Know the various components of a surface grinder and use it for various operations.
7. Undertake cylindrical grinding and produce finished surface.
8. Know the various components of a centreless grinder and use it for various operations.

Practical Competence:

On completion of this module the trainee will demonstrate the following competences to a standard expected in industry:

1. Maintain strict adherence to grinding wheel regulations and safe operational practices during grinding.
2. Demonstrate under supervision, the procedure for wheel turning, dressing and balancing where necessary.
3. Demonstrate the principle of operation of permanent and electro-magnetic chucks.
4. Operate off hand grinder to sharpen cutting tools. Cutting tools: Lathe tools, Flat and twist drills chisels, scrapers.
5. Operate a surface-grinding machine to produce component with parallel, square and angular sides grinding.
6. Operate a cylindrical grinding machine to produce a spindle
7. Operate the center-less grinding machine to produce parallel, taper and necked pins and rollers.

Grinding

Module: GRINDING		Module Code: CME 18	Contact Hours 8hr/wk
Module Specification: Practical Tasks			
Week	General Objective 1.0: Understand The Principles And Constructional Details Of Grinding Machine And Operate The Machine To Produce The Job To Given Specifications		
	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Explain basic safety rules to be observed in using grinding machines e.g. <ol style="list-style-type: none"> a. wear safety goggles or glasses; b. a watch should not be worn when operating any machine where a magnetic chuck is used; c. avoid loose clothing; d. always cover the bed weap and the cross slide during grinding; e. keep away from grinding wheel in motion; f. work should not be forced against a wheel; g. do not measure work near a revolving wheels; h. keep your fingers away from turning wheels; i. hold work piece securely. 	<ul style="list-style-type: none"> • Give an exhaustive list of safety precautions to be observed when using grinding machines. e.g: <ul style="list-style-type: none"> • wear safety goggles • avoid loose clothing etc. • Demonstrate safety practices for students to learn • Assess the students 	<ul style="list-style-type: none"> • Safety gadget
General Objective 2.0: Grinding Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
2-5	2.1 Clean and inspect the component parts of a grinding machine: grinding wheel, work-table, spindle, work-rest, wheel guards, operating switches	<ul style="list-style-type: none"> • Demonstrate for the students to practise and become competent • Assess the students 	<ul style="list-style-type: none"> • Grinding machine and accessories

Module: GRINDING		Module Code: CME 18	Contact Hours 8hr/wk
Module Specification: Practical Tasks			
2-5	2.4 Clean, operate and match the following grinding machine with their uses: a. hand grinder; b. portable grinder; c. surface grinder; d. cylindrical grinder; e. tool and cutter grinder; f. centreless grinder; g. universal grinder; h. internal grinder.		
General Objective 3.0: Maintenance:			
Week	Specific Learning Objective:	Teachers Activities	Resources
6-7	3.1 Maintain any grinding machines e.g; a. cleaning the machines at regular intervals during use and at the end of the day b. top up oil level c. grease the machine d. adjust the slides at the end of the day	<ul style="list-style-type: none"> • Guide the students in the maintenance operations and allow the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Complete tool box, grease pump oil can, etc.
General Objective 4.0: Grinding Wheels			
Week	Specific Learning Objective:	Teachers Activities	Resources
8	4.1 Interpret wheel specification and mount it on the spindle 4.2 Test a grind wheel for soudness	<ul style="list-style-type: none"> • Demonstrate to students to learn and assess them. 	<ul style="list-style-type: none"> • Grinding wheels
General Objective 5.0: Surface Grinder			
Week	Specific Learning Objective:	Teachers Activities	Resources
9-12	Clean, mount and operate work holding devices for a surface grinder e.g permanent and electro-magnetic chuck Carry out surface grinding operation to angular operation to angular and cylindrical surfaces	<ul style="list-style-type: none"> • Demonstrate to students to learn and assess them. 	<ul style="list-style-type: none"> • Surface grinders

Module: GRINDING		Module Code: CME 18	Contact Hours 8hr/wk
Module Specification: Practical Tasks			
General Objective: 6.0: Cylindrical Grinders			
Week	Specific Learning Objective:	Teachers Activities	Resources
13-19	6.1 Select, inspect and operate work holding devices for a cylindrical grinder e.g centers and the clog, work rest in the case of a long work piece 6.2 Carry out cylindrical operation to external surfaces	• Demonstrate to students to learn and assess them.	• Cylindrical grinders
General Objective 7.0: Centreless Grinder			
Week	Specific Learning Objective:	Teachers Activities	Resources
20-24	7.1 Carry out centreless grinding operations practicing: a. Thrufeed grinding b. Infeed grinding c. Endfeed grinding d. Combination of infeed and thrufeed applying the appropriate coolant, grinding wheel, work-rest blade and the regulating wheel.	• Demonstrate to students to learn and assess them.	• Centerless grinder
Note: NTC Assessment Profile: Practical 60% and Theory 40%			

Knowledge Requirement

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GRINDING		MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS			
Week	General Objective 1.0: Understand the principles and constructional details of grinding machine and operate the machines to produce jobs to given specification.		
	Specific Learning Outcome	Teacher's Activities	Learning Resources
1-3	1.1 Explain the principles and the constructional details of a grinding machine. 1.2 State the characteristics of a grinding machine. 1.3 Describe the various components of a grinding machine e.g grinding wheel, workable wheel spindle, workrest blade, etc.	<ul style="list-style-type: none"> • Identify the characteristic detail of the grinding machine. • State them and explain the constructional details of the machine. • Identify the various components of a grinding machine e.g grinding wheel, worktable, wheel head etc and demonstrate their functions. • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, charts, chalkboard, lesson notes etc.
General Objective 2.0: Know The Various Types Of Grinding Machines And The Importance On Modern Engineering Production.			
Week	Specific Learning Objective:	Teachers Activities	Resources
4-5	2.1 State the importance of grinding operations in modern engineering production e.g. <ul style="list-style-type: none"> a. replacement for traditional metal removal process such as milling, turning, etc. b. use in finishing a surface to the required specifications. 2.2 Identify the basic types of grinding machines in common use e.g. <ul style="list-style-type: none"> a. hand grinder; b. portable grinder; c. surface " d. cylindrical " e. tool and cutter grinder; f. centreless grinder; g. universal grinder; h. internal grinder. 	<ul style="list-style-type: none"> • State the importance of grinding as a surface finishing operation. • Assess the students • Identify the basic types of grinding machines and describe their constructional features and functions. • Assess the students • Illustrate to students and make notes where necessary. • Demonstrate: <ul style="list-style-type: none"> • Off hand grinder • Precision grinder and state where each is used. • Assess the students 	<ul style="list-style-type: none"> • Surface grinding machine • Cylindrical grinder • Tool and cutter grinder • Portable grinder • Off-hand grinder. - do -

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GRINDING		MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS			
4-5	2.3 Describe the constructional features and functions of each of the machines listed in 2.2 above. 2.4 Differentiate between off hand and precision grinding and state where each type is used.		
General Objective 3.0: Understand How Grinding Machines And Their Accessories Work.			
Week	Specific Learning Objective:	Teachers Activities	Resources
7	3.1 Explain: a. How each of the machines listed in 2.2 above works. b. The cutting action of a grinding wheel in grinding machine.	<ul style="list-style-type: none"> • Explain with illustration: • How machines in 2.2 works. • The cutting action of a grinding wheel. • Assess the students 	- do -
9	3.3 Calculate the wheel speed (S) of a grinding machine using the formulae: $S = \frac{\pi DN}{1000}$ 3.142 where D = diameter of wheel in mm N = no of revolution per minute S = speed of machine $\pi =$	<ul style="list-style-type: none"> • Solve many problems for students to practise • Assess the students 	- do -
	3.4 Describe how lost of temper in metal due to over-heating is prevented during grinding operations.	<ul style="list-style-type: none"> • Explain: • Over heating of ground surfaces during grinding operation. • Lost temper in metal during grinding operation, and prepare notes for students to copy • Assess the students 	- do -

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GRINDING		MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS			
General Objective 4.0: Know The Composition Of Grinding Wheels, Their Classification And Uses.			
Week	Specific Learning Objective:	Teachers Activities	Resources
10	4.1 Describe the composition of grinding wheel: two main components, the abrasive and the bond.	<ul style="list-style-type: none"> • Explain the two main composition of grinding wheel: • The abrasive • The bonding material. 	
	4.2 State types of abrasives used for grinding wheels and the type of work they are best suited: <ol style="list-style-type: none"> a. Silicon Carbide - grinding of materials with low tensile strength such as aluminium, ceramics, copper and cast iron, b. Aluminium Oxide -grinding with high tensile strength such as heat treated parts, steels and alloys steel etc. 	<ul style="list-style-type: none"> • Explain the types of abrasives used for grinding wheels and the type of work they are suited for: • Silicon Carbide • Aluminum Oxide, and prepare notes for students to copy • Assess the students 	
11	4.3 State the basic classifications of grinding wheel and the basis for such classifications, e.g <ol style="list-style-type: none"> a. Coarse - abrasive grain size of 6-14. b. Medium - abrasive grain size of 30-40. c. Fine - abrasive grain size of 70-180. d. Veryfine - abrasive grain size of 200-260. 	<ul style="list-style-type: none"> • Illustrate with good examples and make notes where necessary • Assess the students 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: GRINDING	MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
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MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS

12	<p>4.4 State the characteristics of a good grinding wheel (stone) for a job:</p> <ul style="list-style-type: none"> a. type of abrasive b. proper bonding of abrasive grains c. size and grade (coarseness of abrasive grains) d. structure (abrasive grain spacing/distribution). 	<ul style="list-style-type: none"> • Explain the characteristics of a good grinding wheel. 	<ul style="list-style-type: none"> • Grinding wheels • Straight cup wheel • Cylindrical • Tapered • Saucer.
	<p>4.5 Describe the shapes of grinding wheels e.g: a straight b cylindrical c tapered d d) saucer.</p>	<ul style="list-style-type: none"> • Show and demonstrate the various shapes of grinding wheels and their appropriate uses for grinding operation. 	
	<p>4.6 State the factors to be considered when selecting a grinding wheel, e.g:</p> <ul style="list-style-type: none"> a. materials to be ground, especially its hardness b. wet or dry operation c. speed of the wheel and the area grinding contact d. the size of machine (horse power). 	<ul style="list-style-type: none"> • Illustrate to the students with good examples and make notes where necessary • Assess the students 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GRINDING		MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS			
General Objective 5.0: Apply Safety Precautions In The Use Of Grinding Machines.			
Week	Specific Learning Objective:	Teachers Activities	Resources
13	5.1 Explain basic safety rules to be observed in using grinding machines e.g. <ul style="list-style-type: none"> a. wear safety goggles or glasses; b. a watch should not be worn when operating any machine where a magnetic chuck is used; c. avoid loose clothing; d. always cover the bed weap and the cross slide during grinding. e. keep away from grinding wheel in motion, f. work should not be forced against a wheel g. do not measure work near a revolving wheels h. keep your fingers away from turning wheels i. hold work piece securely. 	<ul style="list-style-type: none"> • Give an exhaustive list of safety precautions to be observed when using grinding machines. e.g: • wear safety goggles • avoid loose clothing etc. • Assess the students 	<ul style="list-style-type: none"> • Safety gadgets and films on safety
General Objective 6.0: Know The Various Components Of A Surface Grinder And To Use It For Various Operations.			
Week	Specific Learning Objective:	Teachers Activities	Resources
14	6.1 Explain the use of surface grinder in machine shap e.g. producing finished flat surface by means of revolving abrasive wheel.	<ul style="list-style-type: none"> • Identify and demonstrate the skills in the use of surface grinder e.g. flat surface grinding using abrasive grinding wheel. 	<ul style="list-style-type: none"> • Surface grinding machine. • Magnetic chuck.
	6.2 Describe a surface grinder, its size, component parts and their specific functions.	<ul style="list-style-type: none"> • Explain the characteristics of a surface grinder vis-a-vis size, specific functions etc. • Assess the students 	

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
MODULE: GRINDING		MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS			
15	6.3 Explain the following:- a. table speeds b. crossfeeds c. in- feed d. coolants e. wheel speeds (as abrasive)	<ul style="list-style-type: none"> • Explain the processes and functions:- <ul style="list-style-type: none"> • table speed • cross feeds • in-feed • wheel speed • coolant/lubricants. • Identify the various work holding devices for surface grinding and demonstrate their uses. • Assess the students 	
General Objective 7.0: Undertake Cylindrical Grinding Produce Finished Surface.			
Week	Specific Learning Objective:	Teachers Activities	Resources
16-17	7.1 Explain the use of cylindrical grinder in a machine shop e.g. to grind the outside of cylindrical parts (the parts may be straight, tapered or formed.	<ul style="list-style-type: none"> • Identify a cylindrical grinding machine, explain its uses and the limitations. • Assess the students 	<ul style="list-style-type: none"> • Cylindrical grinder (Universal type)
General Objective 8.0: Know The Various Components Of A Centreless Grinder And Use It For Various Operations.			
Week	Specific Learning Objective:	Teachers Activities	Resources
18-20	8.1 Explain the use of centreless grinder in a mass production workshop.	<ul style="list-style-type: none"> • Explain the use of centreless grinder for mass production. • Assess the students 	<ul style="list-style-type: none"> • Centreless grinder.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

MODULE: GRINDING	MODULE CODE: CME 18	CONTACT HOURS: 8hrs/wk
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MODULE SPECIFICATION/GOAL: KNOWLEDGE REQUIREMENTS

21-24	<p>8.2 State the advantages and disadvantages of centreless grinder over a cylindrical grinder.</p> <p>8.3 Describe the centreless grinder, its size, components and their specific functions.</p> <p>8.4 Explain the following:-</p> <ol style="list-style-type: none"> a. Thrufeed grinding b. Infeed grinding c. Endfeed grinding d. Combination of infeed and thrufeed. 	<ul style="list-style-type: none"> • discuss: • advantages • disadvantages of centreless grinder over cylindrical grinder. • Assess the students • Illustrate the characteristics of a centreless grinder, its size and other functional component parts. • Assess the students • Demonstrate the various slide movements ie thrufeed grinding, infeed grinding, endfeed etc. • Assess the students 	
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Advanced Courses

Press, Jig and Fixture

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE		
Course Machine shop production and maintenance	Module Code: CME 22-: Press, Jig and Fixture	Contact Hours 8hrs/wk
<p>Module Specification: Practical/theoretical contents</p> <p>General Objectives: On completion of this module, the trainee should be able to:</p> <ol style="list-style-type: none"> 1. Understand the basic principles of design and constructional details of common presses, jigs and fixtures for individual, series and mass production of engineering of engineering components use and maintain them with proficiency. 2. Produce functional fool-proof jigs for drilling repetitive co-ordinate holes and fool-proof fixture for: a welding four-legged stool b indexing face plate. 3. Understand the basic principles of design of punch and die, care and use in engineering as related to aluminum or brass extruding machine. <p>Practical Competence: On completion of this module trainees will demonstrate the following competences to standard expected in industry.</p> <ol style="list-style-type: none"> 1. Demonstrate safe and skillful use of safety information in recognition of hazards in working environment and operation of presses 2. Presses fly press, foot lever press, power press. 3. Correctly specify press capacity, select and set working speed and feed. 4. Adjust, repair and carry out maintenance schedule on presses. 5. Select suitable materials in the design and manufacture of a working a fool proof fixture. 6. Application: Welding, Indexing,. Assembly, bending, turning milling 7. Select suitable materials in the design and manufacture of jigs 8. Application: Drilling, welding, bending, indexing, boring 9. Select suitable material in the design and manufacture of punch and die 10. Applications: Shaping, stamping, can extrusion, moulding. 		

PRACTICAL TASKS

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine shop production and maintenance		Module Code: CME 22 Press Jig and Fixture	Contact Hours:
Week	Specific Learning Outcome	Teachers Activities	Resources
1-9	<p>a. Collect typical engineering components produced on the presses by the processes of: can extrusion, stamping moulding, shaping etc.</p> <p>b. Recognize the various hazards, their prevention and safety operate the fly, foot lever, and power presses.</p> <p>c. Draw a preventive maintenance schedule and carry out same to keep a common press in good working condition.</p> <p>d. Produce a sectioned sketch of the jigs for the following processes: Drilling, reaming, welding, indexing, bending boring, assembling etc. Dismantle, inspect and couple a drilling fixture.</p> <p>e. Design and Construct a working foot-proof fixture for: Bending and assembling operation, indexing, and a turning operation.</p> <p>f. Select appropriate materials for punch Construction. Selection criteria: Mechanical properties.</p>	<ul style="list-style-type: none"> • Show few samples of products of press work. • Assess the students • Assignment on safety regulations on presswork. • Assess the students • Assignment on alternative plan to, or own interpretation of suggested manufacturer's maintenance plan for a typical press. • Assess the students • Supervise and grade production of sections sketches of Jigs. • Assess the students • Supervise dismantling, inspection of component parts for shape and defects and assembly techniques. • Assess the students • Direct compliance with stipulated material selection criteria. • Assess the students 	<ul style="list-style-type: none"> • Crown cork, ask tray, vent grill. • Manual on accident prevention and relevant section of the factory Act. • Manufacturer's machine manual • Textbooks, Catalogues • Practice on the job • Text on materials and processes. Selection guidelines for die making materials in Engineering materials textbook or journals.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine shop production and maintenance		Module Code: CME 22 Press Jig and Fixture	Contact Hours:
Week	Specific Learning Outcome	Teachers Activities	Resources
10-12	<p>Design and manufacture a punch for extrusion of round and rectangular Cans.</p> <p>Inspect and sketch the section of a die. Dies: Hot aluminum extrusion, moulding, stamping, cutting, blanking etc.</p> <p>Select appropriate materials for die construction. Selection Criteria: Mechanical properties.</p> <p>Design and manufacture a die for: Piercing and bending</p>	<ul style="list-style-type: none"> • Supervise student compliance with design methods and process selection for die manufacture. • Assess the students • Highlight details of Construction • Assess the students • Direct compliance with stipulated material selection criteria. • Assess the students • Approves student design and manufacturing processes considerations and guide the students to perform the design and manufacture • Assess the students 	

KNOWLEDGE REQUIREMENTS

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine shop production and maintenance		Module Code: CME 22 Press Jig and Fixture	Contact Hours: 8hrs/wk
Week	General Objective 1.0: Understand The Basic Principles Of Design And Constructional Details Of Common Presses, Jigs And Fixtures For Individual, Series And Mass Production, Use And Maintain Them With Proficiency		
	Specific Learning Outcome	Teachers Activities	Resources
1-3	1.4 Define press, its functions and application in engineering 1.5 Describe the basic principles and constructional details of common presses on engineering 1.6 State and explain the types of press <ul style="list-style-type: none"> a. fly press b. foot lever press c. power press d. crank press, etc 1.7 Explain what is meant by “upset forging” 1.8 Explain the difference between a forging press and forging hammer 1.9 Explain the load at which the maker bases capacity 1.10 Recognise the various hazards while operating the press and ways to prevent them 1.11 Explain (in order to minimize the accidental starting up of the machine) the mechanical feeding arrangements of the open front power press 1.12 Explain the safety arrangement of: a. foot lever press b. fly press, etc.	<ul style="list-style-type: none"> • The teacher to explain and illustrate with diagrams where necessary 1.7 to 1.9 and prepare notes • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine shop production and maintenance		Module Code: CME 22 Press Jig and Fixture	Contact Hours: 8hrs/wk
Week	General Objective 1.0: Understand The Basic Principles Of Design And Constructional Details Of Common Presses, Jigs And Fixtures For Individual, Series And Mass Production, Use And Maintain Them With Proficiency		
	Specific Learning Outcome	Teachers Activities	Resources
4-6	1.10 Define Jig, its functions and application 1.11 Describe the basic principles of designing common jigs for individual series and mass production of engineering components 1.12 State and explain the types and applications of commonly used jigs in machine shop 1.13 Recognise the various hazards while using the jigs mentioned above, and ways to prevent them. 1.14 State and explain the functions of the components parts of a jig e.g. clamps, buttons, locating pins, grinding bush, nuts, handles, tenors, support, etc. 1.15 Define fixtures, its functions area of application and principles 1.16 State and explain with diagrams, component parts of fixtures	<ul style="list-style-type: none"> The teacher to explain and illustrate with diagrams where necessary 1.13 to 1.16 and prepare notes Assess the students The teacher to explain and illustrate with diagrams where necessary and prepare notes where necessary Assess the students 	<ul style="list-style-type: none"> Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc
General Objective 2.0: Understand The Basic Principles Of Design And Constructional Details Of Jigs For Drilling Repetitive Coordinate Holes And Fool Proof Fixture For (1) Welding For Legged Stool, (2) Indexing Face Plate			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-8	2.1 Explain the selection of suitable materials for jig construction e.g steel, cast iron, brass, etc, and give reasons for the choice e.g toughness, hardness, strength, etc. 2.2 Explain the principles involved in the design and construction of jigs and fixtures, with emphasis on tool-proof jigs for drilling repetitive coordinate holes, trip stand for lamp, wingnut, etc.	<ul style="list-style-type: none"> The teacher to illustrate with good diagrams the activities in 2.1 to 2.2 and prepare notes for the students Assess the students 	<ul style="list-style-type: none"> Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine shop production and maintenance		Module Code: CME 22 Press Jig and Fixture	Contact Hours: 8hrs/wk
General Objective 3.0: Understand The Basic Principles Of Design Of Punch And Die, Their Care And Use In Engineering As Related To Aluminum Or Brass Extruding Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
9-10	3.2 Define punch, its principal functions, classification and application 3.3 Describe the basic constructional details of common punches used in engineering 3.4 Illustrate with diagram the profiles of the working portion of the punch	<ul style="list-style-type: none"> The teacher to illustrate with good diagrams the activities in 3.1 to 3.7 and prepare notes for the students 	<ul style="list-style-type: none"> Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc
	3.5 Explain the working alignment of the punch 3.6 Explain the safety precautions when using the punch 3.7 Explain the features and construction of the punch 3.8 Explain with neat diagram the principles of impact extrusion. Describe the sort of component that are suitable for this cold forging process	<ul style="list-style-type: none"> Assess the students 	
11-12	3.9 Define die as related to equipment for shaping, moulding stamping and cutting metal, its functions classification and area of application. 3.10 Illustrate with diagram the profile of the working portion of the hole in the die 3.11 Explain the features of construction of the die 3.12 Describe the minimum thickness of die 3.13 Explain the safety precautions when using a die 3.14 Explain how to maintain a die in good working conditions	<ul style="list-style-type: none"> The teacher to illustrate with good diagrams the activities in 3.1 to 3.7 and prepare notes for the students Assess the students 	<ul style="list-style-type: none"> Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc

Boring

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine shop production and maintenance	Course Code: CME 23 - Boring	Contact Hours 8hrs/wk
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General Objective: On completion of this module, the trainee should be able to:

1. Understand and apply the general safety precautions for each boring machine
2. Understand the working principles of a boring machine and operate the boring machine to produce a finished job
3. Understand the characteristics of a boring machine
4. Know the various types of boring tools and application
5. Maintain the machine in good working condition

Practical Competence: On completion of this module the trainee will demonstrate the following practical competences to a standard expected in industry.

1. Observe all safety rules and regulations concerning working environment and clothing and operate safety appliances on the boring machine
2. Select, grind and set up boring tool to bore straight hole from the tool post and rotating spindle positions of the tool Machines: Lathe boring machine
3. Set up and align work piece for boring. Equipment: Centering indicator, alignment, bar gauge blocks, locating microscope, reference squares and the use of depth measuring device.
4. Locate positions of features on the work pieces on jig boring by polar and co-ordinate methods on the machine
5. Carry out adjustment of slides, and lubrication schedule on boring machine.
6. Bore a piece of work with the tool held in the revolving spindle of the lathe and drilling machine
7. Carry out button boring operation on the jig boring machine
8. Face and expand the bore of motor vehicle wheel brake drum on the jig boring machine

PRACTICAL TASKS

Week	General Objective: 1.0 Understand and apply general safety precautions for each boring machine		
Week	Specific Learning Outcome:	Teachers Activities	Resources
General Objective 1.0: Safety Practice			
1	1.1 Practice the safe and correct operation power isolation and stop buttons and the drill of safety rules and regulations pertaining to the operator and his surrounding	<ul style="list-style-type: none"> • In all of the following operations, demonstrate of procedure and performance of the given tasks by the teacher immediately followed by a guided student performance of preceding teacher activities of exercises in 1.0. 	<ul style="list-style-type: none"> • All objects of instructions are expected to be live objects in focus except the option of a disused one is judged appropriate
General Objective 2.0: Understand The Working Principles Of Boring Machine And Operate It To Produce A Finished Job.			
Week	Specific Learning Objective:	Teachers Activities	Resources
2-5	2.1 Practice the selection of appropriate and speed for a given operation 2.2 Set up work using different work holding devices and accessories: rotary table, jig and fixture clamps etc. 2.3 Align and center workpiece using centering indicator, alignment bar, gauge block, locating microscope reference squares, and in-built measuring devices. 2.4 Trace out the profile of work pieces using dial indicator and pin traces 2.5 Carrying out angular indexing on rotary liltting table to locate positions and measure with precision measuring instruments	<ul style="list-style-type: none"> • Demonstrate to the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Boring machine and its accessories

Week	General Objective: 1.0 Understand and apply general safety precautions for each boring machine		
	Specific Learning Outcome:	Teachers Activities	Resources
General Objective 3.0: Understand The Use Of Boring Tools			
Week	Specific Learning Objective:	Teachers Activities	Resources
6	<p>3.1 Select suitable boring tool for counter boring, spot facing drilling reaming, boring in jigs, fixtures and press tools</p> <p>3.2 Select suitable tool form and material for a specific operation e.g carbide tippea, inserted and solid boring and setting up boring tool</p>	<ul style="list-style-type: none"> • Demonstrate to the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Boring tools
General Objective 4.0 Carryout Boring Operations			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-11	<p>4.1 Practice various methods of locating holes, scribing lines, arcs and circles using spotting tools</p> <p>1.13 Carry out the layout of Coordinate points from drawing dimensions on the jig boring machine</p> <p>1.14 Bore a piece of work with the tool held in the revolving spindle of the lathe and driving machines respectively</p> <p>1.15 Carry out button boring operation on the jig boring machine</p> <p>1.16 Face and expand the bore of a motor vehicle wheel brake drum on the jig boring machine</p>	<ul style="list-style-type: none"> • Demonstrate to the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Boring tools and achine

Week	General Objective: 1.0 Understand and apply general safety precautions for each boring machine		
	Specific Learning Outcome:	Teachers Activities	Resources
	General Objective 5.0: Maintain The Machines In Good Working Conditions		
Week	Specific Learning Objective:	Teachers Activities	Resources
12	5.1 Interpret and carry out manufacturers maintenance and lubrication scheme 5.2 Adjust machine slides and tension belt	<ul style="list-style-type: none"> • Demonstrate to the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Complete tool box

KNOWLEDGEMENT REQUIREMENTS

Week	General Objective: 1.0 Understand and apply general safety precautions on each boring machine		
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Explain the various hazards associated with the operation of boring 1.2 State the safety rules and regulation applicable in boring	<ul style="list-style-type: none"> • Be familiar with the rules and safety regulations for operating setting and installing 	<ul style="list-style-type: none"> • Boring machines • Horizontal, Vertical, Jig borings • -Set of maintenance kits
General Objective 2.0: Understand The Working Principles Of Boring Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
2-3	2.1 Explain the working principles of boring machine and state its uses 2.2 Identify the types of boring machines <ul style="list-style-type: none"> a. horizontal b. vertical c. jig boring machine 2.3 Describe the basic functions and constructional details of each of the above mentioned boring machine	<ul style="list-style-type: none"> • Explain the various types of a boring machine and to be familiar with the component parts and their respective functions 	<ul style="list-style-type: none"> • Boring machine and accessories
	2.4 Name the important parts of a boring machines 2.5 State the uses of boring bar	<ul style="list-style-type: none"> • Assess the students 	
General Objective 3.0: Understand The Characteristics Of A Boring Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
	3.1 Identify the various types of boring tools and state their applications and method of clamping 3.2 State angles at the point of a boring tool 3.3 Select suitable tool materials for a specific boring operation	<ul style="list-style-type: none"> • Explain criteria for selection of tools and methods of clamping, Describe the process of reconditioning and regrinding of boring tools 	<ul style="list-style-type: none"> • Assorted types of boring tools • Tool grinders
	3.4 State the principles of tool reconditioning, the computation of coordinates and carry out the calculations relating to setting	<ul style="list-style-type: none"> • Assess the students 	

Week	General Objective: 1.0 Understand and apply general safety precautions on each boring machine		
	Specific Learning Outcome:	Teachers Activities	Resources
General Objective 4.0: Know How To Set Up Work			
Week	Specific Learning Objective:	Teachers Activities	Resources
4-5	<p>4.1 Explain how to Set up work and apply different types of work holding devices</p> <p>4.2 Explain the lay out and show the calculations of coordinates for jig boring from drawing</p> <p>4.3 Explain the layout and the calculation of coordinates for jig boring from drawing dimensions</p>	<ul style="list-style-type: none"> Describe the setting up of boring tool in relation of the workpiece. Show the procedure of calculating coordinates of positions on working drawing. Ask students to perform similar tasks Assess the students 	<ul style="list-style-type: none"> Rotary table, auxiliary table, universal vice and angle plate
General Objective 5.0: Know Tool And Work Alignment			
Week	Specific Learning Objective:	Teachers Activities	Resources
6-7	<p>5.1 Explain how to align and center work piece using suitable alignment instruments</p> <p>5.2 Explain the techniques of setting boring tools</p>	<ul style="list-style-type: none"> Explain the alignment problems of the various boring machines Learn to align the tool in relation to the workpiece using appropriate techniques of alignment Assess the students 	<ul style="list-style-type: none"> Dial indicator, Length bars, spirit level, vernier calipers
General Objective 6.0: Know The Various Types Of Boring Tools And Their Applications			
Week	Specific Learning Objective:	Teachers Activities	Resources
8 - 11	<p>6.1 State the use of boring accessories and describe their set-up</p> <p>6.2 Determine a work plan for boring a job</p> <p>6.3 Determine a work plan for boring</p> <p>6.4 Describe the method of setting the lathe to bore a straight hole</p>	<ul style="list-style-type: none"> Illustrate in details and make notes where necessary 	<ul style="list-style-type: none"> Different shapes and sizes of work piece materials
	<p>6.5 Describe the procedure and operations of button boring on jig boring machine</p> <p>6.6 Describe setting and boring large bore on jig boring machine e.g brake drum of motor vehicle</p>	<ul style="list-style-type: none"> Assess the students 	

Week	General Objective: 1.0 Understand and apply general safety precautions on each boring machine		
	Specific Learning Outcome:	Teachers Activities	Resources
	General Objective 7.0: Maintain The Machine In Good Working Conditions		
Week	Specific Learning Objective:	Teachers Activities	Resources
	7.1 Maintenance tips and trouble shooting on boring machines	<ul style="list-style-type: none"> • Interpret manufacturer's maintenance manual and trouble shooting procedure. Give students assignment on maintenance task 	<ul style="list-style-type: none"> • Boring machine, Manufacturer's manual
	ANTC: Assessment Profile: Practical 60%, Theory 40%		

Fitting (Mill-Wright)

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Machine shop production and maintenance

Module Code: CME 24 - Fitting (Mill-Wright)

Contact Hours 8hrs/wk

Module Specification: This module is designed to provide the trainee with further knowledge and skill to carry out fitting and maintenance work on machinery and equipment to an acceptable standard and performance.

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

1. Understand and apply the general safety precautions in a machine shop.
2. Understand fitting installation and maintenance work.
3. Know and apply different methods of protecting metal surfaces/parts against corrosion.
4. Understand the principles of balancing a rotating machine.
5. Apply various portable hand tools to perform mechanical fitting.
6. Install, fit and maintain machinery, equipment or mechanical system with the aid of engineering drawing.
7. Understand the principles of repair and servicing machinery and other mechanical equipment.
8. Understand the correct use of lubricant to machinery and equipment.
9. Understand working gauges and report their conditions.

Practical Competence: On completion of this module the trainee will demonstrate the following competences to a standard expected in industry.

1. Recognize sources of hazards in the machine shop and operation of safety devices to prevent accidents
2. Draw work plan and use hand tools and various work holding devices to carry out a variety of bench fitting and assembly tasks.
3. Apply knowledge of electro-chemical corrosion to proffer solutions for preventing and inhibiting corrosion
Types of corrosion: atmospheric, metal in soil, and coat product surfaces with various agents used for protecting metal surfaces against corrosion.
4. Anti-corrosive agents: painting, electroplating, plastic coating, tinning, iodizing, galvanizing
5. Demonstrate dexterity in the use of portable tools, processes: portable electric hand drill, a grinder, buffing, pneumatic pop-riveter; ratchet and
6. breast drill, pulley and tap extractor
7. Use gauges for rapid production and selection purposes
8. Types of gauges: vacuum, pressure and temperature gauges.
9. Prepare the foundation, install and conduct alignment checks on machinery. Kinds of machine: lathe, cylindrical grinder, shaping machines.
10. Interpreter manufacturers lubricant codes, and follow machine manual lubrication, and trouble shooting recommendations for machine repair

COURSE: Machine Shop Production & Maintenance		MODULE CODE: CME 24	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION: Knowledge Requirements			
Week	General Objective 1.0: Understand And Apply Safety Precautions In The Workshop		
	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Explain the various hazards in a machine shop 1.2 Apply the knowledge of safety rules and regulations to work, others and to self	<ul style="list-style-type: none"> • Conduct the student to recognize points of danger in workshop • Assess the students 	<ul style="list-style-type: none"> • Bench and machine fitting tools
General Objective: 2.0 Understand fitting installation and maintenance work.			
Week	Specific Learning Objective:	Teachers Activities	Resources
2	2.1 Explain the work plan for fitting installation of machine <ul style="list-style-type: none"> a. Interpret the drawing of instruction b. Describe the sequence of operation c. Select appropriate tools and materials for the job d. Carry out related calculation 	<ul style="list-style-type: none"> • The teacher to illustrate with good diagrams and prepare notes for the students • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc.
General Objective 3.0: Know and explain different methods of protecting metal surfaces and parts against corrosion			
Week	Specific Learning Objective:	Teachers Activities	Resources
3-5	3.1 Define corrosion its effect on metal and classification 3.2 State the causes of corrosion and give examples of <ul style="list-style-type: none"> a. Chemical corrosion b. Gas corrosion c. Atmospheric corrosion d. Corrosion of metal in soil, etc. 3.3 State the mechanism of electro-chemical corrosion 3.4 Draw a dependable graph of corrosion from the increase in temperature using equation.	<ul style="list-style-type: none"> • The teacher to explain the activities in 3.1 to 3.7 and prepare notes for the students accordingly • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc.

COURSE: Machine Shop Production & Maintenance		MODULE CODE: CME 24	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION: Knowledge Requirements			
3-5	$K = \frac{Ae^{-Q}}{RT}$ <p>Where K = Corrosion A = Constant e = founding natural logarithm Q = amount of energy of activation R = Constant gas</p> <p>3.5 Describe the process of preparing surfaces of metal against corrosion.</p> <p>3.6 Explain the difference between temporary and permanent corrosion</p> <p>3.7 Describe and use the various agents used for protecting metal surfaces against corrosion e.g</p> <ol style="list-style-type: none"> painting electroplating plastic coating tinning iodizing galvanishing, etc 		
General Objective 4.0: Understand The Functions Of A Rotating Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
6	4.1 Describe the functions of rotating machine	• Explain and make notes for the students	
General Objective 5.0 Apply various portable hand tools to perform mechanical fittings			
Week	Specific Learning Objective:	Teachers Activities	Resources
7	5.1 State the advantages and disadvantages of portable electric hand drill and grinder and be able to use them for a specific operation 5.2 Describe the functions and features of portable electric hand tools. 5.3 State the advantages of pneumatic hand tool-popriveter, buffing and use them for a given operation 5.4 Explain the importance of ratchet drill, press drill, puller and extractors and their applications	• Illustrate and explain activities in 5.1 - 5.4 and make notes for the students • Assess the students	• Recommended textbooks, chalkboard, chalk, lesson notes etc.

COURSE: Machine Shop Production & Maintenance		MODULE CODE: CME 24	CONTACT HOURS: 8hrs/wk
MODULE SPECIFICATION: Knowledge Requirements			
General Objective 6.0: Know how to install, fit and maintain equipment or mechanical system with aid of engineering drawing			
Week	Specific Learning Objective:	Teachers Activities	Resources
8	6.1 Interpret the drawing and the diagrams used in installation 6.2 Recognize materials, limits and fits, code systems and standards in engineering drawing	<ul style="list-style-type: none"> • Illustrate and explain activities in 6.1 to 6.2 and make notes for the students • Assess the students 	
General Objective: 7.0: understand the process of repair and servicing of machinery and other equipments			
Week	Specific Learning Objective:	Teachers Activities	Resources
9-10	7.1 Describe and recognize the type of service 7.2 Explain planning services in a mechanical workshop 7.3 Explain the term capital repair, medium, average and light repair	<ul style="list-style-type: none"> • Illustrate 7.1 to 7.3 and make notes • Assess the students 	Recommended textbooks, chalkboard, chalk, lesson notes etc.
General Objective 8.0: Understand the correct application of lubricant to machinery and equipments			
Week	Specific Learning Objective:	Teachers Activities	Resources
11	8.1 Describe the type of lubricant used for machinery and equipment 8.2 Ascertain the use of lubricant in machiner 8.3 Explain the advantages and disadvantages of lubricant in engineering	<ul style="list-style-type: none"> • Illustrate 8.1 to 8.3 and make notes • Display various kinds of lubricants and applicators and uses each student follow suit • Assess the students 	
General Objective 9.0: Understand working gauges and report their conditions			
Week	Specific Learning Objective:	Teachers Activities	Resources
12	9.1 Explain the important of gauges 9.2 Recognise temperature pressure and vacuum gauges 9.3 Explain the disadvantages of faulty gauges and control instruments	<ul style="list-style-type: none"> • Illustrate 9.1 to 9.3 and make notes • Assess the students 	

PRACTICAL TASKS

General Objective 1.0: Safety Precautions			
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Learn all the safety precautions in the workshop	<ul style="list-style-type: none"> • Conduct the student to recognize points of danger in workshop • Assess the students 	Safety gadgets
General Objective 2.0: Installations			
Week	Specific Learning Objective:	Teachers Activities	Resources
2	2.1 Assemble parts of machinery and equipment using the correct tools or instruments 2.2 Maintain machines and equipment	<ul style="list-style-type: none"> • Demonstrate and allow students to practice • Assess the students 	• Maintenance Tool box
General Objective 3.0: Protection of Metals			
Week	Specific Learning Objective:	Teachers Activities	Resources
3-8	3.1 Practically, prepare surface to be protected with one of the agents in the above section. The thickness of the layer of metal (agent) on the materials manufactured goods) could be determined by the formulae $a = \frac{CthIK}{d, 60.60}$ where a = the thickness of the layer of agent used against corrosion measured in cm. c = Electro-chemical equivalent g/A.h for silver C = 4,025g/A.h gold C = 7,357 g/A.h zinc C = 1,210g/A.h T = duration of electrolyte in minutes h = Exit of metal per current in % Ik = Density of current in cathode A/cm d = Density of metal g/cm	<ul style="list-style-type: none"> • Demonstrate and allow the students to practise till they become competent • Assess the students 	• Recommended apparatus

General Objective 4.0: Rotating Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
8-9	4.1 Carry out an experiment showing the use of rotating machine in single and double planes	<ul style="list-style-type: none"> • Demonstrate and allow students to practice till they become competent 	<ul style="list-style-type: none"> • Manuals, rotating machine and accessories
General Objective 5.0: Installation of Machinery			
Week	Specific Learning Objective:	Teachers Activities	Resources
10-12	5.1 Install, fit and maintain a shaping machine in the workshop	<ul style="list-style-type: none"> • Demonstrate and allows students to practice 	<ul style="list-style-type: none"> • Shaping machine and accessories
General Objective 6.0: Servicing of Machinery			
Week	Specific Learning Objective:	Teachers Activities	Resources
	6.1 Select tools and materials for the equipment to be serviced 6.2 Carry out preventive service or maintenance	<ul style="list-style-type: none"> • Demonstrate and allow students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Maintenance tool box, machinery to be maintained.

Valves, Pumps and Drive

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

**Course: Machine Shop Production and
Maintenance**

**Module Code: CME 25: Valves, Pumps
and Drives**

**Contact Hours:
9hrs/wk**

Goal: This module is designed to equip the trainee with adequate knowledge of valves, pumps and drive components found in industry with intent to be able to install and maintain them.

General Objectives:

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

1. Understand the definition, types, and functions, principles and applications of pumps used in engineering.
2. Know the method and system requirements in selecting pumps for use.
3. Understand the principles and process of packing, sealing, repairing and maintenance of pump.
4. Understand the functions, types, definitions, application and classifications of drive components.
5. Understand the functions, types and method of coupling in engineering.
6. Know the uses, types, classification and maintenance of clutches.
7. Know the functions types and classification of belt drives.
8. Understand the functions, definitions and maintenance of chains.
9. Know the functions and types of gears in a transmission system, effect repairs and maintenance when necessary.
10. Know the function, type and classification of brakes used in stopping or reducing motion.
11. Understand the definition, principles and applications of valves used in engineering.
12. Understand different types, functions and classification of valves.
13. Understand the method of sealing a valve.
14. Know the care and maintenance of valves.

Practical Competence:

On completion, trainee will demonstrate the following:

1. Applications: pumps with respect to types, capacity and safe use. Solids, peculiar velocity pumping.
2. Design, and manufacture simple oil pump from to have features of junction and discharge ports and simple lift mechanism.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

**Course: Machine Shop Production and
Maintenance**

**Module Code: CME 25: Valves, Pumps
and Drives**

**Contact Hours:
9hrs/wk**

3. Install, repair and maintain seals and packing glands.
4. Select, install and maintain drive and brake systems with special regards for their power transmission capacities
5. Drive Components: gear, belts, coupling, clutches, chains, brakes
6. Observe safety requirements pertaining to selection, installation and maintenance of valves.
7. Types of valve Safety valves, regulation relief valve, non-return valves, regulation valve and automatic process control valves etc
8. Operate and maintain precision measuring tools
9. For elements of screw thread, profiles of components and surface text
10. Equipment: Mechanical, optical, electrical and pneumatic comparators tool makers microscope.

KNOWLEDGE REQUIREMENT

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
Week	General Objective: 1.0 Understand the definition, types, and functions, principles and applications of pumps used in engineering.		
	Specific Learning Outcome:	Teacher/Activities	Learning Resources
1-4	<p>1.1 Define pump, explain its function, classification and applications. Draw symbols of different types of pumps. Identify unlabelled symbols of pumps.</p> <p>1.2 Know the methods and system requirements in selecting pumps for use.</p> <p>1.3 Explain various pumping systems e.g:</p> <ol style="list-style-type: none"> a. Water pumping systems b. Waste handling systems c. High velocity pumping systems d. Solid pumping systems e. Chemical handling systems f. Gas pumping systems. <p>1.4 Describe the basic principles and constructional details of gear pumps, rotary pumps, centrifugal pumps and reciprocating pumps. Give maintenance tips for each type of pump.</p> <p>1.5 Explain the principles of rotary pump installation.</p>	<ul style="list-style-type: none"> • Define pumps. Explain functions and different applications of pumps. Explain reasons for the different applications. Explain the identification of pumps with symbols. • Describe the basic principles and constructional details of pumps used in engineering. • Assess the students • Illustrate and explain with the aid of sketches various pumping systems e.g: • Water pumping systems • Waste handling systems • High velocity pumping systems • Solid pumping systems • Chemical handling systems • Gas pumping systems. • Assess the students • Explain the principles, constructional details and maintenance requirements of gear pumps, rotary pumps, centrifugal pumps and reciprocating pumps. Explain to the students reasons if any for differences in materials of construction. • Make notes for the students • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc. • Picture of pumps. • Samples of pumps. - do - - do - • Recommended textbooks, chalkboard, chalk, lesson notes etc.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine Shop Production and Maintenance	Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
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Week	General Objective: 1.0 Understand the definition, types, and functions, principles and applications of pumps used in engineering.		
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	Specific Learning Outcome:	Teacher/Activities	Learning Resources
5	<p>1.6 Explain the difference between centrifugal and rotary pumps.</p> <p>1.7 Calculate the inertia force (f) on the shaft of the rotary pump using equation such as:</p> $F = mrw$ <p>where, m = mass w = angular velocity and r = centre distance of the mass from the axis</p> <p>Calculate F for different m and r values separately and comment on the effect of such variation on the value of F.</p> <p>1.8 State the ways pumps could be classified.</p> <p>1.9 State the advantages and disadvantages of air driven pumps over steam driven pumps.</p> <p>1.10 Mention the safety precautions to be observed on special pumps.</p> <p>1.11 Sketch and explain parallel and series connection of pumps.</p> <p>1.12 Explain the result of each type of connection and what may necessitate a particular type.</p>	<ul style="list-style-type: none"> • Do worked examples on the calculation of the inertia force(F) on the shaft of the rotary pump with different values of m and r, using equation such as • $F = mrw$ where, • m = mass • w = angular velocity and • r = centre distance of the mass from the axis. • Explain practically the implications of different values of r and m (varying one variable at a time). • Discuss pumps classification • State and explain the advantages and disadvantages of air driven pumps over steam driven pumps. • Explain the safety requirements for special pumps and the necessity the such requirement. • Explain and demonstrate simple connections of pumps e.g parallel connection, series connection. • Explain the result of each type of connection. 	<p>Chart</p> <ul style="list-style-type: none"> • Chart

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
General Objective 2.0: Know The Method And System Requirements In Selecting Pumps For Use.			
Week	Specific Learning Objective:	Teachers Activities	Resources
6-7	2.1 Explain the method and system requirements in selecting pumps for use e.g: <ul style="list-style-type: none"> a. Suction side b. Pumps requirements c. Pump discharge side, etc. 2.2 State the conditions for selecting pumps for a particular job. e.g drilling for oil. 2.3 Explain the working operations of centrifugal pump. 2.4 Select suitable material for pump construction and state the reason for the choice.	Illustrate and explain activities in 2.1 to 2.4 and prepare notes <ul style="list-style-type: none"> • Assess the students 	Recommended textbooks, chalkboard, chalk, lesson notes etc.
General Objective 3.0: Understand the Principles and Process of Packing, Sealing, Repair and Maintenance of Pump			
Week	Specific Learning Objective:	Teachers Activities	Resources
8-9	3.1 State the principles and process of packing and sealing a pump. 3.2 State the importance of packing and sealing equipment 3.3 Describe different types of materials for packing. 3.4 Identify types of sealing e.g mechanical seal. 3.5 Explain the types of packing gland. 3.6 Explain the method of installing packing materials in pumps. Demonstrate. 3.7 State the precautions to be observed when packing and sealing equipment.	<ul style="list-style-type: none"> • Explain and illustrate with diagram 3.1 to 3.3 and make notes. • Assess the students. • Describe sealing requirements, state and show the type of sealing e.g mechanical sea, special seal, etc. • Explain and show types of packing gland. • Explain the precautions to be observed when packing and sealing equipment. Emphasize the repercussion of ignoring such precautions. • Assess the students. 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc. • Chart

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
General Objective 4.0: Understand the Functions, Types, Definitions, Application and Classifications of Drive Components.			
Week	Specific Learning Objective:	Teachers Activities	Resources
10-11	<p>4.0 Understand the functions, types, definitions, application and classifications of drive components.</p> <p>4.1 Explain various types of drive components such as:-</p> <p style="margin-left: 40px;">a. Clutch</p> <p style="margin-left: 40px;">b. Belt</p> <p style="margin-left: 40px;">c. Chain</p> <p style="margin-left: 40px;">d. Gear, etc.</p> <p>4.2 State the definitions, functions, application and classifications of drive components in 4.1 above.</p> <p>4.3 State the conditions for power transmission in engineering.</p>	<ul style="list-style-type: none"> • Show and describe various types of drive components such as: <ul style="list-style-type: none"> i. cluth ii. belt iii. chain iv. gear etc. • Illustrate with diagrams and make notes • Define and explain power transmission. State the conditions for power transmission in engineering. • Assess the students. 	<ul style="list-style-type: none"> • Recommended textbook, chalkboard, chalk, lesson notes etc.
General Objective 5.0: Understand The Functions, Types And Methods Of Coupling In Engineering.			
Week	Specific Learning Objective:	Teachers Activities	Resources
12	<p>5.1 Define and explain coupling in engineering.</p> <p>5.2 State the functions and types of coupling in engineering, e.g</p> <p style="margin-left: 40px;">a. Solid coupling</p> <p style="margin-left: 40px;">b. Jaw coupling</p> <p style="margin-left: 40px;">c. Moulded velbber coupling</p> <p style="margin-left: 40px;">d. Chain type coupling</p> <p style="margin-left: 40px;">e. Gear type coupling</p> <p style="margin-left: 40px;">f. Metal disc coupling etc.</p> <p style="margin-left: 40px;">g. Use symbols to describe each of the types above.</p> <p>5.3 State the coupling requirements for the listed common coupling in 5.2</p>	<ul style="list-style-type: none"> • Define and explain coupling in engineering. • State and explain with the aid of symbols types of coupling in engineering. • Show different types with the aid of sketches. • Explain the requirements for the listed coupling in 5.2 • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine Shop Production and Maintenance	Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
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General Objective 6.0: Know the uses, types, classification and maintenance of clutches.

Week	Specific Learning Objective:	Teachers Activities	Resources
13-14	<p>6.1 Define and state the function and application of clutches.</p> <p>6.2 State types of clutches classify types of clutches.</p> <p>6.3 State the advantages and disadvantages of the clutches is 6.2 above.</p>	<ul style="list-style-type: none"> • Define and state the function and application of clutches. • Show with diagrams and state the types and classification of clutches e.g: <ul style="list-style-type: none"> i. mechanical clutch ii. electrical clutch iii. hydraulic clutch • pneumatic clutch, etc. • Explain the advantages and disadvantages of clutches state in 6.2 • Assess the students 	<p>Recommended textbooks, chalkboard, chalk, lesson notes etc.</p>

General Objective 7.0: Know the functions, types and classifications of belt drives.

Week	Specific Learning Objective:	Teachers Activities	Resources
15-18	<p>7.1 State the functions and applications of belt drives.</p> <p>7.2 State the types and classification of belts.</p> <p>7.3 Explain the characteristics features of belt drive.</p> <p>7.4 State the condition for power transmission, the causes of creep and the sources of hysteresis in belt drives.</p> <p>7.5 Explain the difference between the flat pulley drive and the V. pulley drive.</p> <p>7.6 Explain why the performance of the drive depends more on the pulley type than the belt section.</p>	<ul style="list-style-type: none"> • Illustrate and explain with diagrams the activities in 7.1 to 7.6 and make notes accordingly • Assess the students • Solve examples to aid the students to practise • Assess the students • Illustrate and explain with diagrams the activities in 7.8 to 7.10 and make notes accordingly. • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc. • Recommended textbooks, chalkboard, chalk, lesson notes etc. • Recommended textbooks, chalkboard, chalk, lesson notes etc.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine Shop Production and Maintenance		Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
15-18	<p>7.7 Estimate the power capabilities over a range of speeds using equation: $T_1 - MV^2 + T_2 - MV^2 = 2(T_0 - MV^2)$ f_c</p> <p>where T1 = higher tension T2 = lower tension T₀ = initial static tension V = linear belt speed M = mass per unit length of the belt.</p> <p>7.8 Show graphically the variation of maximum tension and power with the belt speed.</p> <p>7.9 With the aid of sketches show the forces acting on a small length of belt with subtending angle at the centre.</p> <p>7.10 Determine the maximum power and corresponding pulley speeds.</p>		
General Objective: 8.0: Understand the function, applications and maintenance of chains in engineering.			
Week	Specific Learning Objective:	Teachers Activities	Resources
19	<p>8.1 State the functions and application of chain in industry e.g. transmission of one motion to another.</p> <p>8.2 State and identify types of chain in industry. Classify them.</p> <p>8.3 Explain the terms concentric, parallel, vertical and right angle shaft reducers in chain drives.</p>	<ul style="list-style-type: none"> • Illustrate and explain activities in 8.1 to 8.3 with diagrams and make notes accordingly • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes etc.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine Shop Production and Maintenance

Module Code: CME 25: Valves, Pumps and Drives

Contact Hours: 9hrs/wk

General Objective: 9.0: Know the functions and types of gears in transmission systems and effect repairs and maintenance when necessary.

Week	Specific Learning Objective:	Teachers Activities	Resources
20-21	<p>9.1 State the functions of gear in a transmission system.</p> <p>9.2 Describe and identify the following gears:</p> <ul style="list-style-type: none"> a. spur gears b. helical gears c. herringbone gears d. bevel gears e. worm gears <p>9.3 State the importance and application of gear in transmitting motions.</p> <p>9.4 Explain the characteristics of:</p> <ul style="list-style-type: none"> a. spur gears b. helical gears c. herringbone gears d. bevel gears e. worm gears <p>9.5 Explain causes of gears misalignment (out of mesh).</p>	<ul style="list-style-type: none"> • Discuss gears in transmission • Describe and show various types of gears used in engineering e.g: <ul style="list-style-type: none"> i. spur gears ii. helical gears iii. herringbone gears iv. bevel gears v. worm gears etc. • Explain the importance and application and make notes • Explain the characteristics of: <ul style="list-style-type: none"> • spur gears • helical gears • herringbone gears • bevel gears • worm gears. • Explain and demonstrate causes of gear misalignment and subsequent damage of them. Particular attention to bearing failures causing gears going out of mesh. • Assess the students 	<ul style="list-style-type: none"> • Chart • Recommended textbooks, chalkboard, chalk, lesson notes etc.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine Shop Production and Maintenance	Module Code: CME 25: Valves, Pumps and Drives	Contact Hours: 9hrs/wk
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General Objective: 10.0: Know the functions, types and classification of brakes used in stopping or reducing motion.

Week	Specific Learning Objective:	Teachers Activities	Resources
22-24	<p>10.1 Explain the functions of brakes in a system e.g motor vehicle, lift bicycle, etc.</p> <p>10.2 Describe the various types of brake in a system e.g shoe brake, friction disc brake, magnetic brake, hydraulic brake, pneumatic brake.</p> <p>10.3 State the applications of the brakes listed in 10.2 above.</p> <p>10.4 Calculate the value of pressure required to develop a braking torque when the drum is rotating:-</p> <ol style="list-style-type: none"> clockwise anti-clockwise; - using the formula: brake torque = $(T1 - T2) \frac{d}{2}$ <p>10.5 Specify various types of fluids used for hydraulic brakes e.g mobil super heavy duty brake fluid 116 Grade NOT.3, Shell 44, SAE 20, etc.</p>	<ul style="list-style-type: none"> Illustrate and explain with diagrams the activities in 10.1 to 10.5 and make notes accordingly Assess the students 	<ul style="list-style-type: none"> Recommended textbooks, chalkboard, chalk, lesson notes etc.

PRACTICAL TASK

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 25	Contact Hours: 9hrs/wk
Week	Specific Learning Outcome	Teacher Activities	Learning Resources
1-9	<p>1.1 Identify various types of pumps used in engineering. Give the characteristics of each type e.g:</p> <ul style="list-style-type: none"> a. Rotary pump b. Centrifugal pump c. Reciprocating pump d. Gear pumps <p>1.2 Explain practically the safety arrangements of gear pumps, their care and maintenance.</p> <p>1.3 Operate and maintain pumps in good working conditions.</p>	<ul style="list-style-type: none"> • Practically show students types of pumps used in engineering. Explain to them the differentiating characteristics. The following pumps should be shown: • Rotary pump • Centrifugal pump • Reciprocating pump • Gear pump, etc. • Practically demonstrate and explain the safety arrangements of gear pumps, their care and maintenance. • Demonstrate the operation and maintenance of pumps and practically carry out the operation and maintenance of one. • Assess the students 	<ul style="list-style-type: none"> • Live pumps • Manuals and catalogues • Maintenance tool box

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Machine Shop Production and Maintenance		Module Code: CME 25	Contact Hours: 9hrs/wk
Week	Specific Learning Outcome	Teacher Activities	Learning Resources
	1.4 Design and make a simple oil pump. 1.5 Group demonstration of installation, repair, maintenance of a selected pump.	<ul style="list-style-type: none"> • Demonstrate and allow students to practice till they become competent • Assess the students • Give a general explanation on installation, repair, maintenance of various types of pumps used in engineering. • Assess the students 	<ul style="list-style-type: none"> • Manual/Catalogues • Complete tool box
5-12	2.1 Identify and differentiate between each of the following clutch: <ul style="list-style-type: none"> a. jaw clutch b. friction clutch c. over-running clutch d. flat plate clutch e. fluid clutch f. conical clutch g. friction type centrifugal clutch h. Draw the symbol for each one. 	<ul style="list-style-type: none"> • Show and explain the difference between each of the following clutches: <ul style="list-style-type: none"> • jaw clutch • friction clutch • over-running clutch • flat plate clutch • fluid clutch • conical clutch • friction type centrifugal clutch, etc • Give the symbol for each type. • Assess the students 	Live clutches
1-2	3.1 Measure, cut and join belt to a given length.	<ul style="list-style-type: none"> • Demonstrate and allow student to practise • Assess the students 	• Recommended apparatus

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 25	Contact Hours: 9hrs/wk
Week	Specific Learning Outcome	Teacher Activities	Learning Resources
6-9	4.1 Maintain and repair chains in good working conditions. 4.2 Maintain gears in good working conditions 4.3 Dismantle, check for worn out parts, repair and reassemble gears in a transmission system.	<ul style="list-style-type: none"> • Demonstrates for the students to practice till they become competent • Assess the students 	<ul style="list-style-type: none"> • Complete tool box
	5.1 Dismantle, check for wear, repair and reassemble a braking system.	<ul style="list-style-type: none"> • Demonstrate and guide students to dismantle, check for wear, repair and reassemble a braking system. 	<ul style="list-style-type: none"> • Live vehicle, tools box, maintenance manual
9-12	6.1 Bleed hydraulic line to excluded air from the system. 6.2 Adjust, maintain and recondition braking system. 8.3 Check air line pressure to ascertain that there is no air leak.	<ul style="list-style-type: none"> • Guide and monitor students bleed hydraulic line to exclude air from the system. • Demonstrate and guide students to adjust, maintain and recondition braking system. • Together with the students, check air line pressure to ascertain that there is no air leak. • Assess the students 	<ul style="list-style-type: none"> • Live vehicle, tools box, Bleeding equipment
ANTC Assessment Profile - practical 60%, theory 40%			

Inspection and Measurement

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE

Course: Machine Shop Production &
Maintenance

Module Code: CME 27: Inspection &
Management

Contact Hours:
7hrs/wk

Goal: This module is designed to provide the trainee with the knowledge and skill to enable him measure and the accuracy of components.

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

1. Understand the working principle and use various measuring instruments to determine the flatness, straightness and squareness of engineering components.
2. Measure and check the correct dimensions of external and internal screw-threads and carry out related calculations.
3. Understand the working principles of an optical projector and use it to determine a project profile against a master profile.
4. Determine the quality of surface finish and texture of job.

Practical Competence:

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

1. Can use spirit level, clinometer, dial testing indicator, etc in determining square and straightness of a job
2. Will be able to set a workpiece running on a lathe machine with dial indicator.
3. Be able to operate optical projector
4. Use tool maker's microscope to measure and check profile

PRACTICAL TASKS

Week	General Objective 1.0: Understand the working principles and use various measuring instruments to determine flatness, straightness		
	Specific Learning Outcome	Teachers Activities	Resources
1-4	<p>1.1 Demonstrate proficiency in the use of these of instruments in determining straightness and squareness of a job: spirit level, clinometer, straight edges, dial testing indicator, interometer, engineer's block, cylindrical block</p> <p>1.2 Use dial indicator to set a work piece running on the lathe machine</p>	<ul style="list-style-type: none"> • The teacher to demonstrate each of the activities and allow the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • All the instruments listed in 1.1 • Live lathe, dial indicator etc
	General Objective 2.0: Measure and check the correct dimensions of external and internal screw-threads		
Week	Specific Learning Objective:	Teachers Activities	Resources
5-7	<p>2.1 Select the correct instruments and measure the following:</p> <ul style="list-style-type: none"> a. major, minor, and effective diameter of screw- thread b. Flank angle thread c. pitch of a thread d. depth of a thread <p>2.2 Determine form of the thread and optical projection</p>	<ul style="list-style-type: none"> • Demonstrate 2.1 to 2.2 and allow the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Optical projector during measurements
	General Objective 3.0: Understand the working principles of an optical projector and use it to determine a projector profile against masters profile		
Week	Specific Learning Objective:	Teachers Activities	Resources
8-10	<p>3.1 Operate an optical projector</p> <p>3.2 Select master profile for the job</p> <p>3.3 Set up the projector for comparison; interpret the projected profile against the master profile</p> <p>3.4 Use the tool marker's microscope to measure and check profile</p>	<ul style="list-style-type: none"> • Demonstrate the activities in 3.1 to 3.4 for the students to practise and become competent • Assess the students 	<ul style="list-style-type: none"> • Optical projector, charts, etc

General Objective 4.0: Determine the quality of surface finish and texture of a job			
Week	Specific Learning Objective:	Teachers Activities	Resources
11-12	4.1 Check surface texture by visual and comparison block 4.2 Check and inspect the size of a job using the following comparators - mechanical, optical, electrical, and pneumatic 4.3 Interpret results from each comparative effect changes in the production line Maintain and care for the comparators listed in 4.2	<ul style="list-style-type: none"> • Demonstrate the activities in 4.1 to 4.4 and allow the students to practise till they become competent • Assess the students 	<ul style="list-style-type: none"> • Charts showing labeled diagram, and uses of different types of comparators

KNOWLEDGE REQUIREMENT

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 27: Inspection & Management	Contact Hours: 7zhrs/wk
Week	General Objective 1.0: Understand the working principles and use various measuring instruments to determine flatness and straightness of a job.		
	Specific Learning Outcome	Teachers Activities	Resources
1-4	1.1 Explain the essential different between engineering measurements and inspection 1.2 Explain why it is necessary to give a tolerance on an engineering dimension 1.3 Explain the effect of the engineering allowance on the different types of fit required in engineering manufacture 1.4 Describe the function of a limit system, and give brief details of a limit system 1.5 Explain the advantages offered by the use of limit gauges in engineering manufacture 1.6 State the basic working principles of the following instruments: spirit level, clinometer, straight edges, dial testing indicator, interferometer, engineer's block, cylindrical block	<ul style="list-style-type: none"> • Give notes and explanation that will explain the essential difference between engineering measurements and inspection • Prepare notes and diagrams that will assist students to explain why it is necessary to give a tolerance on an engineering dimension • Prepare notes that will explain the effect of the engineering allowance on the different types of fit required in engineering manufacture • Prepare explanatory notes that will describe the function of a limit system as well as brief details of a limited system • Prepare explanatory notes that will explain the advantages offered by the use of limit gauges in engineering manufacture • Prepare explanatory notes that will assist students to state the basic working principles of measuring instruments • Assess the students. 	<ul style="list-style-type: none"> • Recommended textbook, chalkboard, lesson notes, chalk etc

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 27: Inspection & Management	Contact Hours: 7zhrs/wk
Week	General Objective 1.0: Understand the working principles and use various measuring instruments to determine flatness and straightness of a job.		
	Specific Learning Outcome	Teachers Activities	Resources
5	1.7 Explain with neat sketches the typical applications of a set of tool maker's straight edges 1.8 Make a neat diagram illustrating the principle of magnification inherent in a dial indicator. Give the workshop applications of this instrument	<ul style="list-style-type: none"> • Prepare detail notes and diagrams that will explain the typical application of a set of tool maker's straight edges • Prepare detail notes with diagrams that will assist students to illustrate the principle of magnification inherent in a dial indicator • Assess the students 	<ul style="list-style-type: none"> • Illustrations from textbooks
General Objective 2.0: Measure and check the correct dimension of external and internal screw threads			
Week	Specific Learning Objective:	Teachers Activities	Resources
6-8	2.1 Explain the term major, minor and effective diameter of a screw-thread. 2.2 Sketch and label the various parts of both internal and external screw threads	<ul style="list-style-type: none"> • -Prepare detail notes with diagram that will explain the following terms on a screw thread: major, minor and effective diameter • Prepare notes and diagrams that will illustrate various parts of both internal and external threads • Assess the students 	<ul style="list-style-type: none"> • Optical Projector during measurement

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Machine Shop Production and Maintenance		Module Code: CME 27: Inspection & Management	Contact Hours: 7zhrs/wk
General Objective 3.0: Understand the working principles of an optical projector and use it to determine the projector profile against the master profile			
Week	Specific Learning Objective:	Teachers Activities	Resources
9	3.1 Explain the working principles of an optical projector	<ul style="list-style-type: none"> • Prepare notes and diagrams that will explain the working principles of an optical projector • Explain to the students how to select master profile for the job • Assess the students 	<ul style="list-style-type: none"> • Chart showing labeled optical projector with notes on uses of control functions
General Objective 4.0: Determine the quality of surface finish and texture of a job			
Week	Specific Learning Objective:	Teachers Activities	Resources
10-12	Explain the following terms used or describing surface texture: lay; profile; spacing; wave; center line average value	<ul style="list-style-type: none"> • Prepare notes that will explain the following terms used to describe surface texture: lay, profile, spacing wave, center line average value • Assess the students 	<ul style="list-style-type: none"> • Chart showing labeled diagram uses of different types of comparator • Show real objects of aforementioned instruments

Press Tool Manufacture

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE

Course: Tool & Die Making | Module Code: CME 28: Press Tool Manufacture | Contact Hours: 11hrs/wk

Goal: The module is designed to enable the trainee to design a simple press tool and to construct a press tool to a given specification for the production of an engineering component.

General Objectives

1. Understand safety rules and their application to press tool manufacture.
2. Know the basic principles and constructional details of common types of presses.
3. know the principle and application of different types of press tools.
4. Understand the advantages of using die sets.
5. Understand the function of the component parts of different types of press tool.
6. Understand the basic principles of designing press tools.
7. Know the common defects found in press work components.
8. Understand the need for the economic use of strip and sheet material.
9. Understand the factors affecting the choice of tool materials for press tool manufacture.
10. Understand the heat treatment of press tool materials produce.
11. Design a simple press tool to a given component e.g. flat washer or simple bracket.

Practical Competence:

On completion of this module trainees will demonstrate the following competences to a standard expected in industry.

1. Demonstrate safe working habits and skillfully, handle the tasks of loading tool on the press and operate it.
2. Presses: Fly press, foot lever press, power press etc.
3. Set and Check press tools for correct clearance, material flow and ejection.
4. Press tool: Bending, blanking, piercing
5. Correct defects found in press tool products.
6. Defects: incorrect material specification, tool design and heat treatment
7. Strip layout a given blanked, bend and pierced shape to obtain the most economic use of material.
8. Use appropriate selection criteria to select and heat treat press tool-material press tool material; Tool steel, Alloy steel, nitrided or case hardened low carbon steel.
9. Design a manufacture and assemble press tool to produce a component using own prepared drawing products: Washer, Corrugated sheet.

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making

Module Code: CME 28: Press Tool Manufacture

Contact Hours: 11hrs/wk

10. Select appropriate copying stylus, position and clamp template or align pattern on the master table of a pantagraph machine to copy firm of a given template or pattern.
11. Set up work piece, select appropriate copying stylus and operate a
12. Regulate current density, type of dielectric fluid, spark frequency, spark gap and flushing technique to effect metal renewal rate and quality surface finish using an E.D.M.
13. Take impression of die and mould and hand finish cavities using files, stones and abrasive materials
14. Carry out modification and repair of dies techniques: hand grinding, welding and recutting, Hardening, annealing and remachining.

PRACTICAL TASKS

	MODULE COURSE: CME 28 Press tool Manufacture	Contact Hours: 8hrs/we	
	General Objective: 1.0: Workshop Practice		
Week	Specific Learning Outcome:	Teachers Activities	Resources
	1.1 Locate master switches and method of immobilizing machines and use machine guards and safety equipment	• Demonstrate the operation of electrical power isolation switches, the proper use of protective clothing and safety equipment and tools.	• Safety charts, film show on safety practices
	General Objective: 2.0: Press Tools		
Week	Specific Learning Objective:	Teachers Activities	Resources
2	2.1 know how to operate Hand, power, hydraulic presses and press brakes	• Demonstrate the operation of the mechanism in 2.1	• Models, real objects, Hand power, Hydraulic presses and press brakes
3	3.1 Know how to operate piercing cuping, drawing bending and forming, drawing chipping conning cropping tools.	• Demonstrate the uses of the tools in 3.1, students to practice	• Press tool in 3.1
4-5	4.1 Operate press tools to produce the following effects -Blanking, Forming, drawing etc	• Demonstrate how to operate the press tool to produce the effects in 4.1. students to practice	• Punch and dies press tools

	MODULE COURSE: CME 28 Press tool Manufacture	Contact Hours: 8hrs/we	
	General Objective: 1.0: Workshop Practice		
	General Objective: 5.0: Designing Press Tools		
Week	Specific Learning Objective:	Teachers Activities	Resources
6-9	<p>5.1 Make a simple piercing punch and die to punch a hole of a given diameters in sheet material using a simple fly press</p> <p>5.2 Make a simple 90° angle bending tool to demonstrate the effects of material elasticity on “spring back” using a simple fly press</p> <p>5.3 Use ‘shear to reduce the cutting force required in blanking and piercing tools</p>	<ul style="list-style-type: none"> • Provides guidance in the production of punch and die, and 90o angle bending tool. • Demonstrate the effect of reduction of cutting surface of press tool to reduce the cutting force required in blanking and piercing and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • From practical exercise in punch and die making
10-12	<p>6.1 Carry out case hardening and nitriding processes on press tools made from low carbon steel</p> <p>6.2 Examine the hardening and tempering of H.C.S and its effects on the degree of hardness obtained</p>	<ul style="list-style-type: none"> • Demonstrate case hardening and nitriding processes on press tools made from low carbon steel • Demonstrate hardening and tempering of tool steel observing its effect on its degree of hardness • Assess the students 	<ul style="list-style-type: none"> • Heat treatment chart
	<p>7.1 Strip layout a given pressed shape to obtain the most economic use of strip material</p>	<ul style="list-style-type: none"> • Demonstrate strip laying out of product on sheet to obtain the most economic use of strip material 	<ul style="list-style-type: none"> • Drancing product profile on strip
	<p>8.1 Manufacture a given parts of the tool e.g washer</p>	<ul style="list-style-type: none"> • Provide guidance in the design and development of operations sequences in the manufacture of a washer 	<ul style="list-style-type: none"> • Flow chart of design and production sequence for making washer
	<p>9.1 Identify defects caused by incorrect tool material specification and grain direction</p>	<ul style="list-style-type: none"> • Demonstrate the use of trouble shooting approach to detect defects causes of tool failure and profer remedies • Students are to be allow to practice till they become competent and proper assessment carried out • Assess the students 	<ul style="list-style-type: none"> • Procedures in trouble shooting write-up
ANTC Assessment Profile: Practical 60% of overall assessment			

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECH. ENGR. CRAFT PRACTICE

MODULE: PRESS TOOL MANUFACTURE	MODULE CODE: CME 28	CONTACT HOURS: 3hr/wk
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MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT

General Objective: 1.0: Understand Safety Rules And Their Application To Press Tool Manufacture

Week	Specific Learning Outcome:	Teacher Activities	Learning Resources:
1	1.1 Recognise the precautions to be observed when operating machinery, tools and equipment 1.2 Know the operations of safety devices and installations	<ul style="list-style-type: none"> Describe the general requirements for the observance of safe practice. General requirements: protecting self and others, alertness to danger, maintaining personal hygiene knowledge, knowledge of emergency and hazard reporting, clothings etc. Explains how safety devices and installations work Assess the students 	<ul style="list-style-type: none"> Safety manuals charts and film shows on general safety. Film shows and real objects

General Objective: 2.0: Know The Basic Principles And Constructional Details Of Common Types Of Presses

Week	Specific Learning Objective:	Teachers Activities	Resources
2	2.1 Know presses and its types 2.2 Know the basic principles and constructed details of common types of presses: Hand, power, Hydraulic presses and press brakes 2.3 Know the press capacity that must be suited to the work requirement e.g force 2.4 Calculate the force required for a simple blanking or pressing operation making use of the formula: Illustrate stress = $\frac{\text{Force}}{\text{Area of shear}}$	<ul style="list-style-type: none"> Introduces types of presses used in manufacturing: <ul style="list-style-type: none"> arbor press fly press power press (rank and hydanlic) press brake. Explain the basic operating principles and construct of each of the presses in 2.1. 	<ul style="list-style-type: none"> Pictorial diagrams and real objects. Slides. Sectional diagrams of presses in 2.1 transparencies. -Recommended textbook and teachers' notes. Recommended textbook, models, slides.

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECH. ENGR. CRAFT PRACTICE			
MODULE: PRESS TOOL MANUFACTURE		MODULE CODE: CME 28	CONTACT HOURS: 3hr/wk
MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT			
2		<ul style="list-style-type: none"> • Relates mechanical properties of component material. • and size to work capacity of press • Solves problems in determining ultimate shear stress • of product material in relation to shear force required 	
General Objective: 3.0: Understand The Functions Of Component Parts Of Different Types Of Press Tool			
Week	Specific Learning Objective:	Teachers Activities	Resources
3-5	3.1 Understand the function of the component parts of different types of press tools 3.2 Describe the basic principles of operation of the Blanking Tools, piercing tools applying tool, drawing tools, Bending and Forming tools clipping, coining, cropping tools 3.3 Determine the need for multi stage tooling and its advantages 3.4 Understand the action of punch and die in blanking and piercing tools, drancing and forming tools 3.5 State methods of locating punch and die during assembly 3.6 State methods of ejection from die 3.6 Identify the common materials used for press tool components part 3.7 Explain the influence of the following factors on tool material selection: Machinability, Type of tool, Wear resistance, Required Heat treatment, Tool cost	<ul style="list-style-type: none"> • Introduces common types of press tools used in manufacturing engineering: blanking tools, piercing tools, cupping tools, drainaging tools, bending and forming tools, clipping tools, coining tools, cropping tools etc. • Explain the cutting action of each of the tools with detailed notes • Simulate need for multi-stage tooling such as deep recess in cups and progressive blanking, bending and cropping of a product • Assess the student 	<ul style="list-style-type: none"> • Pictorial diagrams and chart of press tools. Transparencies. • Chart detailing cutting action of press tools slides. • Flow chart shoning set-up and processes. Products samples, slides. • Chart showing cutting actions of punch and die performing the various metal shaping processes mentioned slides.

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECH. ENGR. CRAFT PRACTICE

MODULE: PRESS TOOL MANUFACTURE	MODULE CODE: CME 28	CONTACT HOURS: 3hr/wk
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MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT

3-5		<ul style="list-style-type: none"> • Explain the action and effects of punch and die in: blanking and piercing tools, drancing tools and forming tools. • Describes the methods of locating punch and die during assembly. Give detailed notes • Describes methods of product ejection from die. • Illustrate and explain with diagrams the activities in 3.6 to 3.8 • Assess the students
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General Objective: 4.0: Understand The Advantages Of Using Die Sets

Week	Specific Learning Objective:	Teachers Activities	Resources
	4.1 Explain different types of the die set, e.g Open front type, diagonal pillar, type, 4 pillar type 4.2 Identify the component parts of a die set 4.3 Distinguish between “Day light” and “shut Height” of a die set 4.4 Explain the advantages to be gained from using die sets	<ul style="list-style-type: none"> • Describe different types of the dies sets on 4.1 • Identifies the component parts of the die sets. • States and contracts the characteristics of "Daylight" and "Shut Height" of a die set. • Explain the advantages of using die sets Assess students • Assess the students 	<ul style="list-style-type: none"> • Real objects, Notes • Real object, Notes • Observe phenomenon on real object. • Problem solving session. Transparencies

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECH. ENGR. CRAFT PRACTICE

MODULE: PRESS TOOL MANUFACTURE	MODULE CODE: CME 28	CONTACT HOURS: 3hr/wk
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MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT

General Objective: 5.0: Understand The Basic Of Designing Press Tool

Week	Specific Learning Objective:	Teachers Activities	Resources
9	<p>Show that the clearance between a punch and die for a drawing or bending tool is dependent on material thickness</p> <p>Calculate the clearance required between a punch and die for a blanking or piercing tool</p> <p>Explain the shape of punch and die needs to be modified to compensate for "spring back" when bending</p>	<ul style="list-style-type: none"> • Give reasons why the clearance between a punch and die for drawing or bending depends on material thickness. • Solves problems on clearance between punch and die for blanking or piercing tool • Solves problems on clearance between punch and die for blanking or piercing tool • Assess the students 	

General Objective: 6.0: Understand The Heat Treatment Of Press Tool Materials

Week	Specific Learning Objective:	Teachers Activities	Resources
10	<p>6.1 Explain heat treatment for the following materials: cast iron, low carbon steel, High carbon steel, alloy steel</p> <p>6.3 Describe a method of heat treatment for a given alloy steel</p>	<ul style="list-style-type: none"> • Describes the processes of heat treatment for the materials listed in 6.1. • Describes heat treatment processes for a given alloy steel e.g tool steel. • Assess the students 	<ul style="list-style-type: none"> • Heat treatment chart containing information for materials in 10.1. • Table of heat treatment for alloy steels. • Transparencies

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECH. ENGR. CRAFT PRACTICE			
MODULE: PRESS TOOL MANUFACTURE		MODULE CODE: CME 28	CONTACT HOURS: 3hr/wk
MODULE SPECIFICATION: KNOWLEDGE REQUIREMENT			
General Objective: 7.0: Understand The Need For Economic Use Of Strip And Sheet Materials			
Week	Specific Learning Objective:	Teachers Activities	Resources
11	7.1 Determine the size of blank required for pressed component 7.2 Calculate the percentage of material wasted for a given sample	<ul style="list-style-type: none"> • Determines the size of blank required for a pressed component. • Estimate the percentage of material for the example in a given sample • Assess students 	<ul style="list-style-type: none"> • Recommended textbook. • Recommended textbook skeleton of pierced products
General Objective: 8.0: Design A Simple Press Tool To Manufacture A Given Component E.G Flat Washer Or Simple Bracket			
Week	Specific Learning Objective:	Teachers Activities	Resources
13	8.1 Explain the selection of suitable material for the tool component parts 8.2 Explain how to identify heat treatment suitable for the component parts 8.3 Explain the selection of suitable measuring processes to produce the tool component parts designed in 8.0	<ul style="list-style-type: none"> • Discuss criteria for selecting suitable materials for the tool component parts. • Identifies heat treatment processes suitable for the various parts of the press tool • Appraises metal machining processes appropriate for producing the tool component parts design in 8.0. • Assess the students 	<ul style="list-style-type: none"> • Recommended textbook. Transparencies • Teachers' notes. Transparencies • Recommended textbooks, Teachers' notes. • Film show.

Jig and Fixture Manufacture

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making

Module Code: CME 29: Jig & Fix Design

Contact Hours: 6hrs/wk

Goals: The module is deigned to enable the trainee to understand the use of jigs and fixtures production and to construct a jig or fixture for a given application.

General Objectives:

On completion, the trainee should be able to know the difference between jigs and fixtures and fixtures

1. Understand the need for jigs and fixtures
2. Understand the principles of location and restraint
3. Understand common methods of clamping
4. Understand the importance of tool guidance and location relative to the component
5. Understand the importance of fixture location relative to a machine to slide construction.
6. Understand different methods of jig and fixtures construction.
7. Understand the advantages of using parts in the construction of jigs and fixtures.
8. Understand the factors which influence the choice of materials for jig and fixture construction
9. Understand the importance of safe working practices in jig and fixture production
10. Design and make a simple jig or fixture for a given component

Practical Competence

On completion of this module:

1. Undertake appropriate research in order to formulate jig or fixture design specification
2. Generate alternative design solutions
3. Select materials suitable to the design function
4. Produce assembly drawing of simple jig or fixture.
5. Prepare a part list and material list select standard bought-out parts from manual. Catalogue
6. Plan the manufacturing and assembly processes
7. Do the cost analysis of the product.
8. Manufacture, inspect and assemble the component parts of the product.
9. Produce a block diagram or table showing the procedure for a systematic approach to jig or fixture manufacture.
10. Conduct simple investigation of factors to be considered in material selection for a particular purpose: factors. Machinability, strength, corrosiveness, cost, rigidity.

PRACTICAL TASKS

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Tool & Die Making		Module Code: CME 29: Jig & Fix Design	Contact Hours: 6hrs/wk
Week	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Use jigs for drilling operation 1.3 Use fixtures for the following operations: Turning, milling, welding, assembly	<ul style="list-style-type: none"> • Demonstrate the use of drilling jigs • Demonstrate the use of fixtures for the operations listed in 1.3 and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • Drill jig for sample coordinator holes • Drawing board/instrument
2	2.1 Describe a jig fixture for a given type of production 2.2 Design a jig and fixture correctly to reduce operators fatigue	<ul style="list-style-type: none"> • Demonstrate by designing an appropriate jig or fixture for a particular job or component in 2.3 and allow students to practise • Assess the students 	
3	3.1 Restrain the six degrees of freedom for cylindrical, rectangular and complex shapes 3.2 Make a simple location system for a given component	<ul style="list-style-type: none"> • Demonstrate location of a lever by plug and vee block - plug and vee block (sliding) provided for the location and allow the students to practise • Assess the students 	<ul style="list-style-type: none"> • Lathe milling machine • cylindrical grinder micrometer
4	4.1 Make a simple slotted plate type clamp using bolt and nut or cam action	<ul style="list-style-type: none"> • Design the slotted plate type clamp and show all the dimensions of the components and allow the students to practise • Assess the students 	<ul style="list-style-type: none"> • Black board, milling machine, drilling machine
5-6	5.1 Use setting block to position cutting tool relative to a component e.g milling fixture 5.2 Make a drill bush and assemble it in a drill bush 5.2 Strip work or material from the punch e.g fixed or spring loaded 5.4 State methods of ejection from die	<ul style="list-style-type: none"> • Ask the students to produce the components in the workshop. Procure the standard parts • Demonstrate the clamping action of the clamp by assembling the components together and setting up on a machine • Give the student the drawing of a drill bush and guide them to manufacture it • Guide the students to set up for the use of milling fixture • Assess the students 	<ul style="list-style-type: none"> • Lathe, milling machine, drilling machine • Lathe, cylindrical grinder with internal grinding, milling machine

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 29: Jig & Fix Design	Contact Hours: 6hrs/wk
Week	Specific Learning Outcome:	Teachers Activities	Resources
7	<p>6.1 Construction of Jig & Fixture</p> <p>6.2 Make drill jig using the drill plate in 5.4</p> <p>6.3 Carry out correct alignment of jig and fixture before welding</p>	<ul style="list-style-type: none"> • The teacher to draw on the board component points of a drill jig • List the manufactured parts e.g: base plate, drill plate, drill bush etc • List the standard parts bought-out parts e.g: bolts and nuts, dowel pins • Guide the students to manufacture the components • Assemble the manufactured parts of the drill jig using the bolts and nuts and other standard bought-out parts • Test the drill jig • Assess the students 	<ul style="list-style-type: none"> • Lathe, Milling machine, drilling machine, micrometer, vernier caliper, surface plate, vernier height gauge
	<p>7.1 Standard parts in construction</p> <p>7.3 Select standard parts from manufacturers catalogue to construct a simple jig fixture</p>		

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 29: Jig & Fix Design	Contact Hours: 6hrs/wk
General Objective 8.0: Safety			
Week	Specific Learning Objective:	Teachers Activities	Resources
8	8.1 Operate machinery, tools and equipment safety	<ul style="list-style-type: none"> • Demonstrate the operation of machines e.g lathe, milling machine, pillar drill etc • Locate master switches and methods of immobilizing them in case of emergency 	<ul style="list-style-type: none"> • Lathe, milling machine, pillar drilling machine
	8.2 Use machine guards and protective equipment such as safety goggles and overalls		
	8.3 Recognise the precautions to be taken when using welding equipment	<ul style="list-style-type: none"> • Discuss the use of safety guards of safety equipment, identify and show the safety guards and equipment • The teacher to show the delicate parts of the welding equipment (oxy-acetylene/arc welding) and state precautions against damage and injury • Demonstrate the use of this equipment • Assess the students 	<ul style="list-style-type: none"> • Oxy-acetylene welding set, Electric arc welding machine
9-12	9.1 Produce a working drawing for the manufacture of the jig or fixture	<ul style="list-style-type: none"> • The teacher to select a suitable component for the exercise of jig or fixture design • Guide the students in producing working drawings for the jig or fixture • Guide the students in producing assembly drawings of the jig or fixture • Guide the students in the selection of suitable materials for jig or fixture • Guide the students to select suitable standard parts • Guide the students to select appropriate heat treatment for the component e.g; hardening/tempering, stress relieving etc. 	
	9.2 Select suitable materials jig or fixture components using factors of type of jig or wear resistance, production quantity, method of construction		
	9.3 Select suitable machining processes to produce the jig or fixture component		
	9.4 Select any necessary heat treatment for the jig or fixture components		

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 29: Jig & Fix Design	Contact Hours: 6hrs/wk
9-12	9.5 Manufacture drilling and welding jig or fixture, selecting appropriate materials, heat treatment method, assemble and prove the design	• Guide the students to write the operation layout or process sheet for the manufacture of the jig or fixture	

KNOWLEDGE REQUIREMENTS

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Tool & Die Making		Module Code: CME 29 - Jig & Fixture Design & Manufacture Contact Hours 6 hrs/wk	
Week	General Objective 1.0: Know The Difference Between Jigs And Fixtures		
	Specific Learning Outcome:	Teachers Activities	Resources
	1.1 Explain the difference between a jig and fixture	<ul style="list-style-type: none"> To illustrate the difference between a jig and fixture with diagrams and notes 	<ul style="list-style-type: none"> Recommended textbooks and Teachers notes. Transparencies Chalkboard, chalk etc.
General Objective 2.0: Understand The Need For Jigs And Fixtures			
Week	Specific Learning Objective:	Teachers Activities	Resources
	2.1 Describe how jigs and fixtures can assist in the manufacture of engineering components 2.2 Explain the different types of manufacturing production: (i) jobbing (ii) bath (iii) mass	<ul style="list-style-type: none"> Illustrate the activities in 2.1 to 2.2 and prepare notes for the students Assess the students 	
General Objective 3.0: Understand The Principles Of Location And Restraint			
Week	Specific Learning Objective:	Teachers Activities	Resources
	3.3 Explain a body (component) in space has six degree of freedom 3.4 Explain the restraint of the six degree of freedom for different component shapes e.g (i) cubic or rectangular (ii) cylindrical (iii) non geometrical (complex shapes) 3.5 Explain how to locate between rough castings or forging parts machined components 3.6 Explain the use of flatted and full-form locator pins for restraining prevailing drilled components	<ul style="list-style-type: none"> The teacher to illustrate the activities in 3.1 to 3.4 and prepare good notes for the students Assess the students 	

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 29 - Jig & Fixture Design & Manufacture Contact Hours 6 hrs/wk	
General Objective 4.0: Understand Common Methods Of Clamping			
Week	Specific Learning Objective:	Teachers Activities	Resources
3-4	<p>4.1 Explain the use of different types of clamps in jigs and fixtures e.g.</p> <p>i. plate type using nut and bolt</p> <p>ii. cam action</p> <p>iii. Toggle action</p> <p>4.2 Give examples of the use of each type of clamp in 4.1</p> <p>4.3 Describe methods of supporting a clamp e.g use of spring and heel pin</p> <p>4.4 Know the relationship between the points of clamping, support and applied force</p> <p>4.5 Explain the problems associated with clamping on unsupported areas of a component</p> <p>4.6 Calculate the force involved in a given system of clamping (by taking moments of the forces)</p>	<ul style="list-style-type: none"> • The teacher to illustrate and explain activities in 4.1 to 4.6 with diagrams where necessary and prepare notes for the students • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks and Teachers notes. Transparencies • Chalkboard, chalk etc.
General Objective 5.0: Understand The Importance Of Tool Guidance And Location Relative To The Component			
Week	Specific Learning Objective:	Teachers Activities	Resources
5	<p>5.1 State the criteria for the identification of the different types of drill bushes and their uses e.g</p> <p>(i) headed</p> <p>(ii) headless</p> <p>(iii) linear</p> <p>(iv) reamer</p> <p>(v) ship</p> <p>5.2 State the purpose of a lock screw used in conjunction with a slip bush</p>	<ul style="list-style-type: none"> • The teacher to illustrate and explain the activities in 5/1 to 5.3 and prepare notes for the students • Assess the students 	

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 29 - Jig & Fixture Design & Manufacture Contact Hours 6 hrs/wk	
General Objective 6.0: Understand The Importance Of Fixture Location Relative To A Machineslide Movement			
Week	Specific Learning Objective:	Teachers Activities	Resources
6	<p>6.1 Explain the use of tenon pieces for locating a fixture relative to a machine table</p> <p>6.2 Explain the need for tenons to be interchangeable to suit different machine tables</p>	<ul style="list-style-type: none"> • The Teacher to illustrate and explain the activities in 6.1 to 6.2 and prepare notes • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks and Teachers notes. Transparencies • Chalkboard, chalk etc.
General Objective 7.0: Understand Different Methods Of Jigs And Fixtures Construction			
Week	Specific Learning Objective:	Teachers Activities	Resources
7-8	<p>7.1 State the advantages and disadvantages of the different methods of construction e.g</p> <ol style="list-style-type: none"> fabrication using screws and dowels casting welding <p>7.2 Explain the parts of a fabricated jig or fixture that must be accurately machine to ensure correct assembly</p> <p>7.3 State the criteria for location of dowels when fixing parts of a jig or fixture together with screws</p> <p>7.4 Explain why jig or fixture parts, dowels must be spaced at minimum center distance</p> <p>7.5 Explain that jig or fixture parts may be welded together without the need for accurate machining</p> <p>7.6 State how to prevent or correct distortion due to welding</p> <p>7.7 Describe a process for stress relieving after welding</p> <p>7.8 State how datum relieving machined after stress relieving</p>	<ul style="list-style-type: none"> • The teacher to explain and illustrate the activities in 7.1 to 7.8 and prepare notes for the students • Assess the students 	

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Tool & Die Making		Module Code: CME 29 - Jig & Fixture Design & Manufacture Contact Hours 6 hrs/wk	
General Objective 8.0: Understand The Advantages Of Using Standard Parts In The Construction Of Jigs And Fixtures			
Week	Specific Learning Objective:	Teachers Activities	Resources
9	8.1 State the advantages of using standards in the construction of jigs and fixtures	<ul style="list-style-type: none"> The teacher to state and explain the advantages of using standard parts in the construction of jigs or fixtures and prepare notes 	<ul style="list-style-type: none"> Recommended textbooks and Teachers notes. Transparencies Chalkboard, chalk etc.
General Objective 9.0: Understand The Factors Which Influence The Choice Of Materials For Jig And Fixture Construction			
Week	Specific Learning Objective:	Teachers Activities	Resources
10	9.1 Explain the influence of the following factors on material section <ul style="list-style-type: none"> (i) type of jig or fixture (ii) shape of component to be located (iii) machinability (iv) resistance (v) method of construction (vi) production quantity 9.2 State the criteria for the selection of suitable materials for a given jig or fixture construction	<ul style="list-style-type: none"> The teacher to illustrate and explain the activities in 9.1 to 9.2 and prepare notes accordingly 	

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 29 - Jig & Fixture Design & Manufacture Contact Hours 6 hrs/wk	
General Objective 11.0: Design And Make A Simple Jig Or Fixture For A Given Component			
Week	Specific Learning Objective:	Teachers Activities	Resources
11-12	11.0 Design and make a simple jig or fixture 11.1 Produce a working drawing for the manufacture of the jig or fixture 11.2 State the criteria for the selection of materials 11.3 State the criteria for the selection of heat treatment processes 11.4 State the machining processes 11.5 State the steps involved in the manufacture of the components 11.6 State the steps involved in the assemble of the jig or fixture components 11.7 State the steps to prove the design of the jig or fixture	<ul style="list-style-type: none"> • The teacher to explain and illustrate the activities in 11.1 to 11.7 and prepare notes to guide the students in the design and manufacturing processes • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks and Teachers notes. Transparencies • Chalkboard, chalk etc.

Die Manufacture

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE

Course: Tool & Die Making

Module Code: CME 30 - DIE Manufacture

Goal: The module is designed to enable the trainee to understand the use of dies in engineering production and to construct a die to a given specification for a given process.

General Objectives

1. Know the application of dies in Engineering production
2. Understand the basic construction of dies used in engineering production.
3. Know the types of materials used in die manufacture and their effect on working practices.
4. Understand the importance of safe working practices in die manufacture.
5. Understand the setting and operation of a vertical milling machine with a universal head.
6. Understand the use and manufacture of templates in the production of die forms.
7. Understand the use of models or patterns as an aid to the production of die forms
8. Understand the setting up and operation of a pantograph copy milling machine.
9. Understand the setting up and operation of a hydraulic copy milling machine.
10. Understand the setting up and operation of an Electric Discharge Machine.
11. Understand Bench work and fitting techniques used in die manufacture.
12. Know the techniques used for modification and repair of dies.
13. Design and make a simple die for a given process

Practical Competence:

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

1. Safe and skillfully strip and assemble a commercial die set
2. Apply the appropriate selection criteria to choice and heat treat die materials
3. Die materials, Die casting die, Chrome molybdenum die steel.
4. Observe the general rules for safe practice in the working environment and wear the correct overall and safety boots.
5. Operate the vertical milling with a universal head to produce to machine a cavity having vertical, tapered sides and compound angle at the corner.
6. Copy and cast existing samples and model of pattern using suitable materials

KNOWLEDGE REQUIREMENT

PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE			
Course: Tool & Die Making		Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk	
Week	General Objective 1.0: Know The Application Of Die In Engineering Production		
	Specific Learning Outcome:	Teachers Activities	Resources
1	1.1 Give examples of the type of component produced by each of the listed in Diecasting, forging, forming and moulding plastics 1.2 Describe the principles of each of the processes listed in: Diecasting, forging, forming and moulding plastics 1.3 Give examples of the type of component produced by each of the listed in: Diecasting, forging, forming and moulding plastics	<ul style="list-style-type: none"> • Lists and discusses the engineering production processes that uses dies for operations in 1.1 • Explains the principles of the processes listed in 1.1 and prepare notes for the students. • Assess the students. 	<ul style="list-style-type: none"> • Recommended textbooks and Teachers notes. • Transparencies • Chart of machining processes
General Objective 2.0: Understand The Basic Construction Of Dies Used In Engineering Production			
Week	Specific Learning Objective:	Teachers Activities	Resources
2	2.1 Distinguish between different types of dies e.g Diecasting, Forging, moulding (plastics) 2.2 Identify the main features of a die e.g: bolster, Impression block, core slides, Guide dowels and bushes, Ejector pins and plates, Sprues and bushes.	<ul style="list-style-type: none"> • Illustrate and explain with diagrams the distinguishing factors among the different types of dies in 2.1, the main features of a die as listed and prepare notes for the students • Assess the students 	

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making	Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk
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General Objective 3.0: Know The Bench Work And Fitting Techniques

Week	Specific Learning Objective:	Teachers Activities	Resources
3	<p>3.1 Explain the operations normally carried out in bench fitting e.g</p> <ul style="list-style-type: none"> a. checking machined dimensions b. Finished after machining c. Taking impressions of dies and moulds for dimensional and visual checks d. Fitting and assembling die components e. Checking fully assembled die f. Modification and repair of dies <p>3.2 Identify special bench tools used in die fitting e.g</p> <ul style="list-style-type: none"> a. hand chasers or gravers b. hand grinding machines c. die files e.g Needle files and Riflers <p>3.7 Describe procedures for hand finishing of cavities using files, stones and abrasive materials</p> <p>3.8 Explain the importance of numbering and marking of all die components</p> <p>3.5 Explain the need for cooling channels in die blocks</p> <p>3.9 Describe a procedure for taking an impression of a die cavity</p> <p>3.7 Explain the need to take impressions of die cavities</p>	<ul style="list-style-type: none"> • Describes each of the bench fitting operations listed in 11.1 and prepare notes accordingly • Assess the students • Describes the procedures for hand finishing of cavities using files, stones and abrasive materials • Explains the importance of numbering and marking die components • Explains the function of the cooling channels in die block • Describes the process of taking impression of die cavities • Appraises the limitations of the types of materials used for taking impressions and prepare notes accordingly • Assess the students 	<ul style="list-style-type: none"> • Recommended textbooks, chalkboard, chalk, lesson notes, etc

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk	
	3.8 State the types of materials used for taking impressions and their limitations e.g.: <ul style="list-style-type: none"> a. Low melting point alloys b. Epoxy resins c. Waxes 		
General Objective 4.0: Know The Types Of Materials Used In Die Manufacture And Their Effects On Working Practice			
Week	Specific Learning Objective:	Teachers Activities	Resources
4	4.1 Identify the common materials used in manufacture of die components e.g: <ul style="list-style-type: none"> Nickel Chrome Die Steel Case hardening chrome Die Steel Chrome Molybdenum Die Steel Chrome Vanadium Die Steel Berylium Copper Cast iron 4.2 Explain the applications of materials covered in 3.1 4.2 Explain the influence of the following factors on the choice of die material: <ul style="list-style-type: none"> a. Machinability b. Wear resistance c. Surface finish required d. Heat treatment required e. Type of die 4.3 Explain the cutting tool geometry which may need to be modified to suit different die steels and materials	<ul style="list-style-type: none"> • Explains the applications of the materials mentioned in 4.1 • Explains selection criteria for choice of materials in 4.3 • Explains the form and cutting tool angles on tools which may be modified to suit different die steels and materials • Recommends appropriate heat treatment for materials listed in 4.1 as well as the required degree of hardness • Explains the heat treatment procedure identified in 4.6 • Assess the students 	<ul style="list-style-type: none"> • Chart of common metal used in die manufacture • Table of properties of metal elements and their uses • Chart of shapes and angles at tool point • Textbook prescriptions in tables • Teacher's notes

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making	Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk
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4.4 Identify the appropriate heat treatment for the die materials listed in 3.1 and the required degree of hardness 4.5 Explain the heat treatment procedures identified in 3.6		
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General Objective 5.0: Understand The Setting And Operation Vertical Milling Machine With Universal Head

Week	Specific Learning Objective:	Teachers Activities	Resources
5	5.1 Describe the angular movement of a universal head 5.3 State the types of surfaces that can be machined using a universal head 5.4 Calculate the angular settings required to machine a compound angle in the corner of a die cavity 5.4 Describe the machining of a compound corner	<ul style="list-style-type: none"> • Describes the angular movements of a universal head • Determines the angular settings required to machine a compound angle in the corner of a cavity • Describes the processes in machining a compound angle in a corner of a cavity • Assess the students. 	<ul style="list-style-type: none"> • Transparencies • Slides

General Objective 6.0: Understand The Use And Manufacture Of Templates In Production Die Forms

Week	Specific Learning Objective:	Teachers Activities	Resources
6	6.1 Give examples of templates for horizontal, vertical and combined machine movements 6.2 Explain the factors affecting the selection of templates material a. Water Resistance b. Required Accuracy 6.3 State the selection criteria for choosing a suitable material for a template for a given application 6.4 Determine the accuracy of the profile using a. precision measuring instruments b. optical projector	<ul style="list-style-type: none"> • Cites examples of templates for horizontal, vertical and combined machine movements i.e plain and solid (3-D templates) • Explains limitations imposed by wear resistance and dimensional accuracy (stability) in selection of template materials • Explains selection criteria for suitable material for template of a given application • Determines the accuracy of template profile using factors listed in 6.5 and prepare notes accordingly. • Assess the students. 	<ul style="list-style-type: none"> • Chart of thin section and solid templates • Slides • Transparency

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making **Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk**

	<p>8.4 Explain the factors affecting the correct selection of the copying stylus:</p> <ul style="list-style-type: none"> a. pattern material b. cutter size and shape c. roughing and finishing operations d. enlargement or reduction ratio <p>8.5 Distinguish between line milling and profile milling copying actions</p>	<ul style="list-style-type: none"> • Compares and contrasts the milling, profile milling and copying actions and prepare notes accordingly. • Assess the students 	<ul style="list-style-type: none"> • Film show
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General Objective 9.0: Understand The Setting Up And Operation Of A Hydraulic Copy Milling Machine

Week	Specific Learning Objective:	Teachers Activities	Resources
9	<p>9.1 Explain the types of tracer unit available e.g:</p> <ul style="list-style-type: none"> a. 180° Depth control b. 360° profile tracer c. Combined Attachment <p>9.2 Identify the main machine components and controls</p> <p>Explain the principles of operation of a hydraulic copying unit</p> <p>9.3 Explain the types of tracer unit available e.g:</p> <p>9.4 Describe the types of cutters used on copying machines e.g: End mills, slot drills, ball end mills</p> <p>9.6 Explain the factors affecting the correct selection of the copying stylus</p> <ul style="list-style-type: none"> a. pattern size and detail b. cutter size and type c. roughing and finishing operations d. stylus deflection 	<ul style="list-style-type: none"> • Identifies and describes the functions of the main components and controls of hydraulic copy milling machine • Explain how the hydraulic copy unit works and its operation • Describes the component parts of the tracer unit and its capabilities stated in 9.1 • Describes the copying machine cutters including the types given in 9.4 • Explains the selection criteria for the copying stylus given in 9.5 and prepare notes accordingly. • Assess the students 	<ul style="list-style-type: none"> • Slides • Film show • Film strip • Transparencies

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk	
10	<p>9.7 Explain the factors affecting the setting up of the work piece</p> <ul style="list-style-type: none"> a. size of blank b. direction of cut c. datum points d. material removal rate e. number of impressions to be machined f. position of workpiece and pattern 	<ul style="list-style-type: none"> • Explains the factors affecting the setting up of the work piece and prepare notes accordingly • Assess the students 	<ul style="list-style-type: none"> • Transparencies
General Objective 10.0: Understand The Setting Up And Operation Of An Electrical Discharge Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
11	<p>10.1 Explain the principle of operation of EDM</p> <p>10.2 Identify the main machine components and controls of an EDM</p> <p>10.3 Explain the factors affecting metal removal rate and surface finish when using an EDM: Current density spark gap, spark frequency, dielectric fluid, flushing techniques</p> <p>10.4 Explain the advantages of different types of electrode material</p> <p>10.5 State the types of materials commonly used for the production of electrodes</p> <p>10.6 Explain the factors affecting the determination of electrode size ie: spark gap, number of electrodes to be used, cleaning up allowances</p>	<ul style="list-style-type: none"> • Explains the principles of operation of EDM • Identifies and describes the functions of component parts of EDM as well as the controls • Explains the factors affecting rate of metal removal and surface finish when using EDM refer to the factors listed in 10.3 • Explains the advantages of different types of electrode materials • State the types of materials commonly used for the production of electrodes • Explains the factors affecting the determination of electrode size refer 10.8 and prepare notes accordingly • Assess the students 	<ul style="list-style-type: none"> • Film show • Film strip • Electrode metals identification board • Transparencies

**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING
CRAFT PRACTICE**

Course: Tool & Die Making		Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk	
12	<p>10.7 Describe different methods of producing electrodes e.g: machining, casting, metal spraying</p> <p>10.8 Describe the procedure for machining a cavity using a Spark Erosion Machine (EDM)</p> <p>10.9 List common faults occurring in EDM</p> <p>10.10 Explain the cause of common faults identified in 10.9</p> <p>10.11 Identify the main machine components and controls of an EDM</p>	<ul style="list-style-type: none"> • Describes different methods of producing electrodes such as machining, casting, metal spraying • Describes the procedures for machining a cavity using an EDM • States common faults occurring in EDM, their causes and prevention and prepare notes accordingly • Assess the students 	<ul style="list-style-type: none"> • Film show • Flow chart for machining cavity in EDM • Film show

PRACTICAL TASKS

	Specific Learning Outcome	Teachers Activities	Resources
Week	General Objective 1.0: Safety Practice In Die Manufacture		
1	1.1 Operate machinery, tools and equipment safety 1.2 Use machine guards and protective equipment such as safety goggles and overalls correctly 1.3 Locate master switches and methods of immobilizing machine 1.4 Use machine guards and safety equipment correctly	<ul style="list-style-type: none"> • Demonstrate operation of electrical power, isolation switches, the proper use of protective clothing and safety equipment and peculiar tools. • Assess the students 	<ul style="list-style-type: none"> • Safety gadgets
	General Objective 2.0: Application Of Die		
Week	Specific Learning Objective:	Teachers Activities	Resources
2	2.1 Identify the engineering production processes that use die example - die casting, forging, forming and moulding plastics 2.2 Give examples of the type of component produced by each of the listed in Diecasting, forging, forming and moulding plastics	<ul style="list-style-type: none"> • Arranges visitation trips to die-casting and plastic extrusion cottage industries • Assess the students 	<ul style="list-style-type: none"> • Field trip
	General Objective 3.0: Common Materials Used In Die Manufacture		
Week	Specific Learning Objective:	Teachers Activities	Resources
3	3.1 Identify the common materials used in manufacture of die components e.g: <ol style="list-style-type: none"> a. Nickel Chrome Die Steel b. Case hardening chrome Die Steel c. Chrome Molybdenum Die Steel d. Chrome Vanadium Die Steel e. Beryllium Copper f. Cast iron 	<ul style="list-style-type: none"> • Demonstrates techniques of quick workshop method of metal identification and describe the industrial versions and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • Film show

General Objective 3.0: Common Materials Used In Die Manufacture			
Week	Specific Learning Objective:	Teachers Activities	Resources
	3.2 Explain the influence of the following factors on the choice of die material <ul style="list-style-type: none"> (i). Machinability (ii) wear resistance (iii) surface finished required (iv) heat treatment required (v) types of die 3.3 Select suitable die materials for a die for a given application e.g Diecasting die-chrome molybdenum die steel		
General Objective 4.0: Construction Of Dies			
Week	Specific Learning Objective:	Teachers Activities	Resources
4	4.1 Dismantle, inspect and couple a simple die incorporating the features: bolster, Impression block, core slides 4.2 Guide dowels and bushes, Ejector pins and plates, Sprues and bushes.	<ul style="list-style-type: none"> • Dismantles and assembles a die, identifying the parts and their functions • Designs and produce an aluminium die for casting a simple object e.g knife handle • Assess the students 	<ul style="list-style-type: none"> • Film show
General Objective: 5.0: Use Of Templates			
Week	Specific Learning Objective:	Teachers Activities	Resources
5	Rough out and finishes the profile of the template Determine the accuracy of the profile using: <ul style="list-style-type: none"> (i) precision measuring instrument (ii) Optical projector 	<ul style="list-style-type: none"> • Demonstrate and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • Slides

General Objective 6.0: Patterns In Production Of Die Forms			
Week	Specific Learning Objective:	Teachers Activities	Resources
6	<p>6.1 Know the manufacture of patterns is normally before the task of a specialist.</p> <p>6.2 Demonstrate how modes may be cast in resin using existing samples</p> <p>6.3 Demonstrate the principles of copying using a model of pattern.</p>	<ul style="list-style-type: none"> • Demonstrates production of pattern for casting alphabets A-Z. • Demonstrate and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • Slides
General Objective 7.0: Vertical Milling With Universal Head			
Week	Specific Learning Objective:	Teachers Activities	Resources
7	<p>7.1 Set the universal head to machine a cavity with vertical and tapered sides</p> <p>7.2 Machine a simple rectangular cavity with tapered sides and compound corner</p>	<ul style="list-style-type: none"> • Demonstrates how to machine rectangular cavity with tapered sides and compound corner e.g billet making die paper brisqisit mould etc and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • Film show
General Objective 8.0: Pantograph Copy Milling Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
8	<p>8.1 Describe how to position and clamp patterns and templates on the master table</p> <p>8.2 Position and clamp templates on the master table</p> <p>8.3 Describe the alignment of pattern and workpiece</p> <p>8.4 Set up and operates a pantograph machine to copy a simple form from a given pattern or template</p>	<ul style="list-style-type: none"> • Demonstrate clamping of tamplates and patterns on the master table and their alignment in relation to the workpiece. Specimens from 5.1 and 5.2 are suggested practice materials • Assess the students 	<ul style="list-style-type: none"> • Film show
General Objective 9.0: Hydraulic Copy Milling Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
9	<p>9.1 Demonstrate the positioning and clamping of patterns</p> <p>9.2 Demonstrate the positioning and clamping of workpieces</p> <p>9.3 Set up and operates a hydraulic copying machine to copy a die form or cavity from a given pattern</p>	<ul style="list-style-type: none"> • Demonstrates positioning and clamping pattern and the workpiece on the hydraulic copying machine e.g shoe mould • Sets up the machine to copy shoe mould or any other product. • Assess the students 	<ul style="list-style-type: none"> • Slides

General Objective 10.0: Electrical Discharge Machine			
Week	Specific Learning Objective:	Teachers Activities	Resources
10	10.0 Demonstrate the procedure for machining cavity using a spark erosion machine (EDM) 10.1 Mount electrodes correctly 10.2 Machine a simple copper electrode to give a cavity of a specified form e.g Hexagonal Hole	<ul style="list-style-type: none"> • Demonstrate machining of a copper electrode into a hexagonal shape • Mounts the machined electrode to spark erode a hexagonal hole • Assess the students 	<ul style="list-style-type: none"> • Film show
General Objective 11.0: Design And Make A Simple Die			
Week	Specific Learning Objective:	Teachers Activities	Resources
11-12	11.1 Produce the working drawing for the manufacture of the die 11.2 Select suitable materials for the die components 11.3 Heat treat the die components 11.4 Select suitable machining processes to produce the die components 11.5 Manufacture the die components 11.6 Assemble and fit the die components 11.7 Take an impression from the die form and inspect for dimensional accuracy	<ul style="list-style-type: none"> • Demonstrate activities 11.1 to 11.7 and allow students to practise • Assess the students 	<ul style="list-style-type: none"> • Die components, manuals and catalogues

Guidelines for Textbook Writers

NATIONAL TECHNICAL CERTIFICATE AND ADVANCED NATIONAL TECHNICAL CERTIFICATE

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.

1. One book should be produced for each syllabus
2. Page size should be A4
3. The font size should be 12 point for normal text and 14 point where emphasis is needed
4. Line spacing should be set to 1.5 lines
5. Headings and subheadings should be bolded
6. Photographs, diagrams and charts should be used extensively throughout the book, and these items must be up-to-date
7. 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'.
8. 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 divide between theory and practice.
9. Illustrations should be labeled and numbered
10. Examples should be drawn from Nigeria wherever possible, so that the information is set in a country context.
11. Each chapter should end with a student self-assessment question (SAG) so that students can check their own mastery of the subject
12. Accurate instructions should be given for any practical work having first conducted the practical to check that the instructions do indeed work
13. 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.
14. 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.
15. 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.

List Of Books

1. Mechanical Engineering Craft Studies Part I, II, III by A. Greer and W.H. Howell
2. Workshop Technology Part I, II and III by WAJ Chapman
3. Workshop Processes, Practices and Materials by Bruce J. Black
4. Theory and Practice of Metal Craft by John R. Bedford
5. General Metals by John L. Feirer
6. Metal Machining Theory and Applications by Childs, Mackawa, Obikawa and Yamne.
7. Practical Bench Work by N. Makienko
8. Dies, Moulds and Jigs by V. Viadimiror
9. Grinding Machines by G. Luric, V. Komissarzhevs Kaya
10. Grinding Metals by V.V. Loskutov
11. Soldering Hand book by Ray Skipp
12. Sharpening of Cutting Tools by S. Poper, Lidibner, A. Kamen Kovich.

Minimum List of Equipment

FITTING

1. Vices 150m
2. Benches
3. Hacksaws
4. Files

- i) 250mm flat Rought
- ii) 10" Hand rough
- iii) 10" Rough Rough
- iv) 10" Three Rough
- v) 10" Square Rough
- vi) 10" Half Roudn 2nd Cut
- vii) 200mm Warding File
- viii) 100" Retail File
- ix) Wallets of Warding Flies

As in I - vii = 2nd Cut Files

As in I-vii = Smooth Files

As in I-vii = Dead Smooth

5. Steel Rules (12") 300m
6. Tape rule 3000mm
7. Dividers
8. Scribers
9. Pocket size (200mm) vernier callipers
10. Centre punches
11. (1/2 lb) hammer $\frac{3}{4}$ kg
12. (1 ½ lb) hammer $\frac{3}{4}$ kg
13. Oil can
14. Pair of pliers 150mm
15. Tool box and lock
16. Odd-ley calipers
17. Engineers square 100
18. Screw drivers 200mm
19. Pair of tin slip
20. Nippy vice

FITTING - WORKSHOP EQUIPMENT

1. Drilling Machines Sensitives
2. Drilling Machines Pillar
3. Drilling Machines Radial
4. Surface Table 12000 × 12000mm (14' × 4')
5. Surface plates 500 × 500mm (18" × 18")
6. Surface gauge
7. Vernier height gauges
8. Vee blocks 100 × 100mm pairs
9. Vee blocks 200mm
10. Parallels strips (pairs) 37 × 25 × 300
11. Flat scrapers
12. Half round scrapers
13. Triangular scraper
14. **Stock & Dies**

i) metric sets 3mm - 12mm

ii) (BA) 150 sets 0-10

15. Sockets spanners 3-22m
16. Open ended 3-22m
17. Pedestal grinders
18. Reamers 3-25mm
19. Reamers machine 3.25mm
20. Dia gauge
22. **Chisels**

i) Flat

ii) Round nose

iii) Diamond

iv) Cross cut

23. Drills

i) Straight shank

ii) Straight shank

iii) Taper shank 3

iv) Drift

24. heat treatment

25. Micrometer

0 - 25

25 - 50

50 - 75

75 - 100

100 - 125

125 - 150

26. Protractors

i) Bevel

ii) Combination set

iii) Vernier

iv) Optical

27. Limit Gauges

i) Telescopic gauge

ii) Plug gauges

iii) Slip gauges (sets)

iv) Feeler 05-64

v) Engineers squared

vi) Calliper

vii) Screw pitch gauge

28. Blacksmith forge (gas)

i) Round nose

ii) Diamond

iii) Cross cut

29. Drills

i) Straight shank 1 ½ - 10mm

ii) Straight shank 6-15mm

iii) Taper shank 3-22mm

iv) drift

30. Heat treatment furnace (medium size)

31. Micrometer

0 - 25

25 - 50

75 - 100

100 - 125

125 - 150

25. Protractors:

i) Brevet

ii) Combination sets

iii) Vernier

iv) Optical

26. Limit Gauges

i) Telescopic gauges

ii) Plug gauges

iii) Slip gauges (sets)

iv) Feeler 05-64

v) Engineers squares 150mm

vi) Calliper

vii) Screw pitch gauges

27. Blacksmith gorge (gas)

28. Blacksmith Tools:

Anvil, hammers, chisels

Fuller, shape block

Pinches and drifts

Tongues differential type

29. Arboy press

32. Extractors

33. Stud extractors

34. Circlip plier (internal and external)

35. Pipe wrench 250mm

36. Pipe wrench 250mm

37. Self grip wrench of moel grip

- 38. Pipe sender
- 39. Guillotine machine
- 40. G. clamp
- 41. Tool maker clamp

TURNING

1. Centre lathe:

- a) small lathe - bench work 150
- b) large size lathe 250

Lathe accessories should be supplied with all the lathes e.g

Three jaw chuck

Four jaw chuck independent and self centring

Face plate

Taper turning attachment

Driving plate

Driving dog

Mandril - one each of all sizes

All accessories to be supplied with the capstan lathe

2. Capstan and Turret lathes

3. Screwing machine.

Instruments Measuring

Vernier caliper

Micrometers

0 - 25

25 - 50

75 - 100

Boring tools

Adjustable mandril

Sleeves:

0 - 1

1 - 2

2 - 3

3 - 4

4 - 5

Centre drills

Drills - sizes - all sizes should be provided

Reamers (a) parallel shank of all sizes
(b) taper reamers - one of each sizes
© adjustable reamers

Knurling Tool

Tapping (a) M₃ to M₁₂ - two sets
(b) M₆ to M₁₆ - two sets

Dies (a) M₃ to M₁₂ - two sets
(b) M₆ to M₁₆ - two sets

Centre finder

Gauges for boring (plug). These should be 10mm to 50mm one per sizes

Oil can

Dial indicator

Boring bars two sizes

Boring bars

SHAPING

1. 18" shaping machines
2. Swivelling vices
3. Straight, right and left hand shaping tools
4. Parallel blocks 8" 200mm
5. Vee blocks 6"
6. Surface gauges
7. Inside and outside callipers
8. Copper and hide faced hammer
9. Bevel protractor

Sitting Machines

1. Slotting machine (training size)
- 2 Parallel blocks

- 3 (Straight, left and right hand) tool
- 4 Swivelling vices
- 5 Rotary tables
- 6 Vernier calipers

Milling Cutters

1. Complete gange of slab cutters
2. Complete set of gearing cutters
3. Assorted slitting saws
4. Assorted side and face cutters
5. Assorted end mills
6. Assorted shell and mills
7. Double angle cutters
8. Single (60) left and right
9. 45° cutter (left and right)
10. Complete range of form cutters e.g concave and convex
11. 30° single cutters (left and right)
12. Universal boring heads
13. Slot drills
14. Face mill

Milling Machines

1. Plain milling machine
2. Vertical milling machine
3. Universal milling machine

Accessories

1. Divinding head
2. Tail stock
3. Indexing plate
4. Collect chucks
5. 30mm dia arbors
6. Rotary table
7. Slotting attachments
8. Can milling attachments
9. Universal vice
10. Coolant pump
11. Milling clamps

12. Milling collars
13. Vertical attachment
14. Medium parallel strips

Drilling

1. Portable breast drill
2. Sensitive drilling machine
3. Pillar drilling machine
4. radial drilling machine
5. Drilling machine vice
6. Solid angle plate
7. Adjustable angle plate
8. Drills (1mm dia - 6mm dia)
9. Drills (6mm dia - 12mm dia)
10. Taper shank drills (13mm) diameter - 40mm diameter (in steps of 0.5mm)
11. Taper sleeves of all sizes
12. Machine reamer 6mm dia to 25mm dia
13. Adjustable reamer
14. Floating reamer
15. Small vee block
16. Large vee block
17. Countersinking tool of different sizes
18. Counterboring tool of different sizes
19. Parallel strips

a) medium size

b) large size

20. Jacob chuck
21. Jacob chuck key
22. Boring bar micrometer

Planner

1. Planner
2. Strap clamps
3. U clamp
4. G clamp
5. T bolts
6. Parallel strips - 12mm square to 50mm square

- 7 Solid shank cutting tools;
8. Angle plate (solid & adjustable)
9. Oil can
10. Grease gum
11. Vernier caliper (range 350mm)
12. Vernier height gauge
13. Vice

Grinding Machine

All the wheels for grinding should be supplied

1. Off-hand grinder
2. Portable grinder
3. Surface grinder
4. Cylindrical grinder

List of Participants

UNESCO-NIGERIA PROJECT IN SUPPORT OF REVITALISATION OF TECHNICAL AND VOCATIONAL EDUCATION IN NIGERIA

PROJECT TEAM MEMBERS

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FINAL REVIEW

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