

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

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## 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

**Module Specification:** Practical/theoretical contents

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

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.

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

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"> <li>• Show few samples of products of press work.</li> <li>• Assess the students</li> <li>• Assignment on safety regulations on presswork.</li> <li>• Assess the students</li> <li>• Assignment on alternative plan to, or own interpretation of suggested manufacturer's maintenance plan for a typical press.</li> <li>• Assess the students</li> <li>• Supervise and grade production of sections sketches of Jigs.</li> <li>• Assess the students</li> <li>• Supervise dismantling, inspection of component parts for shape and defects and assembly techniques.</li> <li>• Assess the students</li> <li>• Direct compliance with stipulated material selection criteria.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Crown cork, ask tray, vent grill.</li> <li>• Manual on accident prevention and relevant section of the factory Act.</li> <li>• Manufacturer's machine manual</li> <li>• Textbooks, Catalogues</li> <li>• Practice on the job</li> <li>• Text on materials and processes. Selection guidelines for die making materials in Engineering materials textbook or journals.</li> </ul>

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

<b>Course: Machine shop production and maintenance</b>		<b>Module Code: CME 22 Press Jig and Fixture</b>	<b>Contact Hours:</b>
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Supervise student compliance with design methods and process selection for die manufacture.</li> <li>• Assess the students</li> <li>• Highlight details of Construction</li> <li>• Assess the students</li> <li>• Direct compliance with stipulated material selection criteria.</li> <li>• Assess the students</li> <li>• Approves student design and manufacturing processes considerations and guide the students to perform the design and manufacture</li> <li>• Assess the students</li> </ul>	

## 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 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"> <li>• The teacher to explain and illustrate with diagrams where necessary 1.7 to 1.9 and prepare notes</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc</li> </ul>

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

<b>Course: Machine shop production and maintenance</b>	<b>Module Code: CME 22 Press Jig and Fixture</b>	<b>Contact Hours: 8hrs/wk</b>
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<b>Week</b>	<b>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</b>		
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	<b>Specific Learning Outcome</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• The teacher to explain and illustrate with diagrams where necessary 1.13 to 1.16 and prepare notes</li> <li>• Assess the students</li> <li>• The teacher to explain and illustrate with diagrams where necessary and prepare notes where necessary</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc</li> </ul>

	<b>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</b>		
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<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• The teacher to illustrate with good diagrams the activities in 2.1 to 2.2 and prepare notes for the students</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc</li> </ul>

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

<b>Course: Machine shop production and maintenance</b>		<b>Module Code: CME 22 Press Jig and Fixture</b>	<b>Contact Hours: 8hrs/wk</b>
<b>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</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>The teacher to illustrate with good diagrams the activities in 3.1 to 3.7 and prepare notes for the students</li> </ul>	<ul style="list-style-type: none"> <li>Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc</li> </ul>
	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"> <li>Assess the students</li> </ul>	
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"> <li>The teacher to illustrate with good diagrams the activities in 3.1 to 3.7 and prepare notes for the students</li> <li>Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>Recommended textbooks, catalogues, lesson notes, chalkboard, chalk etc</li> </ul>

# Boring

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

<b>Course: Machine shop production and maintenance</b>	<b>Course Code: CME 23 - Boring</b>	<b>Contact Hours 8hrs/wk</b>
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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	<b>General Objective: 1.0 Understand and apply general safety precautions for each boring machine</b>		
Week	Specific Learning Outcome:	Teachers Activities	Resources
<b>General Objective 1.0: Safety Practice</b>			
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"> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• All objects of instructions are expected to be live objects in focus except the option of a disused one is judged appropriate</li> </ul>
<b>General Objective 2.0: Understand The Working Principles Of Boring Machine And Operate It To Produce A Finished Job.</b>			
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 liltng table to locate positions and measure with precision measuring instruments	<ul style="list-style-type: none"> <li>• Demonstrate to the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Boring machine and its accessories</li> </ul>

<b>General Objective 3.0: Understand The Use Of Boring Tools</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
6	3.1 Select suitable boring tool for counter boring, spot facing drilling reaming, boring in jigs, fixtures and press tools  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	<ul style="list-style-type: none"> <li>• Demonstrate to the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Boring tools</li> </ul>
<b>General Objective 4.0 Carryout Boring Operations</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
7-11	4.1 Practice various methods of locating holes, scribing lines, arcs and circles using spotting tools  1.13 Carry out the layout of Coordinate points from drawing dimensions on the jig boring machine  1.14 Bore a piece of work with the tool held in the revolving spindle of the lathe and driving machines respectively  1.15 Carry out button boring operation on the jig boring machine  1.16 Face and expand the bore of a motor vehicle wheel brake drum on the jig boring machine	<ul style="list-style-type: none"> <li>• Demonstrate to the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Boring tools and achine</li> </ul>
<b>General Objective 5.0: Maintain The Machines In Good Working Conditions</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrate to the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Complete tool box</li> </ul>

## KNOWLEDGEMENT REQUIREMENTS

Week	<b>General Objective: 1.0 Understand and apply general safety precautions on each boring machine</b>		
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"> <li>• Be familiar with the rules and safety regulations for operating setting and installing</li> </ul>	<ul style="list-style-type: none"> <li>• Boring machines</li> <li>• Horizontal, Vertical, Jig borings</li> <li>• -Set of maintenance kits</li> </ul>
<b>General Objective 2.0: Understand The Working Principles Of Boring Machine</b>			
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"> <li>a. horizontal</li> <li>b. vertical</li> <li>c. jig boring machine</li> </ul> 2.3 Describe the basic functions and constructional details of each of the above mentioned boring machine	<ul style="list-style-type: none"> <li>• Explain the various types of a boring machine and to be familiar with the component parts and their respective functions</li> </ul>	<ul style="list-style-type: none"> <li>• Boring machine and accessories</li> </ul>
	2.4 Name the important parts of a boring machines  2.5 State the uses of boring bar	<ul style="list-style-type: none"> <li>• Assess the students</li> </ul>	
<b>General Objective 3.0: Understand The Characteristics Of A Boring Machine</b>			
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"> <li>• Explain criteria for selection of tools and methods of clamping, Describe the process of reconditioning and regrinding of boring tools</li> </ul>	<ul style="list-style-type: none"> <li>• Assorted types of boring tools</li> <li>• Tool grinders</li> </ul>
	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"> <li>• Assess the students</li> </ul>	

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

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

## Fitting (Mill-Wright)

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

<b>Course: Machine shop production and maintenance</b>	<b>Module Code: CME 24 - Fitting (Mill-Wright)</b>	<b>Contact Hours 8hrs/wk</b>
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**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

<b>COURSE: Machine Shop Production &amp; Maintenance</b>		<b>MODULE CODE: CME 24</b>	<b>CONTACT HOURS: 8hrs/wk</b>
<b>MODULE SPECIFICATION: Knowledge Requirements</b>			
<b>Week</b>	<b>General Objective 1.0: Understand And Apply Safety Precautions In The Workshop</b>		
	<b>Specific Learning Outcome:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Conduct the student to recognize points of danger in workshop</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Bench and machine fitting tools</li> </ul>
<b>General Objective: 2.0 Understand fitting installation and maintenance work.</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
2	2.1 Explain the work plan for fitting installation of machine <ul style="list-style-type: none"> <li>a. Interpret the drawing of instruction</li> <li>b. Describe the sequence of operation</li> <li>c. Select appropriate tools and materials for the job</li> <li>d. Carry out related calculation</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher to illustrate with good diagrams and prepare notes for the students</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>
<b>General Objective 3.0: Know and explain different methods of protecting metal surfaces and parts against corrosion</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>a. Chemical corrosion</li> <li>b. Gas corrosion</li> <li>c. Atmospheric corrosion</li> <li>d. Corrosion of metal in soil, etc.</li> </ul> 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"> <li>• The teacher to explain the activities in 3.1 to 3.7 and prepare notes for the students accordingly</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>

<b>COURSE: Machine Shop Production &amp; Maintenance</b>		<b>MODULE CODE: CME 24</b>	<b>CONTACT HOURS: 8hrs/wk</b>
<b>MODULE SPECIFICATION: Knowledge Requirements</b>			
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"> <li>a. painting</li> <li>b. electroplating</li> <li>c. plastic coating</li> <li>d. tinning</li> <li>e. iodizing</li> <li>f. galvanishing, etc</li> </ol>		
	<b>General Objective 4.0: Understand The Functions Of A Rotating Machine</b>		
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
6	4.1 Describe the functions of rotating machine	• Explain and make notes for the students	
<b>General Objective 5.0 Apply various portable hand tools to perform mechanical fittings</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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.

<b>COURSE: Machine Shop Production &amp; Maintenance</b>		<b>MODULE CODE: CME 24</b>	<b>CONTACT HOURS: 8hrs/wk</b>
<b>MODULE SPECIFICATION: Knowledge Requirements</b>			
<b>General Objective 6.0: Know how to install, fit and maintain equipment or mechanical system with aid of engineering drawing</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Illustrate and explain activities in 6.1 to 6.2 and make notes for the students</li> <li>• Assess the students</li> </ul>	
<b>General Objective: 7.0: understand the process of repair and servicing of machinery and other equipments</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Illustrate 7.1 to 7.3 and make notes</li> <li>• Assess the students</li> </ul>	Recommended textbooks, chalkboard, chalk, lesson notes etc.
<b>General Objective 8.0: Understand the correct application of lubricant to machinery and equipments</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Illustrate 8.1 to 8.3 and make notes</li> <li>• Display various kinds of lubricants and applicators and uses each student follow suit</li> <li>• Assess the students</li> </ul>	
<b>General Objective 9.0: Understand working gauges and report their conditions</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Illustrate 9.1 to 9.3 and make notes</li> <li>• Assess the students</li> </ul>	

## 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"> <li>• Conduct the student to recognize points of danger in workshop</li> <li>• <b>Assess the students</b></li> </ul>	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"> <li>• Demonstrate and allow students to practice</li> <li>• Assess the students</li> </ul>	• 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"> <li>• Demonstrate and allow the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	• Recommended apparatus

<b>General Objective 4.0: Rotating Machine</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrate and allow students to practice till they become competent</li> </ul>	<ul style="list-style-type: none"> <li>• Manuals, rotating machine and accessories</li> </ul>
<b>General Objective 5.0: Installation of Machinery</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
10-12	5.1 Install, fit and maintain a shaping machine in the workshop	<ul style="list-style-type: none"> <li>• Demonstrate and allows students to practice</li> </ul>	<ul style="list-style-type: none"> <li>• Shaping machine and accessories</li> </ul>
<b>General Objective 6.0: Servicing of Machinery</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
	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"> <li>• Demonstrate and allow students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance tool box, machinery to be maintained.</li> </ul>

# 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  
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**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

<b>PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE</b>			
<b>Course: Machine Shop Production and Maintenance</b>		<b>Module Code: CME 25: Valves, Pumps and Drives</b>	<b>Contact Hours: 9hrs/wk</b>
<b>Week</b>	<b>General Objective: 1.0 Understand the definition, types, and functions, principles and applications of pumps used in engineering.</b>		
	<b>Specific Learning Outcome:</b>	<b>Teacher/Activities</b>	<b>Learning Resources</b>
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"> <li>a. Water pumping systems</li> <li>b. Waste handling systems</li> <li>c. High velocity pumping systems</li> <li>d. Solid pumping systems</li> <li>e. Chemical handling systems</li> <li>f. Gas pumping systems.</li> </ol> <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"> <li>• Define pumps. Explain functions and different applications of pumps. Explain reasons for the different applications. Explain the identification of pumps with symbols.</li> <li>• Describe the basic principles and constructional details of pumps used in engineering.</li> <li>• Assess the students</li> <li>• Illustrate and explain with the aid of sketches various pumping systems e.g:               <ul style="list-style-type: none"> <li>• Water pumping systems</li> <li>• Waste handling systems</li> <li>• High velocity pumping systems</li> <li>• Solid pumping systems</li> <li>• Chemical handling systems</li> <li>• Gas pumping systems.</li> </ul> </li> <li>• Assess the students</li> <li>• 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.</li> <li>• Make notes for the students</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> <li>• Picture of pumps.</li> <li>• Samples of pumps.</li> <li>- do -</li> <li>- do -</li> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>

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

<b>Course: Machine Shop Production and Maintenance</b>		<b>Module Code: CME 25: Valves, Pumps and Drives</b>	<b>Contact Hours: 9hrs/wk</b>
<b>Week</b>	<b>General Objective: 1.0 Understand the definition, types, and functions, principles and applications of pumps used in engineering.</b>		
	<b>Specific Learning Outcome:</b>	<b>Teacher/Activities</b>	<b>Learning Resources</b>
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"> <li>• 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</li> <li>• <math>F = mrw</math> where,</li> <li>• m = mass</li> <li>• w = angular velocity and</li> <li>• r = centre distance of the mass from the axis.</li> <li>• Explain practically the implications of different values of r and m (varying one variable at a time).</li> <li>• Discuss pumps classification</li> <li>• State and explain the advantages and disadvantages of air driven pumps over steam driven pumps.</li> <li>• Explain the safety requirements for special pumps and the necessity the such requirement.</li> <li>• Explain and demonstrate simple connections of pumps e.g parallel connection, series connection.</li> <li>• Explain the result of each type of connection.</li> </ul>	<p>Chart</p> <ul style="list-style-type: none"> <li>• Chart</li> </ul>

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

<b>Course: Machine Shop Production and Maintenance</b>	<b>Module Code: CME 25: Valves, Pumps and Drives</b>	<b>Contact Hours: 9hrs/wk</b>
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**General Objective 2.0: Know The Method And System Requirements In Selecting Pumps For Use.**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
6-7	<p>2.1 Explain the method and system requirements in selecting pumps for use e.g:</p> <ul style="list-style-type: none"> <li>a. Suction side</li> <li>b. Pumps requirements</li> <li>c. Pump discharge side, etc.</li> </ul> <p>2.2 State the conditions for selecting pumps for a particular job. e.g drilling for oil.</p> <p>2.3 Explain the working operations of centrifugal pump.</p> <p>2.4 Select suitable material for pump construction and state the reason for the choice.</p>	<p>Illustrate and explain activities in 2.1 to 2.4 and prepare notes</p> <ul style="list-style-type: none"> <li>• Assess the students</li> </ul>	<p>Recommended textbooks, chalkboard, chalk, lesson notes etc.</p>

**General Objective 3.0: Understand the Principles and Process of Packing, Sealing, Repair and Maintenance of Pump**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
8-9	<p>3.1 State the principles and process of packing and sealing a pump.</p> <p>3.2 State the importance of packing and sealing equipment</p> <p>3.3 Describe different types of materials for packing.</p> <p>3.4 Identify types of sealing e.g mechanical seal.</p> <p>3.5 Explain the types of packing gland.</p> <p>3.6 Explain the method of installing packing materials in pumps. Demonstrate.</p> <p>3.7 State the precautions to be observed when packing and sealing equipment.</p>	<ul style="list-style-type: none"> <li>• Explain and illustrate with diagram 3.1 to 3.3 and make notes.</li> <li>• Assess the students.</li> <li>• Describe sealing requirements, state and show the type of sealing e.g mechanical sea, special seal, etc.</li> <li>• Explain and show types of packing gland.</li> <li>• Explain the precautions to be observed when packing and sealing equipment. Emphasize the repercussion of ignoring such precautions.</li> <li>• Assess the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> <li>• Chart</li> </ul>

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<b>Course: Machine Shop Production and Maintenance</b>	<b>Module Code: CME 25: Valves, Pumps and Drives</b>	<b>Contact Hours: 9hrs/wk</b>
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**General Objective 4.0: Understand the Functions, Types, Definitions, Application and Classifications of Drive Components.**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Show and describe various types of drive components such as:                             <ul style="list-style-type: none"> <li>i. cluth</li> <li>ii. belt</li> <li>iii. chain</li> <li>iv. gear etc.</li> </ul> </li> <li>• Illustrate with diagrams and make notes</li> <li>• Define and explain power transmission. State the conditions for power transmission in engineering.</li> <li>• Assess the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textboosk, chalkboard, chalk, lesson notes etc.</li> </ul>

**General Objective 5.0: Understand The Functions, Types And Methods Of Coupling In Engineering.**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Define and explain coupling in engineering.</li> <li>• State and explain with the aid of symbols types of coupling in engineering.</li> <li>• Show different types with the aid of sketches.</li> <li>• Explain the requirements for the listed coupling in 5.2</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>

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

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

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

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

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Illustrate and explain with diagrams the activities in 7.1 to 7.6 and make notes accordingly</li> <li>• Assess the students</li> <li>• Solve examples to aid the students to practise</li> <li>• Assess the students</li> <li>• Illustrate and explain with diagrams the activities in 7.8 to 7.10 and make notes accordingly.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>

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

<b>Course: Machine Shop Production and Maintenance</b>	<b>Module Code: CME 25: Valves, Pumps and Drives</b>	<b>Contact Hours: 9hrs/wk</b>
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**General Objective 7.0: Know the functions, types and classifications of belt drives.**

15-18	<p>7.7 Estimate the power capabilities over a range of speeds using equation:  <math>T_1 - MV^2 + T_2 - MV^2 = 2(T_0 - MV^2)</math>  <math>f_c</math></p> <p>where T1 = higher tension  T2 = lower tension  T<sub>0</sub> = 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>		
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**General Objective: 8.0: Understand the function, applications and maintenance of chains in engineering.**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Illustrate and explain activities in 8.1 to 8.3 with diagrams and make notes accordingly</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>

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

<b>Course: Machine Shop Production and Maintenance</b>	<b>Module Code: CME 25: Valves, Pumps and Drives</b>	<b>Contact Hours: 9hrs/wk</b>
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**General Objective: 9.0: Know the functions and types of gears in transmission systems and effect repairs and maintenance when necessary.**

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

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

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

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>clockwise</li> <li>anti-clockwise; - using the formula:</li> <li>brake torque = <math>(T1 - T2) \frac{d}{2}</math></li> </ol> <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"> <li>Illustrate and explain with diagrams the activities in 10.1 to 10.5 and make notes accordingly</li> <li>Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>Recommended textbooks, chalkboard, chalk, lesson notes etc.</li> </ul>

## PRACTICAL TASK

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

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

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

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

<b>Course: Machine Shop Production and Maintenance</b>		<b>Module Code: CME 25</b>	<b>Contact Hours: 9hrs/wk</b>
<b>Week</b>	<b>Specific Learning Outcome</b>	<b>Teacher Activities</b>	<b>Learning Resources</b>
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"> <li>• Demonstrates for the students to practice till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Complete tool box</li> </ul>
	5.1 Dismantle, check for wear, repair and reassemble a braking system.	<ul style="list-style-type: none"> <li>• Demonstrate and guide students to dismantle, check for wear, repair and reassemble a braking system.</li> </ul>	<ul style="list-style-type: none"> <li>• Live vehicle, tools box, maintenance manual</li> </ul>
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"> <li>• Guide and monitor students bleed hydraulic line to exclude air from the system.</li> <li>• Demonstrate and guide students to adjust, maintain and recondition braking system.</li> <li>• Together with the students, check air line pressure to ascertain that there is no air leak.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Live vehicle, tools box, Bleeding equipment</li> </ul>
<b>ANTC Assessment Profile - practical 60%, theory 40%</b>			

# 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 the 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 optional 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

<b>Week</b>	<b>General Objective 1.0: Understand the working principles and use various measuring instruments to determine flatness, straightness</b>		
	<b>Specific Learning Outcome</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• The teacher to demonstrate each of the activities and allow the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• All the instruments listed in 1.1</li> <li>• Live lathe, dial indicator etc</li> </ul>
	<b>General Objective 2.0: Measure and check the correct dimensions of external and internal screw-threads</b>		
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
5-7	<p>2.1 Select the correct instruments and measure the following:</p> <ol style="list-style-type: none"> <li>a. major, minor, and effective diameter of screw- thread</li> <li>b. Flank angle thread</li> <li>c. pitch of a thread</li> <li>d. depth of a thread</li> </ol> <p>2.2 Determine form of the thread and optical projection</p>	<ul style="list-style-type: none"> <li>• Demonstrate 2.1 to 2.2 and allow the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Optical projector during measurements</li> </ul>
	<b>General Objective 3.0: Understand the working principles of an optical projector and use it to determine a projector profile against masters profile</b>		
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrate the activities in 3.1 to 3.4 for the students to practise and become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Optical projector, charts, etc</li> </ul>

<b>General Objective 4.0: Determine the quality of surface finish and texture of a job</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrate the activities in 4.1 to 4.4 and allow the students to practise till they become competent</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Charts showing labeled diagram, and uses of different types of comparators</li> </ul>

## 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"> <li>• Give notes and explanation that will explain the essential difference between engineering measurements and inspection</li> <li>• Prepare notes and diagrams that will assist students to explain why it is necessary to give a tolerance on an engineering dimension</li> <li>• Prepare notes that will explain the effect of the engineering allowance on the different types of fit required in engineering manufacture</li> <li>• Prepare explanatory notes that will describe the function of a limit system as well as brief details of a limited system</li> <li>• Prepare explanatory notes that will explain the advantages offered by the use of limit gauges in engineering manufacture</li> <li>• Prepare explanatory notes that will assist students to state the basic working principles of measuring instruments</li> <li>• Assess the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbook, chalkboard, lesson notes, chalk etc</li> </ul>

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

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

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

<b>Course: Machine Shop Production and Maintenance</b>	<b>Module Code: CME 27: Inspection &amp; Management</b>	<b>Contact Hours: 7zhrs/wk</b>
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**General Objective 3.0: Understand the working principles of an optical projector and use it to determine the projector profile against the master profile**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
9	3.1 Explain the working principles of an optical projector	<ul style="list-style-type: none"> <li>• Prepare notes and diagrams that will explain the working principles of an optical projector</li> <li>• Explain to the students how to select master profile for the job</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Chart showing labeled optical projector with notes on uses of control functions</li> </ul>

**General Objective 4.0: Determine the quality of surface finish and texture of a job**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Prepare notes that will explain the following terms used to describe surface texture: lay, profile, spacing wave, center line average value</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Chart showing labeled diagram uses of different types of comparator</li> <li>• Show real objects of aforementioned instruments</li> </ul>

# 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

	<b>MODULE COURSE: CME 28</b> <b>Press tool Manufacture</b>	<b>Contact Hours: 8hrs/we</b>	
<b>General Objective: 1.0: Workshop Practice</b>			
<b>Week</b>	<b>Specific Learning Outcome:</b>	<b>Teachers Activities</b>	<b>Resources</b>
	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
<b>General Objective: 2.0: Press Tools</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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

	<b>MODULE COURSE: CME 28 Press tool Manufacture</b>	<b>Contact Hours: 8hrs/we</b>	
	<b>General Objective: 1.0: Workshop Practice</b>		
	<b>General Objective: 5.0: Designing Press Tools</b>		
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Provides guidance in the production of punch and die, and 90o angle bending tool.</li> <li>• 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</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• From practical exercise in punch and die making</li> </ul>
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"> <li>• Demonstrate case hardening and nitriding processes on press tools made from low carbon steel</li> <li>• Demonstrate hardening and tempering of tool steel observing its effect on its degree of hardness</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Heat treatment chart</li> </ul>
	<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"> <li>• Demonstrate strip laying out of product on sheet to obtain the most economic use of strip material</li> </ul>	<ul style="list-style-type: none"> <li>• Drancing product profile on strip</li> </ul>
	<p>8.1 Manufacture a given parts of the tool e.g washer</p>	<ul style="list-style-type: none"> <li>• Provide guidance in the design and development of operations sequences in the manufacture of a washer</li> </ul>	<ul style="list-style-type: none"> <li>• Flow chart of design and production sequence for making washer</li> </ul>
	<p>9.1 Identify defects caused by incorrect tool material specification and grain direction</p>	<ul style="list-style-type: none"> <li>• Demonstrate the use of trouble shooting approach to detect defects causes of tool failure and profer remedies</li> <li>• Students are to be allow to practice till they become competent and proper assessment carried out</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Procedures in trouble shooting write-up</li> </ul>
<b>ANTC Assessment Profile: Practical 60% of overall assessment</b>			

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

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

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

<b>Week</b>	<b>Specific Learning Outcome:</b>	<b>Teacher Activities</b>	<b>Learning Resources:</b>
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"> <li>Describe the general requirements for the observance of safe practice. General requirements: protecting self and others, alertness to danger, maintaining personal hygiene</li> <li>knowledge, knowledge of emergency and hazard reporting, clothings etc.</li> <li>Explains how safety devices and installations work</li> <li>Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>Safety manuals charts and film shows on general safety.</li> <li>Film shows and real objects</li> </ul>

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

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
2	2.1 Know presses and its types 2.2 Know the basic principles and constructional 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"> <li>Introduces types of presses used in manufacturing:                             <ul style="list-style-type: none"> <li>arbor press</li> <li>fly press</li> <li>power press (rank and hydraulic)</li> <li>press brake.</li> </ul> </li> <li>Explain the basic operating principles and construction of each of the presses in 2.1.</li> </ul>	<ul style="list-style-type: none"> <li>Pictorial diagrams and real objects. Slides.</li> <li>Sectional diagrams of presses in 2.1 transparencies.</li> <li>-Recommended textbook and teachers' notes.</li> <li>Recommended textbook, models, slides.</li> </ul>

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

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

2		<ul style="list-style-type: none"> <li>• Relates mechanical properties of component material.</li> <li>• and size to work capacity of press</li> <li>• Solves problems in determining ultimate shear stress</li> <li>• of product material in relation to shear force required</li> </ul>	
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**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"> <li>• 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.</li> <li>• Explain the cutting action of each of the tools with detailed notes</li> <li>• Simulate need for multi-stage tooling such as deep recess in cups and progressive blanking, bending and cropping of a product</li> <li>• Assess the student</li> </ul>	<ul style="list-style-type: none"> <li>• Pictorial diagrams and chart of press tools.</li> <li>Transparencies.</li> <li>• Chart detailing cutting action of press tools slides.</li> <li>• Flow chart shoning set-up and processes. Products samples, slides.</li> <li>• Chart showing cutting actions of punch and die performing the various metal shaping processes mentioned slides.</li> </ul>

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: 3.0: Understand The Functions Of Component Parts Of Different Types Of Press Tool			
3-5		<ul style="list-style-type: none"> <li>• Explain the action and effects of punch and die in: blanking and piercing tools, drancing tools and forming tools.</li> <li>• Describes the methods of locating punch and die during assembly. Give detailed notes</li> <li>• Describes methods of product ejection from die.</li> <li>• Illustrate and explain with diagrams the activities in 3.6 to 3.8</li> <li>• Assess the students</li> </ul>	
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"> <li>• Describe different types of the dies sets on 4.1</li> <li>• Identifies the component parts of the die sets.</li> <li>• States and contracts the characteristics of "Daylight" and "Shut Height" of a die set.</li> <li>• Explain the advantages of using die sets Assess students</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Real objects, Notes</li> <li>• Real object, Notes</li> <li>• Observe phenomenon on real object.</li> <li>• Problem solving session.</li> <li>• Transparencies</li> </ul>

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

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

<b>General Objective: 5.0: Understand The Basic Of Designing Press Tool</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Give reasons why the clearance between a punch and die for drawing or bending depends on material thickness.</li> <li>• Solves problems on clearance between punch and die for blanking or piercing tool</li> <li>• Solves problems on clearance between punch and die for blanking or piercing tool</li> <li>• Assess the students</li> </ul>	
<b>General Objective: 6.0: Understand The Heat Treatment Of Press Tool Materials</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Describes the processes of heat treatment for the materials listed in 6.1.</li> <li>• Describes heat treatment processes for a given alloy steel e.g tool steel.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Heat treatment chart containing information for materials in 10.1.</li> <li>• Table of heat treatment for alloy steels.</li> <li>• Transparencies</li> </ul>

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

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

**General Objective: 7.0: Understand The Need For Economic Use Of Strip And Sheet Materials**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Determines the size of blank required for a pressed component.</li> <li>• Estimate the percentage of material for the example in a given sample</li> <li>• Assess students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbook.</li> <li>• Recommended textbook skeleton of pierced products</li> </ul>

**General Objective: 8.0: Design A Simple Press Tool To Manufacture A Given Component E.G Flat Washer Or Simple Bracket**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Discuss criteria for selecting suitable materials for the tool component parts.</li> <li>• Identifies heat treatment processes suitable for the various parts of the press tool</li> <li>• Appraises metal machining processes appropriate for producing the tool component parts design in 8.0.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbook.</li> <li>Transparencies</li> <li>• Teachers' notes.</li> <li>Transparencies</li> <li>• Recommended textbooks, Teachers' notes.</li> <li>• Film show.</li> </ul>

# 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 designed 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

<b>PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE</b>			
<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29: Jig &amp; Fix Design</b>	<b>Contact Hours: 6hrs/wk</b>
<b>Week</b>	<b>Specific Learning Outcome:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrate the use of drilling jigs</li> <li>• Demonstrate the use of fixtures for the operations listed in 1.3 and allow students to practise</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Drill jig for sample coordinator holes</li> <li>• Drawing board/instrument</li> </ul>
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"> <li>• Demonstrate by designing an appropriate jig or fixture for a particular job or component in 2.3 and allow students to practise</li> <li>• Assess the students</li> </ul>	
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"> <li>• 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</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Lathe milling machine</li> <li>• cylindrical grinder micrometer</li> </ul>
4	4.1 Make a simple slotted plate type clamp using bolt and nut or cam action	<ul style="list-style-type: none"> <li>• Design the slotted plate type clamp and show all the dimensions of the components and allow the students to practise</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Black board, milling machine, drilling machine</li> </ul>
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"> <li>• Ask the students to produce the components in the workshop. Procure the standard parts</li> <li>• Demonstrate the clamping action of the clamp by assembling the components together and setting up on a machine</li> <li>• Give the student the drawing of a drill bush and guide them to manufacture it</li> <li>• Guide the students to set up for the use of milling fixture</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Lathe, milling machine, drilling machine</li> <li>• Lathe, cylindrical grinder with internal grinding, milling machine</li> </ul>

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

<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29: Jig &amp; Fix Design</b>	<b>Contact Hours: 6hrs/wk</b>
<b>Week</b>	<b>Specific Learning Outcome:</b>	<b>Teachers Activities</b>	<b>Resources</b>
7	<p>6.1 Construction of Jig &amp; 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"> <li>• The teacher to draw on the board component points of a drill jig</li> <li>• List the manufactured parts e.g: base plate, drill plate, drill bush etc</li> <li>• List the standard parts bought-out parts e.g: bolts and nuts, dowel pins</li> <li>• Guide the students to manufacture the components</li> <li>• Assemble the manufactured parts of the drill jig using the bolts and nuts and other standard bought-out parts</li> <li>• Test the drill jig</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Lathe, Milling machine, drilling machine, micrometer, vernier caliper, surface plate, vernier height gauge</li> </ul>
	<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**

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

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

<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29: Jig &amp; Fix Design</b>	<b>Contact Hours: 6hrs/wk</b>
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

<b>PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE</b>			
<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29 - Jig &amp; Fixture Design &amp; Manufacture Contact Hours 6 hrs/wk</b>	
<b>Week</b>	<b>General Objective 1.0: Know The Difference Between Jigs And Fixtures</b>		
	<b>Specific Learning Outcome:</b>	<b>Teachers Activities</b>	<b>Resources</b>
	1.1 Explain the difference between a jig and fixture	<ul style="list-style-type: none"> <li>To illustrate the difference between a jig and fixture with diagrams and notes</li> </ul>	<ul style="list-style-type: none"> <li>Recommended textbooks and Teachers notes. Transparencies</li> <li>Chalkboard, chalk etc.</li> </ul>
<b>General Objective 2.0: Understand The Need For Jigs And Fixtures</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
	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"> <li>Illustrate the activities in 2.1 to 2.2 and prepare notes for the students</li> <li>Assess the students</li> </ul>	
<b>General Objective 3.0: Understand The Principles Of Location And Restraint</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
	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"> <li>The teacher to illustrate the activities in 3.1 to 3.4 and prepare good notes for the students</li> <li>Assess the students</li> </ul>	

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

<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29 - Jig &amp; Fixture Design &amp; Manufacture Contact Hours 6 hrs/wk</b>	
<b>General Objective 4.0: Understand Common Methods Of Clamping</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
3-4	<p>4.1 Explain the use of different types of clamps in jigs and fixtures e.g.</p> <ul style="list-style-type: none"> <li>i. plate type using nut and bolt</li> <li>ii. cam action</li> <li>iii. Toggle action</li> </ul> <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"> <li>• The teacher to illustrate and explain activities in 4.1 to 4.6 with diagrams where necessary and prepare notes for the students</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks and Teachers notes. Transparencies</li> <li>• Chalkboard, chalk etc.</li> </ul>
<b>General Objective 5.0: Understand The Importance Of Tool Guidance And Location Relative To The Component</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
5	<p>5.1 State the criteria for the identification of the different types of drill bushes and their uses e.g</p> <ul style="list-style-type: none"> <li>(i) headed</li> <li>(ii) headless</li> <li>(iii) linear</li> <li>(iv) reamer</li> <li>(v) ship</li> </ul> <p>5.2 State the purpose of a lock screw used in conjunction with a slip bush</p>	<ul style="list-style-type: none"> <li>• The teacher to illustrate and explain the activities in 5/1 to 5.3 and prepare notes for the students</li> <li>• Assess the students</li> </ul>	

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

<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29 - Jig &amp; Fixture Design &amp; Manufacture Contact Hours 6 hrs/wk</b>	
<b>General Objective 6.0: Understand The Importance Of Fixture Location Relative To A Machineslide Movement</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• The Teacher to illustrate and explain the activities in 6.1 to 6.2 and prepare notes</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks and Teachers notes. Transparencies</li> <li>• Chalkboard, chalk etc.</li> </ul>
<b>General Objective 7.0: Understand Different Methods Of Jigs And Fixtures Construction</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
7-8	<p>7.1 State the advantages and disadvantages of the different methods of construction e.g</p> <p style="padding-left: 20px;">a. fabrication using screws and dowels</p> <p style="padding-left: 20px;">b. casting</p> <p style="padding-left: 20px;">c. welding</p> <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"> <li>• The teacher to explain and illustrate the activities in 7.1 to 7.8 and prepare notes for the students</li> <li>• Assess the students</li> </ul>	

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

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

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

<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 29 - Jig &amp; Fixture Design &amp; Manufacture Contact Hours 6 hrs/wk</b>	
<b>General Objective 11.0: Design And Make A Simple Jig Or Fixture For A Given Component</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• 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</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks and Teachers notes. Transparencies</li> <li>• Chalkboard, chalk etc.</li> </ul>

# 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"> <li>• Lists and discusses the engineering production processes that uses dies for operations in 1.1</li> <li>• Explains the principles of the processes listed in 1.1 and prepare notes for the students.</li> <li>• Assess the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Recommended textbooks and Teachers notes.</li> <li>• Transparencies</li> <li>• Chart of machining processes</li> </ul>
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"> <li>• 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</li> <li>• Assess the students</li> </ul>	

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

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

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

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**General Objective 3.0: Know The Bench Work And Fitting Techniques**

3.8 State the types of materials used for taking impressions and their limitations  
e.g.:

- 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**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
4	<p>4.1 Identify the common materials used in manufacture of die components e.g:</p> <p>Nickel Chrome Die Steel Case hardening chrome Die Steel Chrome Molybdenum Die Steel Chrome Vanadium Die Steel Beryllium Copper Cast iron</p> <p>4.2 Explain the applications of materials covered in 3.1</p> <p>4.2 Explain the influence of the following factors on the choice of die material:</p> <ol style="list-style-type: none"> <li>a. Machinability</li> <li>b. Wear resistance</li> <li>c. Surface finish required</li> <li>d. Heat treatment required</li> <li>e. Type of die</li> </ol> <p>4.3 Explain the cutting tool geometry which may need to be modified to suit different die steels and materials</p>	<ul style="list-style-type: none"> <li>• Explains the applications of the materials mentioned in 4.1</li> <li>• Explains selection criteria for choice of materials in 4.3</li> <li>• Explains the form and cutting tool angles on tools which may be modified to suit different die steels and materials</li> <li>• Recommends appropriate heat treatment for materials listed in 4.1 as well as the required degree of hardness</li> <li>• Explains the heat treatment procedure identified in 4.6</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Chart of common metal used in die manufacture</li> <li>• Table of properties of metal elements and their uses</li> <li>• Chart of shapes and angles at tool point</li> <li>• Textbook prescriptions in tables</li> <li>• Teacher's notes</li> </ul>

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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**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Describes the angular movements of a universal head</li> <li>• Determines the angular settings required to machine a compound angle in the corner of a cavity</li> <li>• Describes the processes in machining a compound angle in a corner of a cavity</li> <li>• Assess the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Transparencies</li> <li>• Slides</li> </ul>

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

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Cites examples of templates for horizontal, vertical and combined machine movements i.e plain and solid (3-D templates)</li> <li>• Explains limitations imposed by wear resistance and dimensional accuracy (stability) in selection of template materials</li> <li>• Explains selection criteria for suitable material for template of a given application</li> <li>• Determines the accuracy of template profile using factors listed in 6.5 and prepare notes accordingly.</li> <li>• Assess the students.</li> </ul>	<ul style="list-style-type: none"> <li>• Chart of thin section and solid templates</li> <li>• Slides</li> <li>• Transparency</li> </ul>

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**General Objective: 7.0: Understand The Use Of Models Or Pattern As An Aid To Production Of Die Forms**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
7	<p>7.1 Know the manufacture of patterns is normally before the task of a specialist, state the responsibilities of a pattern maker.</p> <p>7.2 Explain the type of materials used for producing patterns e.g: wood, plaster of paris, epoxy resin, brass, aluminium</p> <p>7.3 Explain the factors affecting the choice of pattern material including: size of pattern, amount of detail, accuracy of finished work, number of impressions required from pattern</p> <p>7.4 Explain how models may be cast in resin using existing samples</p> <p>7.5 Explain the principle of copy using a model of pattern</p>	<ul style="list-style-type: none"> <li>• Identifies the roles of patternmaker in the manufacture of pattern</li> <li>• Describes the type of materials used for production of patterns as in 7.2</li> <li>• Explains criteria for selecting materials as given in 7.3</li> <li>• Explains how models are cast in resin from samples</li> <li>• Explains how to copy a model of a pattern and prepare notes accordingly.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> <li>• Transparencies</li> <li>• Charts showing how modes are cast from resin samples</li> <li>• Film show</li> </ul>

**General Objective: 8.0: Understand The Setting Up An Operation Of A Pantograph Copy Milling Machine**

<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
8	<p>8.1 Identify the main machine components and controls of a pantograph machine</p> <p>8.2 Identify the main machine components and controls of a pantograph machine</p> <p>8.3 Describe the pantograph principle of copying</p> <p>8.3 Describe the common types of cutters used on pantograph machines e.g: single lip cutter (D. bits), End mills, slot drills, ball and mills, high speed burrs, engraving cutters</p>	<ul style="list-style-type: none"> <li>• Describes the main machine components and controls of a pantograph machine</li> <li>• Explain the copying principle of pantograph</li> <li>• Explains the selection criteria for the copying stylus given the factors in 8.4 and prepare notes accordingly.</li> </ul>	<ul style="list-style-type: none"> <li>• Film strip</li> <li>• Transparencies</li> </ul>

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	<p>8.4 Explain the factors affecting the correct selection of the copying stylus:</p> <ul style="list-style-type: none"> <li>a. pattern material</li> <li>b. cutter size and shape</li> <li>c. roughing and finishing operations</li> <li>d. enlargement or reduction ratio</li> </ul> <p>8.5 Distinguish between line milling and profile milling copying actions</p>	<ul style="list-style-type: none"> <li>• Compares and contrasts the milling, profile milling and copying actions and prepare notes accordingly.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> </ul>
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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"> <li>a. 180° Depth control</li> <li>b. 360° profile tracer</li> <li>c. Combined Attachment</li> </ul> <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"> <li>a. pattern size and detail</li> <li>b. cutter size and type</li> <li>c. roughing and finishing operations</li> <li>d. stylus deflection</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies and describes the functions of the main components and controls of hydraulic copy milling machine</li> <li>• Explain how the hydraulic copy unit works and its operation</li> <li>• Describes the component parts of the tracer unit and its capabilities stated in 9.1</li> <li>• Describes the copying machine cutters including the types given in 9.4</li> <li>• Explains the selection criteria for the copying stylus given in 9.5 and prepare notes accordingly.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Slides</li> <li>• Film show</li> <li>• Film strip</li> <li>• Transparencies</li> </ul>

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

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**General Objective 9.0: Understand The Setting Up And Operation Of A Hydraulic Copy Milling Machine**

10	<p>9.7 Explain the factors affecting the setting up of the work piece</p> <ul style="list-style-type: none"> <li>a. size of blank</li> <li>b. direction of cut</li> <li>c. datum points</li> <li>d. material removal rate</li> <li>e. number of impressions to be machined</li> <li>f. position of workpiece and pattern</li> </ul>	<ul style="list-style-type: none"> <li>• Explains the factors affecting the setting up of the work piece and prepare notes accordingly</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Transparencies</li> </ul>
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**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"> <li>• Explains the principles of operation of EDM</li> <li>• Identifies and describes the functions of component parts of EDM as well as the controls</li> <li>• Explains the factors affecting rate of metal removal and surface finish when using EDM refer to the factors listed in 10.3</li> <li>• Explains the advantages of different types of electrode materials</li> <li>• State the types of materials commonly used for the production of electrodes</li> <li>• Explains the factors affecting the determination of electrode size refer 10.8 and prepare notes accordingly</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> <li>• Film strip</li> <li>• Electrode metals identification board</li> <li>• Transparencies</li> </ul>
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**PROGRAMME: ADVANCED NATIONAL TECHNICAL CERTIFICATE IN MECHANICAL ENGINEERING CRAFT PRACTICE**

<b>Course: Tool &amp; Die Making</b>		<b>Module Code: CME 30 - Press Tool Manufacture Contact Hours 11 hrs/wk</b>	
<b>General Objective 10.0: Understand The Setting Up And Operation Of An Electrical Discharge Machine</b>			
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"> <li>• Describes different methods of producing electrodes such as machining, casting, metal spraying</li> <li>• Describes the procedures for machining a cavity using an EDM</li> <li>• States common faults occurring in EDM, their causes and prevention and prepare notes accordingly</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> <li>• Flow chart for machining cavity in EDM</li> <li>• Film show</li> </ul>

## PRACTICAL TASKS

	Specific Learning Outcome	Teachers Activities	Resources
<b>Week</b>	<b>General Objective 1.0: Safety Practice In Die Manufacture</b>		
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"> <li>• Demonstrate operation of electrical power, isolation switches, the proper use of protective clothing and safety equipment and peculiar tools.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Safety gadgets</li> </ul>
	<b>General Objective 2.0: Application Of Die</b>		
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Arranges visitation trips to die-casting and plastic extrusion cottage industries</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Field trip</li> </ul>
	<b>General Objective 3.0: Common Materials Used In Die Manufacture</b>		
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
3	3.1 Identify the common materials used in manufacture of die components e.g: <ol style="list-style-type: none"> <li>a. Nickel Chrome Die Steel</li> <li>b. Case hardening chrome Die Steel</li> <li>c. Chrome Molybdenum Die Steel</li> <li>d. Chrome Vanadium Die Steel</li> <li>e. Beryllium Copper</li> <li>f. Cast iron</li> </ol>	<ul style="list-style-type: none"> <li>• Demonstrates techniques of quick workshop method of metal identification and describe the industrial versions and allow students to practise</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> </ul>

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

<b>General Objective 6.0: Patterns In Production Of Die Forms</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrates production of pattern for casting alphabets A-Z.</li> <li>• Demonstrate and allow students to practise</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Slides</li> </ul>
<b>General Objective 7.0: Vertical Milling With Universal Head</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• 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</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> </ul>
<b>General Objective 8.0: Pantograph Copy Milling Machine</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• 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</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Film show</li> </ul>
<b>General Objective 9.0: Hydraulic Copy Milling Machine</b>			
<b>Week</b>	<b>Specific Learning Objective:</b>	<b>Teachers Activities</b>	<b>Resources</b>
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"> <li>• Demonstrates positioning and clamping pattern and the workpiece on the hydraulic copying machine e.g shoe mould</li> <li>• Sets up the machine to copy shoe mould or any other product.</li> <li>• Assess the students</li> </ul>	<ul style="list-style-type: none"> <li>• Slides</li> </ul>

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