

TRAINING REGULATIONS



CNC MILLING MACHINE OPERATION NC II

METALS AND ENGINEERING SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY

East Service Road, South Superhighway, Taguig City, Metro Manila

METALS AND ENGINEERING SECTOR

CNC MILLING MACHINE OPERATION NC II

	Page No.
SECTION 1 CNC MILLING MACHINE OPERATION NC II QUALIFICATION	1
SECTION 2 COMPETENCY STANDARDS	2 – 38
• Basic Competencies	2 – 13
• Common Competencies	14 – 28
• Core Competencies	29 – 38
SECTION 3 TRAINING STANDARDS	39 – 45
3.1 Curriculum Design	39 – 41
3.2 Training Delivery	42
3.3 Trainee Entry Requirements	43
3.4 List of Tools, Equipment and Materials	43 – 44
3.5 Training Facilities	45
3.6 Trainers' Qualifications	45
3.7 Institutional Assessment	45
SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS	46
COMPETENCY MAP	47
DEFINITION OF TERMS	48
ACKNOWLEDGEMENTS	49-50

TRAINING REGULATIONS FOR CNC MILLING MACHINE OPERATION NC II

SECTION 1 CNC MILLING MACHINE OPERATION NC II QUALIFICATION

The CNC Milling Machine Operation NC II Qualification consists of competencies that a person must achieve to write basic CNC milling machine program, set-up machine, workpiece and cutting tools and perform basic CNC milling machine operations.

The Units of Competency comprising this qualification include the following:

Code No.	BASIC COMPETENCIES
500311105	Participate in workplace communication
500311106	Work in a team environment
500311107	Practice career professionalism
500311108	Practice occupational health and safety procedures

Code No.	COMMON COMPETENCIES
MEE722202	Interpret working drawings and sketches
MEE722203	Select and cut workshop materials
MEE722204	Perform shop computations (Basic)
MEE722205	Measure workpiece (Basic)
MEE722207	Perform shop computations (Intermediate)
MEE722208	Measure workpiece using angular measuring instruments
MEE722211	Perform preventive and corrective maintenance

Code No.	CORE COMPETENCIES
MEE821307	Write basic CNC milling machine program
MEE821308	Set-up CNC milling machine, workpiece and cutting tools
MEE821309	Perform basic CNC milling machine operations

A person who has achieved this qualification is competent to be:
- CNC Milling Machine Operator (Basic)

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in CNC MILLING MACHINE OPERATION NC II.

BASIC COMPETENCIES

UNIT OF COMPETENCY : PARTICIPATE IN WORKPLACE COMMUNICATION

UNIT CODE : 500311105

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Obtain and convey workplace information	1.1 Specific and relevant information is accessed from appropriate sources 1.2 Effective questioning , active listening and speaking skills are used to gather and convey information 1.3 Appropriate medium is used to transfer information and ideas 1.4 Appropriate non- verbal communication is used 1.5 Appropriate lines of communication with supervisors and colleagues are identified and followed 1.6 Defined workplace procedures for the location and storage of information are used 1.7 Personal interaction is carried out clearly and concisely
2. Participate in workplace meetings and discussions	2.1 Team meetings are attended on time 2.2 Own opinions are clearly expressed and those of others are listened to without interruption 2.3 Meeting inputs are consistent with the meeting purpose and established protocols 2.4 Workplace interactions are conducted in a courteous manner 2.5 Questions about simple routine workplace procedures and matters concerning working conditions of employment are asked and responded to 2.6 Meetings outcomes are interpreted and implemented
3. Complete relevant work related documents	3.1 Range of forms relating to conditions of employment are completed accurately and legibly 3.2 Workplace data is recorded on standard workplace forms and documents 3.3 Basic mathematical processes are used for routine calculations 3.4 Errors in recording information on forms/ documents are identified and properly acted upon 3.5 Reporting requirements to supervisor are completed according to organizational guidelines

RANGE OF VARIABLES

VARIABLE	RANGE
1. Appropriate sources	1.1. Team members 1.2. Suppliers 1.3. Trade personnel 1.4. Local government 1.5. Industry bodies
2. Medium	2.1. Memorandum 2.2. Circular 2.3. Notice 2.4. Information discussion 2.5. Follow-up or verbal instructions 2.6. Face to face communication
3. Storage	3.1. Manual filing system 3.2. Computer-based filing system
4. Forms	4.1. Personnel forms, telephone message forms, safety reports
5. Workplace interactions	5.1. Face to face 5.2. Telephone 5.3. Electronic and two way radio 5.4. Written including electronic, memos, instruction and forms, non-verbal including gestures, signals, signs and diagrams
6. Protocols	6.1. Observing meeting 6.2. Compliance with meeting decisions 6.3. Obeying meeting instructions

EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1. Prepared written communication following standard format of the organization 1.2. Accessed information using communication equipment 1.3. Made use of relevant terms as an aid to transfer information effectively 1.4. Conveyed information effectively adopting the formal or informal communication
<p>2. Underpinning Knowledge and Attitudes</p>	<ul style="list-style-type: none"> 2.1. Effective communication 2.2. Different modes of communication 2.3. Written communication 2.4. Organizational policies 2.5. Communication procedures and systems 2.6. Technology relevant to the enterprise and the individual's work responsibilities
<p>3. Underpinning Skills</p>	<ul style="list-style-type: none"> 3.1. Follow simple spoken language 3.2. Perform routine workplace duties following simple written notices 3.3. Participate in workplace meetings and discussions 3.4. Complete work related documents 3.5. Estimate, calculate and record routine workplace measures 3.6. Basic mathematical processes of addition, subtraction, division and multiplication 3.7. Ability to relate to people of social range in the workplace 3.8. Gather and provide information in response to workplace Requirements
<p>4. Resource Implications</p>	<ul style="list-style-type: none"> 4.1. Fax machine 4.2. Telephone 4.3. Writing materials 4.4. Internet
<p>5. Methods of Assessment</p>	<ul style="list-style-type: none"> 5.1. Direct Observation 5.2. Oral interview and written test
<p>6. Context of Assessment</p>	<ul style="list-style-type: none"> 6.1. Competency may be assessed individually in the actual workplace or through accredited institution

UNIT OF COMPETENCY: WORK IN TEAM ENVIRONMENT

UNIT CODE : 500311106

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Describe team role and scope	1.1. The <i>role and objective of the team</i> is identified from available <i>sources of information</i> 1.2. Team parameters, reporting relationships and responsibilities are identified from team discussions and appropriate external sources
2. Identify own role and responsibility within team	2.1. Individual role and responsibilities within the team environment are identified 2.2. Roles and responsibility of other team members are identified and recognized 2.3. Reporting relationships within team and external to team are identified
3. Work as a team member	3.1. Effective and appropriate forms of communications used and interactions undertaken with team members who contribute to known team activities and objectives 3.2. Effective and appropriate contributions made to complement team activities and objectives, based on individual skills and competencies and <i>workplace context</i> 3.3. Observed protocols in reporting using standard operating procedures 3.4. Contribute to the development of team work plans based on an understanding of team's role and objectives and individual competencies of the members.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Role and objective of team	1.1. Work activities in a team environment with enterprise or specific sector 1.2. Limited discretion, initiative and judgement maybe demonstrated on the job, either individually or in a team environment
2. Sources of information	2.1. Standard operating and/or other workplace procedures 2.2. Job procedures 2.3. Machine/equipment manufacturer's specifications and instructions 2.4. Organizational or external personnel 2.5. Client/supplier instructions 2.6. Quality standards 2.7. OHS and environmental standards
3. Workplace context	3.1. Work procedures and practices 3.2. Conditions of work environments 3.3. Legislation and industrial agreements 3.4. Standard work practice including the storage, safe handling and disposal of chemicals 3.5. Safety, environmental, housekeeping and quality guidelines

EVIDENCE GUIDE

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1. Operated in a team to complete workplace activity 1.2. Worked effectively with others 1.3. Conveyed information in written or oral form 1.4. Selected and used appropriate workplace language 1.5. Followed designated work plan for the job 1.6. Reported outcomes
<p>2. Underpinning Knowledge and Attitude</p>	<ul style="list-style-type: none"> 2.1. Communication process 2.2. Team structure 2.3. Team roles 2.4. Group planning and decision making
<p>3. Underpinning Skills</p>	<ul style="list-style-type: none"> 3.1. Communicate appropriately, consistent with the culture of the workplace
<p>4. Resource Implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or tasks
<p>5. Methods of Assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> 5.1. Observation of the individual member in relation to the work activities of the group 5.2. Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
<p>6. Context for Assessment</p>	<ul style="list-style-type: none"> 6.1. Competency may be assessed in workplace or in a simulated workplace setting 6.2. Assessment shall be observed while task are being undertaken whether individually or in group

UNIT OF COMPETENCY: PRACTICE CAREER PROFESSIONALISM

UNIT CODE : 500311107

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes in promoting career growth and advancement.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Integrate personal objectives with organizational goals	1.1 Personal growth and work plans are pursued towards improving the qualifications set for the profession 1.2 Intra- and interpersonal relationships are maintained in the course of managing oneself based on performance evaluation 1.3 Commitment to the organization and its goal is demonstrated in the performance of duties
1. Set and meet work priorities	2.1 Competing demands are prioritized to achieve personal, team and organizational goals and objectives. 2.2 Resources are utilized efficiently and effectively to manage work priorities and commitments 2.3 Practices along economic use and maintenance of equipment and facilities are followed as per established procedures
2. Maintain professional growth and development	3.1 Trainings and career opportunities are identified and availed of based on job requirements 3.2 Recognitions are -sought/received and demonstrated as proof of career advancement 3.3 Licenses and/or certifications relevant to job and career are obtained and renewed

RANGE OF VARIABLES

VARIABLE	RANGE
1. Evaluation	1.1 Performance Appraisal 1.2 Psychological Profile 1.3 Aptitude Tests
2. Resources	2.1 Human 2.2 Financial 2.3 Technology 2.3.1 Hardware 2.3.2 Software
3. Trainings and career opportunities	3.1 Participation in training programs 3.1.1 Technical 3.1.2 Supervisory 3.1.3 Managerial 3.1.4 Continuing Education 3.2 Serving as Resource Persons in conferences and workshops
4. Recognitions	4.1 Recommendations 4.2 Citations 4.3 Certificate of Appreciations 4.4 Commendations 4.5 Awards 4.6 Tangible and Intangible Rewards
5. Licenses and/or certifications	5.1 National Certificates 5.2 Certificate of Competency 5.3 Support Level Licenses 5.4 Professional Licenses

EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Attained job targets within key result areas (KRAs) 1.2 Maintained intra - and interpersonal relationship in the course of managing oneself based on performance evaluation 1.3 Completed trainings and career opportunities which are based on the requirements of the industries 1.4 Acquired and maintained licenses and/or certifications according to the requirement of the qualification
<p>2. Underpinning Knowledge</p>	<ul style="list-style-type: none"> 2.1 Work values and ethics (Code of Conduct, Code of Ethics, etc.) 2.2 Company policies 2.3 Company-operations, procedures and standards 2.4 Fundamental rights at work including gender sensitivity 2.5 Personal hygiene practices
<p>3. Underpinning Skills</p>	<ul style="list-style-type: none"> 3.1 Appropriate practice of personal hygiene 3.2 Intra and Interpersonal skills 3.3 Communication skills
<p>4. Resource Implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 Workplace or assessment location 4.2 Case studies/scenarios
<p>5. Methods of Assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> 5.1 Portfolio Assessment 5.2 Interview 5.3 Simulation/Role-plays 5.4 Observation 5.5 Third Party Reports 5.6 Exams and Tests
<p>6. Context of Assessment</p>	<ul style="list-style-type: none"> 6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: PRACTICE OCCUPATIONAL HEALTH AND SAFETY PROCEDURES

UNIT CODE : 500311108

UNIT DESCRIPTOR: This unit covers the outcomes required to comply with regulatory and organizational requirements for occupational health and safety.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Identify hazards and risks	1.1 Safety regulations and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures 1.2 Hazards/risks in the workplace and their corresponding indicators are identified to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures 1.3 Contingency measures during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures
2. Evaluate hazards and risks	2.1 Terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV) 2.2 Effects of the hazards are determined 2.3 OHS issues and/or concerns and identified safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation
3. Control hazards and risks	3.1 Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed 3.2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OHS policies 3.3 Personal protective equipment (PPE) is correctly used in accordance with organization OHS procedures and practices 3.4 Appropriate assistance is provided in the event of a workplace emergency in accordance with established organization protocol
4. Maintain OHS awareness	4.1 Emergency-related drills and trainings are participated in as per established organization guidelines and procedures 4.2 OHS personal records are completed and updated in accordance with workplace requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Safety regulations	May include but are not limited to: 1.1 Clean Air Act 1.2 Building code 1.3 National Electrical and Fire Safety Codes 1.4 Waste management statutes and rules 1.5 Philippine Occupational Safety and Health Standards 1.6 DOLE regulations on safety legal requirements 1.7 ECC regulations
2. Hazards/Risks	May include but are not limited to: 2.1 Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation 2.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects 2.3 Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors 2.4 Ergonomics <ul style="list-style-type: none"> • Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles • Physiological factors – monotony, personal relationship, work out cycle
3. Contingency measures	May include but are not limited to: 3.1 Evacuation 3.2 Isolation 3.3 Decontamination 3.4 (Calling designed) emergency personnel
4. PPE	May include but are not limited to: 4.1 Mask 4.2 Gloves 4.3 Goggles 4.4 Hair Net/cap/bonnet 4.5 Face mask/shield 4.6 Ear muffs 4.7 Apron/Gown/coverall/jump suit 4.8 Anti-static suits
5. Emergency-related drills and training	5.1 Fire drill 5.2 Earthquake drill 5.3 Basic life support/CPR 5.4 First aid 5.5 Spillage control 5.6 Decontamination of chemical and toxic 5.7 Disaster preparedness/management
6. OHS personal records	6.1 Medical/Health records 6.2 Incident reports 6.3 Accident reports 6.4 OHS-related training completed

EVIDENCE GUIDE

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Explained clearly established workplace safety and hazard control practices and procedures 1.2 Identified hazards/risks in the workplace and its corresponding indicators in accordance with company procedures 1.3 Recognized contingency measures during workplace accidents, fire and other emergencies 1.4 Identified terms of maximum tolerable limits based on threshold limit value- TLV. 1.5 Followed Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace 1.6 Used Personal Protective Equipment (PPE) in accordance with company OHS procedures and practices 1.7 Completed and updated OHS personal records in accordance with workplace requirements
<p>2. Underpinning Knowledge and Attitude</p>	<ul style="list-style-type: none"> 2.1 OHS procedures and practices and regulations 2.2 PPE types and uses 2.3 Personal hygiene practices 2.4 Hazards/risks identification and control 2.5 Threshold Limit Value -TLV 2.6 OHS indicators 2.7 Organization safety and health protocol 2.8 Safety consciousness 2.9 Health consciousness
<p>3. Underpinning Skills</p>	<ul style="list-style-type: none"> 3.1 Practice of personal hygiene 3.2 Hazards/risks identification and control skills 3.3 Interpersonal skills 3.4 Communication skills
<p>3. Resource Implications</p>	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> 4.1 Workplace or assessment location 4.2 OHS personal records 4.3 PPE 4.4 Health records
<p>4. Methods of Assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> 5.1 Portfolio Assessment 5.2 Interview 5.3 Case Study/Situation
<p>5. Context for Assessment</p>	<p>6.1 Competency may be assessed in the work place or in a simulated work place setting</p>

COMMON COMPETENCIES

UNIT OF COMPETENCY: INTERPRET WORKING DRAWINGS AND SKETCHES

UNIT CODE: MEE722202

UNIT DESCRIPTOR: This unit covers the competencies required to read and interpret drawings and sketches.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Interpret technical drawing	1.1 Components, assemblies or objects recognized as required. 1.2 Dimensions identified as appropriate. 1.3 Instructions identified and followed as required. 1.4 Material requirements identified as required. 1.5 Symbols recognized as appropriate in the <i>drawing</i> . 1.6 Tolerance , limits and fits identified in the drawing.
2. Prepare freehand sketch of parts	2.1 Sketch drawn correctly and appropriately. 2.2 Sketch depicted objects or part appropriately. 2.3 Dimensions indicated in sketch are clear and correct. 2.4 2.5 Instructions included in sketch are clear and correct. Base line or datum points indicated as required.
3. Interpret details from freehand sketch	3.1 Components, assemblies or objects recognized as required. 3.2 Dimensions identified as appropriate. 3.3 Instructions identified and followed as required. 3.4 Material requirements identified as required. 3.5 Symbols recognized as appropriate in the drawing.



RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawing	1.1 Drawing technique include 1.1.1 Perspective 1.1.2 Exploded view 1.1.3 Hidden view technique 1.2 Projections 1.2.1 First angle projections 1.2.2 Third angle projections
2. Tolerance	2.1 General tolerance 2.2 Angular tolerance 2.3 Geometric tolerance

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 Interpreted technical drawing 1.2 Prepared sketches 1.3 Interpreted sketches.
2. Underpinning knowledge	2.1 Alphabet of lines 2.2 Projections 2.3 Drawing symbols 2.4 Dimensioning techniques 2.5 Tolerance, limits and fits 2.6 Engineering materials 2.7 Drawing tools and supplies
3. Underpinning skills	3.1 Handling tools and drawing instruments 3.2 Using measuring instruments
4. Resource implications	The following resources should be provided 4.1 Drafting room/facilities and drafting instruments and supplies appropriate to the activity 4.2 Measuring tools 4.3 Drawings, sketches or blueprint 4.4 Specimen parts/components
5. Method of assessment	The following assessment methods are suggested: 5.1 direct observation 5.2 written or oral short answer questions 5.3 demonstration 5.4 project/work sample 5.5 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



UNIT OF COMPETENCY: SELECT/ CUT WORKSHOP MATERIALS

UNIT CODE: MEE722203

UNIT DESCRIPTOR: This unit covers the skills and knowledge required to select and cut workshop materials

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Determine requirement	1.1 Plans/ drawings are interpreted to produce component to specification 1.2 Sequence of operation is determined to produce component to specification
2. Select and measure materials	2.1 Materials are selected according to the requirement of the operation 2.2 Materials are measured to required level of accuracy using measuring tools 2.3 Measuring tools are used according to manufacturers specification
3. Cut materials	3.1 Materials are cut according to plans/drawing instruction 3.2 Cutting tools/equipment are used based on manufacturers specification, appropriate techniques or the safety procedure

RANGE OF VARIABLES

VARIABLE	RANGE
1. Plan/drawings	1.1 Dimensions 1.2 Tolerance
2. Materials	2.1 Ferrous 2.2 Non-ferrous
3. Measuring tools	3.1 Steel rule 3.2 Pull-push rule
4. Cutting tools/equipment	4.1 Hacksaw 4.2 Power hacksaw
5. Safety procedure	Safety involves the handling of 5.1 Equipment 5.2 Tools 5.3 Materials



EVIDENCE GUIDE

1. Critical aspects of evidence	<p>Assessment requires evidence that the candidate</p> <ul style="list-style-type: none"> 1.1 Interpreted plans/drawings 1.2 Selected natural according to the requirement 1.3 Performed cutting operation 1.4 Cutting tools/equipment used safely
2. Underpinning knowledge and attitude	<ul style="list-style-type: none"> 2.1 Shop safety practices <ul style="list-style-type: none"> 2.1.1 Safe working habits 2.1.2 Safe handling of tools, equipment and materials 2.2 Blueprint reading <ul style="list-style-type: none"> 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Assembly and details of drawing 2.2.3 Dimensions 2.3 Measurement <ul style="list-style-type: none"> 2.3.1 Linear measuring tools 2.4 Materials and related science <ul style="list-style-type: none"> 2.4.1 Classification and mechanical properties of engineering materials
3. Underpinning skills	<ul style="list-style-type: none"> 3.1 Selecting materials 3.2 Using measuring tools 3.3 Operating power hacksaw
4. Resource implications	<p>The following resources should be provided</p> <ul style="list-style-type: none"> 4.1 Tools, equipment and facilities appropriate processes of an activity 4.2 Materials relevant to the proposal activity 4.3 Drawings/plans
5. Method Assessment	<p>The following assessment activity are suggested</p> <ul style="list-style-type: none"> 5.1 Direct observation 5.2 Oral short answer question 5.3 Practical exercises
6. Context for assessment	<p>Competency may be assessed in the workplace or in simulated work environment</p>



UNIT OF COMPETENCY: PERFORM SHOP COMPUTATIONS (BASIC)

UNIT CODE: MEE722204

UNIT DESCRIPTOR: This unit covers the competencies required to perform basic calculations using the four fundamental operation.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Perform four fundamental operations.	1.1 Simple calculations performed using four fundamental operations . 1.2 Simple calculations performed involving fractions and mixed numbers using four fundamental operations
2. Perform basic calculations involving fractions and decimals	2.1 Simple calculations are performed involving fractions and decimals using the four fundamental operations. 2.2 Decimal are converted into fraction (and vice versa) accurately,
3. Perform basic calculations involving percentages.	3.1 Simple calculations are performed to obtain percentages from information expressed in either fractional or decimal format
4. Perform basic calculation involving ration and proportion	4.1 Simple calculations are performed involving ratios and proportion using whole numbers, fractions and decimal fractions.
5. Perform calculations on algebraic expressions	5.1 Simple calculations are performed on algebraic expressions using the four fundamental operations. 5.2 Simple transposition of formulae is carried out to isolate the variable required, involving the four fundamental operations.



RANGE OF VARIABLES

VARIABLE	RANGE
1. Four fundamental operations	1.1 Addition 1.2 Subtraction 1.3 Multiplication 1.4 Division
2. Algebraic expressions	Calculation using formula for determining 2.1 tap drill size 2.2 feed 2.3 speed

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate performed calculations: 1.1 using four fundamental operations 1.2 involving fractions and mixed numbers 1.3 involving fractions and decimals 1.4 involving percentages 1.5 involving ratio and proportion 1.6 on algebraic expressions 1.7 of simple formulae
2. Underpinning knowledge and attitude	2.1 English and metric system of measurements
3. Underpinning skills	3.1 Performing calculations using pen and paper or on a calculator
4. Resource implications	The following resources should be provided 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	The following assessment methods are suggested: 5.1 written or oral short answer questions 5.2 practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



UNIT OF COMPETENCY: MEASURE WORKPIECE (BASIC)

UNIT CODE: MEE722205

UNIT DESCRIPTOR: This unit covers the competencies required to measure workpieces using measuring instruments such as steel rules, vernier calipers , micrometers, etc....

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Select and use measuring tools	1.1 Measuring tools are selected and used according to the level of accuracy required. 1.2 Measurements taken are accurate to the finest graduation of the selected measuring instrument. 1.3 Measuring technique used is correct and appropriate to the device used.
2. Clean and store measuring tools	2.1 Care and storage of devices undertaken to manufacturer's specifications or standard operating procedures.



RANGE OF VARIABLES

VARIABLE	RANGE
1. Measuring tools	Measuring tools include 1.1 Steel tape 1.2 Steel rule 1.3 Straight edge 1.4 Combination square 1.5 Steel square 1.6 Divider or trammel 1.7 Caliper 1.8 Protractor 1.9 Vernier caliper 1.10 Micrometer
2. Measurements	2.1 length 2.2 diameter 2.3 depth 2.4 flatness 2.5 straightness 2.6 squareness

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 Selected and used measuring instruments 1.2 Cleaned and stored measuring instruments
2. Underpinning knowledge	2.1 Types, purposes and accuracy of measuring instruments 2.2 Capability of measuring instruments 2.3 Part dimensions and tolerances 2.4 Techniques for measuring dimensions 2.5 Care and storage procedure of measuring tools
3. Underpinning skills	3.1 Safe handling of measuring tools and materials
4. Resource implications	The following resources should be provided 4.1 Tools, equipment and facilities appropriate to the activity 4.2 Specimen component or part to the proposed activity
5. Method of assessment	The following assessment methods are suggested: 5.1 direct observation 5.2 demonstration 5.3 written or oral short answer questions 5.4 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



UNIT OF COMPETENCY: **PERFORM SHOP COMPUTATIONS (INTERMEDIATE)**

UNIT CODE: **MEE722207**

UNIT DESCRIPTOR: This unit covers the competencies required to perform calculation involving triangles and tapers.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Perform calculations involving triangles	1.1 Problems involving right triangles are performed using the <i>trigonometric functions</i> . 1.2 Problems involving non-right triangles are performed using sine and cosine rules.
2. Calculate taper	2.1 Taper of work calculated correctly using appropriate formula.



RANGE OF VARIABLES

VARIABLE	RANGE
1. trigonometric functions	1.1 Sine 1.2 Cosine 1.3 Tangent 1.4 Cotangent 1.5 Secant 1.6 Cosecant

EVIDENCE GUIDE

1 Critical aspects of evidence	Assessment requires evidence that the candidate performed calculations: 1.1 Involving right triangles 1.2 Involving non-right triangles 1.3 involving tapers
2 Underpinning knowledge and attitude	2.1 English and metric system of measurements 2.2 Geometrical shapes
3 Underpinning skills	Performing calculations using pen and paper or on a calculator
4 Resource implications	The following resources should be provided 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5 Method of assessment	The following assessment methods are suggested: 5.1 written or oral short answer questions 5.2 practical exercises
6 Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



UNIT OF COMPETENCY: MEASURE WORKPIECE USING ANGULAR MEASURING INSTRUMENTS

UNIT CODE: MEE722208

UNIT DESCRIPTOR: This unit covers the competencies required to measure workpieces using angular measuring instruments.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Select and use angular measuring tools	1.1 Angular measuring tools are selected and used according to the level of accuracy required. 1.2 Measurements taken are accurate to the finest graduation of the selected measuring instrument. 1.3 Measuring technique used is correct and appropriate to the device used.
2. Maintain angular measuring tools	2.1 Measuring tools are adjusted and maintained to the required accuracy utilizing manufacturer's or worksite procedures.
3. Clean and store measuring tools	3.1 Care and storage of devices undertaken to manufacturer's specifications or standard operating procedures.



RANGE OF VARIABLES

VARIABLE	RANGE
1. Angular measuring tools	Measuring tools include 1.1 Bevel protractor 1.2 Gage blocks 1.3 Sine bar
2. Measurements	2.1 angle 2.2 taper

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 Selected and used angular measuring instruments 1.2 Maintained/adjusted instruments 1.3 Cleaned and stored measuring instruments
2. Underpinning knowledge	2.2 Types, purposes and accuracy of angular measuring instruments 2.3 Capability of measuring tools 2.4 Techniques for measuring angles and tapers 2.5 Care and storage procedure of measuring tools
3. Underpinning skills	3.2 Safe handling of measuring tools and materials 3.3 Reading vernier scale 3.4 Reading micrometer
4. Resource implications	The following resources should be provided 4.1 Tools, equipment and facilities appropriate to the activity 4.2 Specimen component or part to the proposed activity
5. Method of assessment	The following assessment methods are suggested: 5.1 direct observation 5.2 demonstration 5.3 written or oral short answer questions 5.4 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



UNIT OF COMPETENCY PERFORM PREVENTIVE AND REPAIR/CORRECTIVE MAINTENANCE

UNIT CODE: MEE722211

UNIT DESCRIPTOR: This unit covers the knowledge and skills required in performing preventive and repair/corrective maintenance such as inspection and repair of hand tools, machine parts, cleaning and lubrication and changing drive pulley and belts.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Perform inspection of machine	1.1 Machine inspected according to worksite procedures . 1.2 Status report is recorded on maintenance record sheets or reported orally according to worksite procedure. 1.3 Unusual /abnormal machine conditions are reported or responded to in accordance with worksite procedures
2. Perform cleaning and lubricating of machine	2.1 Machines are lubricated as per manufacturer's recommendation using appropriate lubricant/materials 2.2 Fluids and lubricants replaced and/or filled up according to prescribed schedule. 2.3 Cleaning and lubrication performed is recorded and reported in accordance with worksite procedures.
3. Perform machine repair and adjustments	3.1 Machine repairs performed according to manufacturer's instruction or worksite procedures. 3.2 Machine moving parts adjusted to manufacturer's specifications. 3.3 Repairs and adjustments performed are recorded and reported in accordance with worksite procedures.
4. Maintain hand and cutting tools	4.1 Cutting tools are ground to recommended specifications 4.2 Hand tools lubricated and stored according to prescribed procedure 4.3 Where necessary tool replacements are made in accordance with job requirements.



RANGE OF VARIABLES

VARIABLES	RANGE
1. Inspected	Inspected machine parts include: <ul style="list-style-type: none"> 1.1 V-belt 1.2 Bearing 1.3 Gears 1.4 Clutch 1.5 Drive pulley 1.6 Control panel 1.7 Machine guard
2. Machines	Machine includes but not limited to: <ul style="list-style-type: none"> 2.1 CNC Lathe machine 2.2 CNC Milling machine 2.3 Grinding machine 2.4 Conventional machine tools
3. Tools and materials	Tools and materials used include: <ul style="list-style-type: none"> 3.1 Lubricants 3.2 Oil can 3.3 Grease gun 3.4 Oil 3.5 Coolant or compound
4. Machine maintenance and repairs	4.1 Machine repairs may include the following: <ul style="list-style-type: none"> 4.1.1 Replacement of defective parts such as Gears, belts, pulleys, screws, bearings, pins lead screw, batteries 4.1.2 Adjustment/calibration of machines such belt tensions, bolts and nuts, digital read-out
5. Machine moving/rotating parts	5.1 May include: <ul style="list-style-type: none"> 5.1.1 Carriage 5.1.2 Gears 5.1.3 Pulley 5.1.4 Belts
6. Unusual /abnormal machine conditions	6.1 May include: <ul style="list-style-type: none"> 6.1.1 Unusual sound/ noisy Motor, Machine 6.1.2 Excessive vibration 6.1.3 Unusual smell 6.1.4 Excessive backlash 6.1.5 Misalignment



EVIDENCE GUIDE

<p>1. Critical aspects of evidence</p>	<p>Assessment requires evidence that the candidate</p> <ul style="list-style-type: none"> 1.1 Performed inspection of machine 1.2 Performed cleaning and lubricating of machine 1.3 Performed machine repairs and adjustments 1.4 Documented work done
<p>2. Underpinning knowledge</p>	<ul style="list-style-type: none"> 2.1 Proper cleaning and oiling 2.2 Kinds of oil 2.3 Parts and function of machine tools 2.4 Cutting oil, coolant or compound 2.5 Pulleys and belts 2.6 Handling and storage of tools 2.7 Checklist of safe working conditions 2.8 Procedures in cleaning and disposal of waste materials 2,09 Conventional and CNC Machine tools 2.10 5s (housekeeping) 2.11 Quality and safety procedures
<p>3. Underpinning skills</p>	<ul style="list-style-type: none"> 3.1 Inspecting and repairing hand tools 3.2 Inspecting and changing drive pulleys and belts 3.3 Replacing and adjusting machine parts 3.4 Distinguishing old and new coolant 3.5 Distinguishing polluted coolant 3.6 Selecting coolant, cutting oil or compounds 3.7 Changing coolant 3.8 Inspecting work area for safe working environment 3.9 Cleaning work area 3.10 Disposing metal scraps, chips and waste materials. 3.11 Operation of conventional and CNC machines 3.12 Communication skills 3.13 Observing safety precautions
<p>4. Resource Implications</p>	<p>The following resources should be provided</p> <ul style="list-style-type: none"> 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
<p>5. Method of Assessment</p>	<p>The following assessment methods are suggested:</p> <ul style="list-style-type: none"> 5.1 Direct observation of activities 5.2 Oral or written questioning 5.3 Practical demonstration 5.4 Third party report 5.5 Portfolio assessment
<p>6. Context for Assessment</p>	<p>Competency may be assessed in the workplace or in simulated workplace environment.</p>



CORE COMPETENCIES

UNIT OF COMPETENCY :	Write Basic CNC Milling Machine Program
UNIT CODE :	MEE821307
UNIT DESCRIPTOR :	This unit covers the knowledge and skills required to write Basic CNC milling program.

ELEMENTS	PERFORMANCE CRITERIA
	<i>Italicized</i> terms are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component according to specification. 1.3 Cutting tools are selected according to the requirements of the operation. 1.4 Cutting speed and feed rate calculated based on workpiece and cutting tool material. 1.5 Process / job / adjustment sheets are filled up with relevant machine, tool and raw material data.
2 Write basic CNC milling machine program	2.1 Coordinates calculated for simple tool path or basic machining functions based on part or product to be produced. 2.2 Program written in standard CNC milling operations , code format in accordance with standard operating procedures.
3 Edit basic CNC milling programs	3.1 Program is simulated and edited according to standard operating procedures. 3.2 Program is saved to the machine according to standard operating procedures. 3.3 Program is downloaded to the machine according to standard operating procedures.(Optional)



RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawings	Reading and interpretation 1.1 Dimensions and symbols 1.2 Tolerances
2. Cutting Tools	Cutting tools used in milling operations include: 2.1 Drills 2.2 Reamers 2.3 Slitter 2.4 End mills 2.5 Shell mills 2.6 Side and face cutters 2.7 Formed cutter 2.8 T-slot cutter 2.9 Ball end mill 2.10 Engraving 2.11 Dovetail 2.12 Tap 2.13 NC start drill 2.14 Center drill
3. Workpiece	Workpiece materials used in milling operations 3.1 Ferrous metals 3.2 Non-ferrous metals 3.3 Non – metallic materials
4. Milling Operations	Simple CNC milling operations: 4.1 drilling 4.2 boring 4.3 milling slot and keyways 4.4 milling serrations 4.5 milling vees 4.6 milling circular and rectangular pockets 4.7 milling circular slots 4.8 milling contour 4.9 Tapping 4.10 Reaming 4.11 Engraving 4.12 Chamfering



EVIDENCE GUIDE

1. Critical aspects of evidence	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 determined job requirements 1.2 wrote basic CNC milling machine program 1.3 edited basic CNC milling machine programs
2. Underpinning knowledge and attitude	<ul style="list-style-type: none"> 2.1 Drawing interpretation <ul style="list-style-type: none"> 2.1.1 Standard drawing scales, symbols and abbreviations 2.1.2 Orthographic and isometric drawings 2.1.3 Assembly and detailed drawings 2.1.4 Interpreting tolerances 2.1.5 Geometrical Tolerances (form and position) 2.1.6 Surface condition (surface finish/texture) 2.1.7 limits and fits 2.2 Shop mathematics <ul style="list-style-type: none"> 2.2.1 Four fundamental operation 2.2.2 Fractions and decimals 2.2.3 Percentages and ratios 2.2.4 Conversion of units (English to metric) 2.2.5 Pythagorean theorem 2.2.6 Basic trigonometric function 2.3 Materials and related science <ul style="list-style-type: none"> 2.3.1 Classification and mechanical properties of engineering materials 2.4 Milling machine operations <ul style="list-style-type: none"> 2.4.1 Calculation of cutting speed, rpm, feed rate 2.4.2 Classification/selection of cutting tools and tool geometry 2.4.3 Milling operation processes
3. Underpinning skills	<ul style="list-style-type: none"> 3.1 Identification of cutting tools 3.2 Computation of feed, cutting speed and machine rpm 3.3 Application of G – codes and M – codes
4. Resource implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> 4.1 Drawings, sketches or blueprint/materials 4.2 Computers and simulation software's
5. Method of assessment	<p>Competency must be assessed through:</p> <ul style="list-style-type: none"> 5.1 direct observation with questioning 5.2 written exam 5.3 demonstration (actual programming)
6. Context for assessment	<p>Competency may be assessed in the workplace or in simulated workplace environment.</p>



UNIT OF COMPETENCY : Set-up CNC milling machine, workpiece and cutting tools

UNIT CODE : MEE821308

UNIT DESCRIPTOR : This unit covers the knowledge and skills required to set-up CNC milling machine and cutting tools, download program, set-up workpiece, dry-run program and perform trial cut on workpiece.

ELEMENTS	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1 Set up machine and cutting tools	1.1 Oil and coolant is checked according to manufacturer's specification. 1.2 Air and hydraulic pressure is checked according to manufacturer's specification. 1.3 Machine zero point is set to the required position. 1.4 Cutting Tools are set according to required sequence of operations. 1.5 Workholding and clamping devices are tightened according to standard operating procedures. 1.6 Tool set-up is performed according to standard operating procedures.
2 Download/ inputed program	2.1 Program is downloaded/ inputed to the machine using appropriate devices. 2.2 Program is simulated to determine the correctness of the tool path and other work parameters. 2.3 Workpiece zero point is set to the required position.
3. Set-up workpiece	3.1 Workpiece is mounted on clamping device to required level of accuracy using tools and instruments / equipment in accordance with worksite procedures. 3.2 Set-up is performed in accordance with safety procedures and using personal protective devices.
4 Dry-run program	4.1 Dry run is performed in accordance with the desired tool path movement. 4.2 Where necessary, program is edited according to required tool path movement.
5 Perform trial cut on workpiece	5.1 Machined workpiece as programmed. 5.2 Checked and measured workpiece dimensions using appropriate measuring instruments. 5.3 Where required, program is edited and tool parameters are corrected/adjusted.



RANGE OF VARIABLES

VARIABLE	RANGE
1. Cutting Tools	Cutting tools used in milling operations include: <ul style="list-style-type: none"> 1.1 Drills 1.2 Reamers 1.3 Slitter 1.4 End mills 1.5 Shell mills 1.6 Side and face cutters 1.7 Formed cutter 1.8 T-slot cutter 1.9 Ball end mill 1.10 Engraving 1.11 Dovetail 1.12 Tap 1.13 NC start drill 1.14 Center drill
2. Tool set-up	<ul style="list-style-type: none"> 2.1 Scratch method 2.2 Tool-setting device method
3. Workpiece	Workpiece materials used in milling operations: <ul style="list-style-type: none"> 3.1 Ferrous metals 3.2 Non-ferrous metals 3.3 Non – metallic materials
4. Work holding and clamping device	4.1 Workholding devices <ul style="list-style-type: none"> 4.1.1 clamps 4.1.2 vises 4.1.3 angle plates 4.1.4 parallel bars 4.1.5 vee-blocks
5. Instruments	<ul style="list-style-type: none"> 5.1 Tool pre - setting device (optional) 5.2 Dial indicator 5.3 Dial test indicator 5.4 Gauges (go-no go, pitch, plug, radius, etc.) 5.5 Coordinate measuring machine (CMM) (optional) 5.6 Bevel protractor 5.7 Profile projector 5.8 Surface-texture tester 5.9 Surface-finish comparator 5.10 Edge finder 5.11 Steel rule 5.12 Bore gage



EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 Performed machine and cutting tools set up 1.2 Downloaded/ inputed programs 1.3 Performed workpiece set-up 1.4 Performed program dry run 1.5 Performed trial cut on workpiece
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Measurements 2.2.1 Linear measuring tools (vernier, micrometer) 2.2.2 Angular measuring tools 2.2.3 Geometrical tolerances checking tools 2.2.4 Surface finish measuring instrument
3. Underpinning skills	3.1 Identification of cutting tools 3.2 Use of measuring instruments 3.3 Determining workpiece specifications 3.4 Scratch method for tool set-up 3.5 Use of tool setter
4. Resource implications	The following resources must be provided: 4.1 Tools, equipment and facilities appropriate for the processes or activities for the job requirements 4.2 Materials as specified in the drawing 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency must be assessed through: 5.1 direct observation with questioning 5.2 demonstration
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



UNIT OF COMPETENCY : Perform Basic CNC Milling Machine Operations

UNIT CODE : MEE821309

UNIT DESCRIPTOR : This unit covers the skills required to operate CNC milling machine. It details the requirements for performing simple CNC milling operations such as drilling, boring, reaming, milling blocks, shoulder, parallel and angled faces, milling slots, keys, serrations, and milling castings and circular slots and external radius.

ELEMENTS	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Mill workpiece	1.1 Workpiece is mounted or set in accordance with standard operating procedures. 1.2 Basic CNC Milling operations are performed to produce component as programmed. Corrective measures/adjustments are performed if necessary. 1.3 Safety procedures are observed during machining operation.using personal protective devices. 1.4 Personal protective devices are used in accordance with occupational health and safety (OHS) requirements. 1.5
2. Check, and measure workpiece	2.1 Workpiece is checked and measured in conformance to specification using appropriate methods, measuring tools and equipment. Defective workpieces are marked, recorded and reported for proper action. 2.2



RANGE OF VARIABLES

VARIABLE	RANGE
1. Basic CNC Milling Operations	Basic CNC milling operations: 1.1 Drilling 1.2 Boring 1.3 Milling slot and keyways 1.4 Milling serrations 1.5 Milling vees 1.6 Circular and rectangular pockets 1.7 Milling circular slots 1.8 Milling contour 1.9 Tapping 1.10 Reaming 1.11 Engraving 1.12 Chamfering
2 Corrective measures/adjustments	2.1 Replacement of cutting tools 2.2 Adjustment of tool offset 2.3 Adjustment of cutting speed and feed rate
3. Measuring Tools	3.1 Vernier caliper (Digital/ read out) 3.2 Micrometer (Digital/ read out) 3.3 Gages (thread, drill, surface comparator / roughness tester, radius, screw pitch, taper)



EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 milled workpiece 1.2 checked and measured workpiece
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Orthographic and isometric drawings 2.2.3 1 st and 3 rd angle projections 2.2.4 Assembly and detail drawings 2.2.5 Interpreting tolerances, limits and fits 2.2.6 Surface finish 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Pythagorean theorem/trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (vernier, micrometer) 2.4.2 Precision angular measuring tools 2.4.3 Geometrical tolerances measuring tools 2.4.4 Dial indicator 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.6 CNC Milling machine operations: 2.6.1 Milling types and specifications 2.6.2 Milling machine parts and functions 2.6.3 Milling cutters and holders 2.6.4 Setting rpm, feed rate 2.6.5 Workholding devices 2.6.6 Milling machine accessories, fixtures and attachments



3. Underpinning skills	3.1 Selection of cutting tools 3.2 Use of measuring instruments 3.3 Determination workpiece specifications 3.4 Computation of feed machine rpm 3.5 Application of G – codes and M – codes
4. Resource implications	The following resources must be provided: 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency must be assessed through: 5.1 direct observation with questioning 5.2 written exam 5.3 demonstration
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.



SECTION 3 TRAINING STANDARDS

These guidelines are set to provide the Technical and Vocational Education and Training (TVET) providers with information and other important requirements to consider when designing training programs for CNC MILLING MACHINE OPERATION NC II.

3.1 CURRICULUM DESIGN

Course Title: CNC MILLING MACHINE OPERATION

NC Level: NC II

Training Duration: 18 Hours (Basic)

138 Hours (Common)

80 Hours (Core)

236 Hours

Course Description:

This qualification is designed to develop knowledge, desirable attitudes and skills in CNC Milling Machine Operation NC II.

It covers the competencies required to write basic CNC milling program, set-up machine, workpiece and cutting tools and perform basic CNC milling machine operations.

To obtain this, all units of competency prescribed for this qualification must be achieved.

BASIC COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Participate in workplace communication	1.1 Obtain and convey workplace information. 1.2 Complete relevant work related documents. 1.3 Participate in workplace meeting and discussion.	<ul style="list-style-type: none">• Group discussion• Interaction	<ul style="list-style-type: none">• Demonstration• Observation• Interviews/questioning
2. Work in a team environment	2.1 Describe and identify team role and responsibility in a team. 2.2 Describe work as a team member.	<ul style="list-style-type: none">• Discussion• Interaction	<ul style="list-style-type: none">• Demonstration• Observation• Interviews/questioning
3. Practice career professionalism	3.1 Integrate personal objectives with organizational goals. 3.2 Set and meet work priorities. 3.3 Maintain professional growth and development.	<ul style="list-style-type: none">• Discussion• Interaction	<ul style="list-style-type: none">• Demonstration• Observation• Interviews/questioning

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
4. Practice occupational health and safety	4.1 Evaluate hazard and risks 4.2 Control hazards and risks 4.3 Maintain occupational health and safety awareness	<ul style="list-style-type: none"> • Discussion • Plant tour • Symposium 	<ul style="list-style-type: none"> • Observation • Interview

COMMON COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Interpret working drawings and sketches	1.1 Interpret technical drawing 1.2 Prepare freehand sketch of parts 1.3 Interpret details from freehand sketch	<ul style="list-style-type: none"> • Lecture • Group Discussion/ interaction 	<ul style="list-style-type: none"> • Observation • Interview • Interview/ Questioning
2. Select and cut workshop materials	2.1 Determine requirements 2.2 Select and measure materials 2.3 Cut materials	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning
3. Perform shop computations (Basic)	3.1 Perform four fundamental operations 3.2 Perform basic calculations involving fractions and decimals 3.3 Perform basic calculations involving percentages 3.4 Perform basic calculation involving ratio and proportion 3.5 Perform calculations on algebraic expressions	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning
4. Measure workpiece (Basic)	4.1 Select and use measuring instruments 4.2 Clean and store measuring instruments	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning



Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
5. Perform shop computations (Intermediate)	5.1 Perform calculations involving triangles 5.2 Calculate taper	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning
6. Measure workpiece using angular measuring instruments	6.1 Select and use angular measuring tools. 6.2 Maintain angular measuring tools 6.3 Clean and store measuring tools	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning
7. Perform preventive and corrective maintenance	7.1 Perform inspection of machine 7.2 Perform cleaning and lubricating of machine 7.3 Perform minor machine repair and adjustments 7.4 Maintain hand tools	<ul style="list-style-type: none"> • Lecture • Demonstration • Group discussion • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Write basic CNC milling program	1.1 Determine job requirements 1.2 Write basic CNC Milling machine program 1.3 Edit basic CNC Milling machine programs	<ul style="list-style-type: none"> • Lecture • Group Discussion/ interaction 	<ul style="list-style-type: none"> • Observation • Interview • Interview/ Questioning
2. Set-up CNC milling machine, workpiece and cutting tools	2.1 St-up machine and cutting tools 2.2 Download program 2.3 Set-up workpiece 2.4 Dry-run workpiece 2.5 Perform trial cut on workpiece	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning
3 Perform basic CNC milling machine operations	3.1 Mill workpiece 3.2 Check and measure workpiece	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercise 	<ul style="list-style-type: none"> • Demonstration • Observation • Performance test • Interview/ Questioning



3.2 TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery should be guided by the 10 basic principles of competency-based TVET.

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is individualized and self-paced;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and the curriculum modules;
- Assessment is based in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Approved training programs are Nationally Accredited

The competency-based TVET system recognizes various types of delivery modes, both on and off-the-job as long as the learning is driven by the competency standards specified by the industry. The following training modalities may be adopted when designing training programs:

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.
- Modular/self-paced learning is a competency-based training modality wherein the trainee is allowed to progress at his own pace. The trainer just facilitates the training delivery.
- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.
- Supervised industry training or on-the-job training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire specific competencies prescribed in the training regulations.
- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, audio, video or computer technologies.



3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and their educational attainment. Other requirements like health and physical requirements are also stated. Passing entry written entrance examinations may also be indicated if necessary.

- Must be high school graduate
- With good moral character;
- Able to communicate in writing
- Physically and mentally fit ; and
- Must have knowledge and skills in conventional milling machine operation and basic computer operation

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS CNC MILLING MACHINE OPERATION NC II

Recommended list of tools, equipment and materials for the training of 16 trainees for CNC Milling Machine Operation NC II

EQUIPMENT			
QTY	Description	QTY	Description
8 units	3-axis CNC Milling Machine with complete standard accessories	1 unit	OHP/LCD Projector
1 unit	Power Hack saw		

SUPPLIES AND MATERIALS			
QTY	Description	QTY	Description
2 pcs.	Aluminum bar 50x50mm x 5m, T6	2 pcs.	Aluminum bar 50 x100mm x 5m, T6
1 pc.	Aluminum Flat bar 60 x 100mm x 5m, T6	10 kgs.	Rags
16 pcs.	256 mb flash drive	3 boxes	Whiteboard marker Black, Blue and red color
16 pcs.	Paint brush 50 mm width		

TRAINING MATERIALS			
QTY	Description	QTY	Description
8 pcs.	Teachers Guide	6 pcs.	Manuals
16 pcs.	CNC simulation software		Reference books
	Catalogs		Brochures
	Modules/ LEs		CDs/ Video tapes
	Handouts		

TOOLS					
				TRAINING MATERIALS	
QTY	Description	QTY	Description	QTY	DESCRIPTION
8 pcs.	Staggered tooth side cutter dia. 36mm x 5mm	32 pcs .	End Mill 4, 6, 8, 10, 12, 16 mm dia	8 pcs.	Face Mill, 16 x 20 x 40mm dia.
3 sets	Hand Tap M6, M8, M10, M12	8 pcs.	NC start drill 10mm dia.	6 boxes	Drill bit dia.1mm-13mm set
8 pcs. each	Machine tap M3-M6, M8, M10 set	16 pcs.	Center drill # 2	8 pcs.	Slot cutter dia. 16 mm
8 sets	Engraving Tool	8 pcs.	Edge finder	8 sets	Needle File
8 pcs.	Flat File, 2 nd cut, 150 mm	8 pcs.	Rubber mallet	1 set	Letter punch
2 pcs.	Ball peen hammer, 0.5 kgs				

MEASURING INSTRUMENTS					
QTY	Description				
8 pcs.	Vernier caliper (Digital) 150mm	8 pcs.	Micrometer (Digital) 0- 25 mm	8 pcs.	Dial indicator with magnetic stand, lever-type, 0.01 least count
1 pc.	Bevel protractor	1 pc.	Thread pitch gage	1 set	Gage block (optional)
1 pc.	Vernier height gage with dial indicator (optional)				

3.5 TRAINING FACILITIES

CNC LATHE MACHINE OPERATION NC II

The CNC Machining workshop must be of concrete structure for 16 trainees. The space requirements for the teaching/learning and circulation areas are as follows:

SPACE REQUIREMENT	SIZE IN METERS	AREA IN SQ. METERS	TOTAL AREA IN SQ. METERS
• Building (Permanent)	79M x 25M		1,975 sq. M
• CNC Basic Milling workshop	10.0M x 5.5M	55 sq. M	55 sq. M
• CNC Intermediate and Production workshop	7.5M x 11.0M	82.5 sq. M	82.5 sq. M
• Quality Control room	10.0M x 11.0M	110 sq. M	110 sq. M
• Learning Resource Center	5.0M x 5.0M	25 sq. M	25 sq. M
• Audio Visual room	5.0M x 5.0M	25 sq. M	25 sq. M
• Tool Room and Storage	10.0M x 11.0M	110 sq. M	110 sq. M
• Metrology room	7.0M x 11.0M	70 sq. M	70 sq. M

3.6 TRAINER'S QUALIFICATIONS FOR CNC MILLING MACHINE OPERATION NC II

TRAINER QUALIFICATION (TQ III)

- Must be a holder of CNC Milling Machine Operation NC III or equivalent qualification.
- Must have undergone training on Training Methodology II (TM II) or equivalent in training /experience
- Must be computer literate
- Must be physically and mentally fit
- *Must have at least 2 years job/industry experience
- Must be a civil service eligible (for government position or appropriate professional license issued by the Professional Regulatory Commission)

* **Optional. Only when required by the hiring institution.**

Reference: TESDA Board Resolution No. 2004 03

3.7 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their achievement of units of competency. A certificate of achievement is issued for each unit of competency.

SECTION 4: NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

- 4.1 To attain the National Qualification of CNC Milling Machine Operation NC II, the candidate must demonstrate competence in all the units listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.
- 4.2 The qualification of CNC Lathe Milling Machine Operation NC II may be attained through:
 - 4.2.1 Accumulation of Certificates of Competency (COCs) in all the following units of competencies:
 - 4.2.1.1 Write Basic CNC milling machine program
 - 4.2.1.2 Set-up CNC milling machine, workpiece and cutting tools
 - 4.2.1.3 Perform basic CNC milling machine operations

Successful candidates shall be awarded a Certificate of Competency (COC) in each of the core units.
 - 4.2.2 Demonstration of competence through project-type assessment covering all the units required in the qualification.
- 4.3 Accumulation and submission of all COCs acquired for the relevant units of competency comprising a qualification, an individual shall be issued the corresponding National Certificate.
- 4.4 Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.
- 4.5 The following are qualified to apply for assessment and certification:
 - 4.5.1. Graduate of formal, non-formal, and informal including enterprise-based training programs.
 - 4.5.2. Experienced workers (wage employed or self employed)

The guidelines on assessment and certification are discussed in detail in the *“Procedures Manual on Assessment and Certification”* and *“Guidelines on the Implementation of the Philippine TVET Qualification and Certification System (PTQCS)”*.



**Competency Map
Metals and Engineering Sector**

CORE COMPETENCIES	Turn workpiece (Basic)	Turn workpiece (Advanced)	Grind workpiece (Basic)	Grind workpiece (Complex)	Apply CAD/CAM program
	Mill workpiece (Basic)	Mill workpiece (Advanced)	Perform bench work (Basic)	Perform bench work (Complex)	Create drawing using CAD software
	Write basic CNC lathe machine program	Perform basic CNC lathe machine operations	Write advanced CNC Lathe Machine program	Set-up multiple-axis CNC lathe machine, work-piece and cutting tools	Perform advanced CNC Lathe Machine operations
	Write basic CNC milling machine program	Perform basic CNC milling machine operations	Write advanced CNC Milling machine program	Set-up multiple-axis CNC milling machine, work-piece and cutting tools	Perform advanced CNC Milling Machine operation
COMMON COMPETENCIES	Select and cut workshop materials	Perform preventive and corrective maintenance	Perform routine housekeeping	Measure workpiece using gages and comparators	Prepare cost estimates
	Interpret working drawings and sketches	Perform shop computations (Intermediate)	Measure workpiece using angular measuring instruments	Apply safety practices	Perform shop computations (Advanced)
	Receive and respond to workplace communication	Lead in workplace communication	Solve problems related to workplace activities	Utilize specialist communication skills	Collect, analyze and organize information
	Work with others	Lead small teams	Use mathematical concepts and techniques	Develop team and individual	Plan and organize work
BASIC COMPETENCIES	Demonstrate work values	Develop and practice negotiation skills	Use relevant technologies	Apply problem-solving techniques in the workplace	Promote environmental protection
	Practice housekeeping procedures	Practice occupational health and safety procedures			

CNC Milling Machine Operation NC II

Definition of Terms

bench work	the operations incident to the process of laying out, fitting, assembling, etc... when the work is placed on the bench or in a bench vise
boring	is the operation of enlarging a hole by means of an adjustable cutting tool with only one cutting edge
chipping	is the operation of removing/cutting metal using hammer and chisel
counter boring	is the operation of enlarging the end of a hole cylindrically
drilling	is the operation of producing a circular hole by removing solid metal
facing	the lathe operation of finishing the ends of the work, to make the piece the right length. Also known as squaring
grinding	refers to the removal of material from a workpiece with grinding wheel
laying out	term used to include the marking or scribbling of center points, circles, arcs, or straight lines upon metal surfaces, either curved or flat, for the guidance of the worker
milling	refers to removal of metal by feeding a workpiece through the periphery of rotating circular cutter
reaming	is an operation of sizing and finishing a hole by means of a cutting tool having several cutting edges. reaming serves to make the hole smoother, straighter, and more accurate
spot-facing	is the operation of smoothing and squaring the surface around a hole
tapping	is the operation of forming internal threads by means of a tool called tap
turning	refers to shaping a workpiece by gripping it in a workholding device and rotating it under power against a suitable cutting tool
CNC machining	refers to the fabrication of work piece either turning, milling or any other machining process with the use of Computerized Numerically Controlled machine tools
programming	the process of coding machining conditions in which informations such as cutter dimensions, cutter movement , processing orders, federate or spindle speed all under fixed regulation or specified format which refers to the workpiece drawing to instruct Numerically Controlled machine tool
CAD	Computer Aided Design – the use of graphics-oriented computer software for designing and drafting applications
CAM	Computer Aided Manufacturing - computer software that generates programs for the operation of NC (numerical control) machine tools



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