TRAINING REGULATIONS

CAD/CAM OPERATION NC III

METALS AND ENGINEERING SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Superhighway, Taguig City, Metro Manila

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METALS AND ENGINEERING SECTOR

CAD/CAM OPERATION NC III

TRAINING REGULATIONS FOR

CAD/CAM OPERATION NC III

SECTION 1 CAD/CAM OPERATION NC III QUALIFICATION

The CAD/ CAM Operation NC III Qualification consist of competencies that a person must achieve to create drawing using CAD software and apply CAD/CAM program.

The Units of Competency comprising this qualification include the following:

Code No.	BASIC COMPETENCIES
500311109	Lead workplace communication
500311110	Lead small teams
500311111	Develop and practice negotiation skills
500311112	Solve problems related to work activities
500311113	Use mathematical concepts and techniques
500311114	Use relevant technologies

Code No.	COMMON COMPETENCIES
MEE722201	Apply safety practices
MEE722202	Interpret working drawings and sketches
MEE722203	Select/ cut workshop materials
MEE722204	Perform shop computations (Basic)
MEE722205	Measure workpiece (Basic)
MEE722206	Perform routine housekeeping
MEE722207	Perform shop computations (Intermediate)
MEE722208	Measure workpiece using angular measuring instruments
MEE 722209	Perform shop computations (Advanced)
MEE722210	Measure workpiece using gages and surface texture comparator
MEE722211	Perform preventive and corrective maintenance
ICT311201	Operate a personal computer

Code No.	CORE COMPETENCIES
MEE312301	Create drawing using CAD software
MEE821313	Apply CAD/CAM program

A person who has achieved this qualification is competent to be:
- CAD Operator
- CAD/CAM Operator

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in CAD/CAM OPERATION NC III.

BASIC COMPETENCIES

UNIT OF COMPETENCY : LEAD WORKPLACE COMMUNICATION

UNIT CODE : 500311109

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Communicate information about workplace processes	1.1. Appropriate ***communication method*** is selected 1.2. Multiple operations involving several topics areas are communicated accordingly 1.3. Questions are used to gain extra information 1.4. Correct sources of information are identified 1.5. Information is selected and organized correctly 1.6. Verbal and written reporting is undertaken when required 1.7. Communication skills are maintained in all situations
2. Lead workplace discussions	2.1. Response to workplace issues are sought 2.2. Response to workplace issues are provided immediately 2.3. Constructive contributions are made to workplace discussions on such issues as production, quality and safety 2.4. Goals/objectives and action plan undertaken in the workplace are communicated
3. Identify and communicate issues arising in the workplace	3.1. Issues and problems are identified as they arise 3.2. Information regarding problems and issues are organized coherently to ensure clear and effective communication 3.3. Dialogue is initiated with appropriate personnel 3.4. Communication problems and issues are raised as they arise

RANGE OF VARIABLES

VARIABLE	RANGE
1. Methods of communication	1.1. Non-verbal gestures 1.2. Verbal 1.3. Face to face 1.4. Two-way radio 1.5. Speaking to groups 1.6. Using telephone 1.7. Written 1.8. Internet

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate*:* 1.1. Dealt with a range of communication/information at one time 1.2. Made constructive contributions in workplace issues 1.3. Sought workplace issues effectively 1.4. Responded to workplace issues promptly 1.5. Presented information clearly and effectively written form 1.6. Used appropriate sources of information 1.7. Asked appropriate questions 1.8. Provided accurate information
2. Underpinning knowledge	2.1. Organization requirements for written and electronic communication methods 2.2. Effective verbal communication methods
3. Underpinning Skills	3.1. Organize information 3.2. Understand and convey intended meaning 3.3. Participate in variety of workplace discussions 3.4. Comply with organization requirements for the use of written and electronic communication methods
4. Resource Implications	The following resources **MUST** be provided: 4.1. Variety of Information 4.2. Communication tools 4.3. Simulated workplace
5. Method of Assessment	Competency may be assessed through: 5.1. Direct Observation 5.2. Interview
6. Context for Assessment	Competency may be assessed in the workplace or in simulated workplace environment

UNIT OF COMPETENCY : LEAD SMALL TEAMS

UNIT CODE : 500311110

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Provide team leadership	1.1. ***Work requirements*** are identified and presented to team members 1.2. Reasons for instructions and requirements are communicated to team members 1.3. ***Team members' queries and concerns*** are recognized, discussed and dealt with
2. Assign responsibilities	2.1. Duties, and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task and according to company policy 2.2. Duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible
3. Set performance expectations for team members	3.1. Performance expectations are established based on client needs and according to assignment requirements 3.2. Performance expectations are based on individual team members duties and area of responsibility 3.3. Performance expectations are discussed and disseminated to individual team members
4. Supervised team performance	4.1. ***Monitoring of performance*** takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2. Team members are provided with *feedback*, positive support and advice on strategies to overcome any deficiencies 4.3. ***Performance issues*** which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy 4.4. Team members are kept informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and satisfaction 4.5. Team operations are monitored to ensure that employer/client needs and requirements are met 4.6. Follow-up communication is provided on all issues affecting the team 4.7. All relevant documentation is completed in accordance with company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work requirements	1.1. Client Profile 1.2. Assignment instructions
2. Team member's concerns	2.1. Roster/shift details
3. Monitor performance	3.1. Formal process 3.2. Informal process
4. Feedback	4.1. Formal process 4.2. Informal process
5. Performance issues	5.1. Work output 5.2. Work quality 5.3. Team participation 5.4. Compliance with workplace protocols 5.5. Safety 5.6. Customer service

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Maintained or improved individuals and/or team performance given a variety of possible scenario 1.2. Assessed and monitored team and individual performance against set criteria 1.3. Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf 1.4. Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed 1.5. Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members
2. Underpinning Knowledge	2.1. Company policies and procedures 2.2. Relevant legal requirements 2.3. How performance expectations are set 2.4. Methods of Monitoring Performance 2.5. Client expectations 2.6. Team member's duties and responsibilities
3. Underpinning Skills	3.1. Communication skills required for leading teams 3.2. Informal performance counseling skills 3.3. Team building skills 3.4. Negotiating skills
4. Resource Implications	The following resources **MUST** be provided: 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or task
5. Method of Assessment	Competency may be assessed through: 5.1. Direct observations of work activities 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
6. Context for Assessment	6.1. Competency assessment may occur in workplace or any appropriately simulated environment 6.2. Assessment shall be observed while task are being undertaken whether individually or in-group

UNIT OF COMPETENCY: DEVELOP AND PRACTICE NEGOTIATION SKILLS

UNIT CODE : 500311111

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on ***preparing for negotiation*** is identified and included in the plan 1.2 Information on creating ***non verbal environments*** for positive negotiating is identified and included in the plan 1.3 Information on ***active listening*** is identified and included in the plan 1.4 Information on different ***questioning techniques*** is identified and included in the plan 1.5 Information is checked to ensure it is correct and up-to- date
2. Participate in negotiations	2.1 Criteria for successful outcome are agreed upon by all parties 2.2 Desired outcome of all parties are considered 2.3 Appropriate language is used throughout the negotiation 2.4 A variety of questioning techniques are used 2.5 The issues and processes are documented and agreed upon by all parties 2.6 Possible solutions are discussed and their viability assessed 2.7 Areas for agreement are confirmed and recorded 2.8 Follow-up action is agreed upon by all parties

RANGE OF VARIABLES

VARIABLE	RANGE
1. Preparing for negotiation	1.1 Background information on other parties to the negotiation 1.2 Good understanding of topic to be negotiated 1.3 Clear understanding of desired outcome/s 1.4 Personal attributes 1.4.1 self awareness 1.4.2 self esteem 1.4.3 objectivity 1.4.4 empathy 1.4.5 respect for others 1.5 Interpersonal skills 1.5.1 listening/reflecting 1.5.2 non verbal communication 1.5.3 assertiveness 1.5.4 behavior labeling 1.5.5 testing understanding 1.5.6 seeking information 1.5.7 self disclosing 1.6 Analytic skills 1.6.1 observing differences between content and process 1.6.2 identifying bargaining information 1.6.3 applying strategies to manage process 1.6.4 applying steps in negotiating process 1.6.5 strategies to manage conflict 1.6.6 steps in negotiating process 1.6.7 options within organization and externally for resolving conflict
2. Non verbal environments	2.1 Friendly reception 2.2 Warm and welcoming room 2.3 Refreshments offered 2.4 Lead in conversation before negotiation begins
3. Active listening	3.1 Attentive 3.2 Don't interrupt 3.3 Good posture 3.4 Maintain eye contact 3.5 Reflective listening
4. Questioning techniques	4.1 Direct 4.2 Indirect 4.3 Open-ended

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome 1.2 Participated in negotiation with at least one person to achieve an agreed outcome
2. Underpinning Knowledge and Attitude	2.1 Codes of practice and guidelines for the organization 2.2 Organizations policy and procedures for negotiations 2.3 Decision making and conflict resolution strategies procedures 2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation 2.5 Flexibility 2.6 Empathy
3. Underpinning Skills	3.1 Interpersonal skills to develop rapport with other parties 3.2 Communication skills (verbal and listening) 3.3 Observation skills 3.1 Negotiation skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Room with facilities necessary for the negotiation process 4.2 Human resources (negotiators)
5. Methods of Assessment	Competency may be assessed through: 5.1 Observation/demonstration and questioning 5.2 Portfolio assessment 5.3 Oral and written questioning 5.4 Third party report
6. Context for Assessment	Competency to be assessed in real work environment or in a simulated workplace setting.

UNIT OF COMPETENCY : SOLVE PROBLEMS RELATED TO WORK ACTIVITIES

UNIT CODE : 500311112

UNIT DESCRIPTOR : This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Identify the problem	1.1. Variances are identified from normal operating parameters; and product quality 1.2. Extent, cause and nature are of the problem are defined through observation, investigation and ***analytical techniques*** 1.3. ***Problems*** are clearly stated and specified
2. Determine fundamental causes of the problem	2.1. Possible causes are identified based on experience and the use of problem solving tools / analytical techniques. 2.2. Possible cause statements are developed based on findings 2.3. Fundamental causes are identified per results of investigation conducted
3. Determine corrective action	3.1. All possible options are considered for resolution of the problem 3.2. Strengths and weaknesses of possible options are considered 3.3. Corrective actions are determined to resolve the problem and possible future causes 3.4. **Action *plans*** are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures
4. Provide recommendation/s to manager	4.1. Report on recommendations are prepared 4.2. Recommendations are presented to appropriate personnel. 4.3. Recommendations are followed-up, if required

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	1.1. Brainstorming 1.2. Intuitions/Logic 1.3. Cause and effect diagrams 1.4. Pareto analysis 1.5. SWOT analysis 1.6. Gant chart, Pert CPM and graphs 1.7. Scattergrams
2. Problem	2.1. Non – routine process and quality problems 2.2. Equipment selection, availability and failure 2.3. Teamwork and work allocation problem 2.4. Safety and emergency situations and incidents
3. Action plans	3.1. Priority requirements 3.2. Measurable objectives 3.3. Resource requirements 3.4. Timelines 3.5. Co-ordination and feedback requirements 3.6. Safety requirements 3.7. Risk assessment 3.8. Environmental requirements

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Identified the problem 1.2. Determined the fundamental causes of the problem 1.3. Determined the correct / preventive action 1.4. Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Underpinning Knowledge	2.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 2.2.1. Relevant equipment and operational processes 2.2.2. Enterprise goals, targets and measures 2.2.3. Enterprise quality, OHS and environmental requirement 2.2.4. Principles of decision making strategies and techniques 2.2.5. Enterprise information systems and data collation 2.2.6. Industry codes and standards
3. Underpinning Skills	3.1. Using range of formal problem solving techniques 3.2. Identifying and clarifying the nature of the problem 3.3. Devising the best solution 3.4. Evaluating the solution 3.5. Implementation of a developed plan to rectify the problem
4. Resource Implications	Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios / case studies / what ifs will be required as well as bank of questions which will be used to probe the reason behind the observable action.
5. Method of Assessment	Competency may be assessed through: 5.1. Case studies on solving problems in the workplace 5.2. Observation The unit will be assessed in a holistic manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation. Simulation may be required to allow for timely assessment of parts of this unit of competency. Simulation should be based on the actual workplace and will include walk through of the relevant competency components.
6. Context for Assessment	In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units.

UNIT OF COMPETENCY: **USE MATHEMATICAL CONCEPTS AND TECHNIQUES**

UNIT CODE : **500311113**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required in the application of mathematical concepts and techniques.

ELEMENT	Performance Criteria ***Italicized terms*** are elaborated in the Range of Variables
1. Identify mathematical tools and techniques to solve problem	1.1 Problem areas are identified based on given condition 1.2 ***Mathematical techniques*** are selected based on the given problem
2. Apply mathematical procedure/solution	2.1 Mathematical techniques are applied based on the problem identified 2.2 Mathematical computations are performed to the level of accuracy required for the problem 2.3 Results of mathematical computation is determined and verified based on job requirements
3. Analyze results	3.1 Result of application is reviewed based on expected and required specifications and outcome 3.2 ***Appropriate action*** is applied in case of error

RANGE OF VARIABLES

VARIABLE	RANGE
1. Mathematical techniques	May include but are not limited to: 1.1 Four fundamental operations 1.2 Measurements 1.3 Use/Conversion of units of measurements 1.4 Use of standard formulas
2. Appropriate action	2.1 Review in the use of mathematical techniques (e.g. recalculation, re-modeling) 2.2 Report error to immediate superior for proper action

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate identified, applied and reviewed the use of mathematical concepts and techniques to workplace problems
2. Underpinning Knowledge	2.1 Fundamental operation (addition, subtraction, division, multiplication) 2.2 Measurement system 2.3 Precision and accuracy 2.4 Basic measuring tools/devices
3. Underpinning Skills	3.1 Applying mathematical computations 3.2 Using calculator 3.3 Using different measuring tools
4. Resource Implications	The following resources **MUST** be provided: 4.1 Calculator 4.2 Basic measuring tools 4.3 Case Problems
5. Method of Assessment	Competency may be assessed through: 5.1 Authenticated portfolio 5.2 Written Test 5.3 Interview/Oral Questioning 5.4 Demonstration
6. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: USE RELEVANT TECHNOLOGIES

UNIT CODE : 500311114

UNIT DESCRIPTOR : This unit of competency covers the knowledge, skills, and attitude required in selecting, sourcing and applying appropriate and affordable technologies in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Study/select appropriate technology	1.1 Usage of different ***technologies*** is determined based on job requirements 1.2 Appropriate technology is selected as per work specification
2. Apply relevant technology	2.1 Relevant technology is effectively used in carrying out function 2.2 Applicable software and hardware are used as per task requirement 2.3 ***Management concepts*** are observed and practiced as per established industry practices
3. Maintain/enhance ~~of~~ relevant technology	3.1 Maintenance of technology is applied in accordance with the ***industry standard operating procedure***, ***manufacturer's operating guidelines*** and ***occupational health and safety procedure*** to ensure its operative ability 3.2 Updating of technology is maintained through continuing education or training in accordance with job requirement 3.3 Technology failure/ defect is immediately reported to the concern/responsible person or section for ***appropriate action***

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technology	May include but are not limited to: 1.1 Office technology 1.2 Industrial technology 1.3 System technology 1.4 Information technology 1.5 Training technology
2. Management concepts	May include but not limited to: 2.1 Real Time Management 2.2 KAIZEN or continuous improvement 2.3 5s 2.4 Total Quality Management 2.5 Other management/productivity tools
3. Industry standard operating procedure	3.1 Written guidelines relative to the usage of office technology/equipment 3.2 Verbal advise/instruction from the co-worker
4. Manufacturer's operating guidelines/ instructions	4.1 Written instruction/manuals of specific technology/ equipment 4.2 General instruction manual 4.3 Verbal advise from manufacturer relative to the operation of equipment
5. Occupational health and safety procedure	5.1 Relevant statutes on OHS 5.2 Company guidelines in using technology/equipment
6. Appropriate action	6.1 Implementing preventive maintenance schedule 6.2 Coordinating with manufacturer's technician

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Studied and selected appropriate technology consistent with work requirements 1.2 Applied relevant technology 1.3 Maintained and enhanced operative ability of relevant technology
2. Underpinning Knowledge	2.1 Awareness on technology and its function 2.2 Repair and maintenance procedure 2.3 Operating instructions 2.4 Applicable software 2.5 Communication techniques 2.6 Health and safety procedure 2.7 Company policy in relation to relevant technology 2.8 Different management concepts 2.9 Technology adaptability
3. Underpinning Skills	3.1 Relevant technology application/implementation 3.2 Basic communication skills 3.3 Software applications skills 3.4 Basic troubleshooting skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Relevant technology 4.2 Interview and demonstration questionnaires 4.3 Assessment packages
5. Method of Assessment	Competency may be assessed through: 5.1 Interview 5.2 Actual demonstration 5.3 Authenticated portfolio (related certificates of training/seminar)
6. Context for Assessment	Competency may be assessed in actual workplace or simulated environment

COMMON COMPETENCIES

UNIT OF COMPETENCY: APPLY SAFETY PRACTICES

UNIT CODE: MEE722201

UNIT DESCRIPTOR: This unit covers the competencies required to apply safety practices in the workplace.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Identify hazards	1.1 ***Hazards*** are identified correctly in accordance with OHS principles. 1.2 Safety signs and symbols are identified and adhered to.
2. Use protective clothing and devices	2.1 Appropriate ***protective clothing and devices*** correctly selected and used in accordance with OHS requirements or industry/company policy
3. Perform safe handling of tools, equipment and materials	3.1 Safety procedures for pre-use check and operation of tools and equipment followed in accordance with industry/ company policies. 3.2 Tools, equipment and materials handled safely in accordance with OHS requirements and industry/ company policies.
4. Perform first aid	4.1 First aid treatment of ***injuries*** are carried out according to recommended procedures
5. Use fire extinguisher	5.1 Fire extinguisher selected and operated correctly according to the ***type of fire***.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hazards	1.1 Cluttered tools and materials 1.2 Slippery floors (caused by oil, grease or any liquid) 1.3 Exposed electrical wires 1.4 Sharp edges 1.5 Machine without guards or with exposed moving parts 1.6 Uncollected chips or other wastes etc.
2. Protective clothing and devices	Protective clothing and devices may include but is not limited to: 2.1 safety glasses/goggles 2.2 safety shoes 2.3 overalls 2.4 cap
3. Injuries	Injuries may include: 3.1 burns/scalds 3.2 fractures 3.3 cuts and abrasions 3.4 poisoning 3.5 foreign bodies in the eye 3.6 concussion 3.7 shock
4. Type of fires	Fires involving or caused by: 4.1 common combustibles (wood, cloth, paper, rubber and plastic) 4.2 flammable liquids (gasoline, oil, solvents, paints, etc.) 4.3 energized electrical equipment (wiring, fuse boxes, circuit breakers, appliances, etc. 4.4 combustible metals (magnesium, sodium, etc.)

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 identified hazardous area 1.2 used protective clothing and devices 1.3 handled tools, equipment and materials properly 1.4 performed first aid 1.5 used fire extinguisher
2. Underpinning knowledge and attitude	2.1 Shop safety signs, symbols and alarms 2.2 Safety precautionary measures 2.3 Housekeeping 2.4 Machine tools 2.5 First aid 2.6 Engineering materials 2.7 Fire extinguishers
3. Underpinning skills	3.1 Operating machine tools 3.2 Handling tools and materials 3.3 Communicating with superiors and co-workers 3.4 Interpreting instructions
4. Resource implications	The following resources **MUST** 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	Competency may be assessed through: 5.1 Demonstration 5.2 Written or oral short answer questions 5.3 Practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

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.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized 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 ***drawing*.** 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 Instructions included in sketch are clear and correct. 2.5 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 Competency	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 **MUST** 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	Competency may be assessed through: 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

ELEMENTS	PERFORMANCE CRITERIA ***Italicized 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 Competency	Assessment requires evidence that the candidate: 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	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Safe handling of tools, equipment and materials 2.2 Blueprint reading 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Assembly and details of drawing 2.2.3 Dimensions 2.3 Measurement 2.3.1 Linear measuring tools 2.4 Materials and related science 2.4.1 Classification and mechanical properties of engineering materials
3. Underpinning skills	3.1 Selecting materials 3.2 Using measuring tools 3.3 Operating power hacksaw
4. Resource implications	The following resources **MUST** be provided: 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	Competency may be assessed through: 5.1 Direct observation 5.2 Oral short answer question 5.3 Practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated work environment

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.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized 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 Competency	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	English and metric system of measurements
3. Underpinning skills	Performing calculations using pen and paper or on a calculator
4. Resource implications	The following resources **MUST** 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	Competency may be assessed through: 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….

ELEMENTS	PERFORMANCE CRITERIA ***Italicized 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 competency	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 **MUST** 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	Competency may be assessed through: 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 ROUTINE HOUSEKEEPING

UNIT CODE: MEE722206

UNIT DESCRIPTOR: This unit covers the competencies required to maintain an organized and clean work area.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Organize work area	1.1 Work area maintained in a safe, uncluttered and organized manner according to ***workshop policy***. 1.2 All tasks carried out safely, effectively and efficiently with minimum inconvenience according to workshop policy. 1.3 Workshop policies and procedures for tidying work areas and placing items in designated areas applied.
2. Clean work area	2.1 Shop policies and procedures applied for cleaning ***work area.*** 2.2 Wastes promptly removed and disposed of according to shop policies and environmental requirements. 2.3 Spills, wastes and other potential hazards reported to appropriate personnel and removed according to shop policies and environmental requirements. 2.4 Signage promptly displayed in regard to unsafe areas. 2.5 Consumable materials maintained and stored correctly after use. 2.6 ***Tools and equipment*** (including guards) cleaned and used in accordance with manufacturer's instructions.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Workshop policy	Shop policy and procedure in regard to: 1.1 Housekeeping practices 1.2 Maintenance and storage of cleaning equipment 1.3 Use and storage of cleaning chemicals
2. Work area	Work area may include: 2.1 Work benches 2.2 Walkways and aisles 2.3 Fixtures and other working surfaces
3. Tools and Equipment	Equipment and tools may include: 3.1 Drill Press 3.2 Pedestal Grinder 3.3 Surface plate 3.4 Layout and marking tools 3.5 Cutting tools (hacksaw, chisel, files) 3.6 Inspection and measuring tools (templates, vernier caliper, micrometer, straight edge, gages, etc…)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate organized and cleaned work area according shop policies and environmental requirements.
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.2 Machine shop equipment 2.3 Shop policies regulations 2.4 5-S 2.5 Shop cleaning equipment
3. Underpinning skills	3.1 Using and storing of cleaning equipment 3.2 Using and storing chemicals, hazardous substances and flammable liquids 3.3 Literacy and numeracy skills in reading and understanding labels and instructions for the handling and use of chemicals and hazardous substances 3.4 Communication skills 3.5 Organizing skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials and documentation relevant to the proposed activity 4.3 Shop policy and/or procedures manual on housekeeping, cleaning and occupational health and safety
5. Method of assessment	Competency may be assessed through: 5.1 direct observation 5.2 demonstration or role play 5.3 written or oral short answer questions 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
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.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Perform calculations involving triangles	1.1 Problems involving right triangles are performed using the ***trigonometric functions***. 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 competency	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	3.1 Performing calculations using pen and paper or on a calculator
4. Resource implications	The following resources **MUST** 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	Competency may be assessed through: 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.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized 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 competency	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	2.1 Types, purposes and accuracy of angular measuring instruments 2.2 Capability of measuring tools 2.3 Techniques for measuring angles and tapers 2.4 Care and storage procedure of measuring tools
3. Underpinning skills	3.1 Safe handling of measuring tools and materials 3.2 Reading vernier scale 3.3 Reading micrometer
4. Resource implications	The following resources **MUST** 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	Competency may be assessed through: 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 (ADVANCED)

UNIT CODE: MEE722209

UNIT DESCRIPTOR: This unit covers the competencies required to perform calculation involving gear ratio, indexing problems and gearing problems.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Calculate gear ratio	1.1 ***Gear ratio*** calculated using appropriate formula
2. Solve indexing problems	2.1 ***Indexing*** problems involving number of turns, spaces and circle plate are solved using appropriate formula
3. Solve gearing problems	3.1 Gearing problems are solved using appropriate formula
4. Use geometrical principles in the solution of problems	4.1 Solution to problems is obtained by applying geometrical properties of angles, triangles and circles in the calculation.

RANGE OF VARIABLES

VARIABLE	RANGE
1. gear ratio	1.1 addendum 1.2 clearance 1.3 dedendum 1.4 diametral pitch 1.5 module 1.6 outside diameter 1.7 pitch diameter 1.8 root diameter 1.9 number of teeth etc.
2. indexing	2.1 direct indexing 2.2 simple indexing 2.3 compound indexing 2.4 differential indexing

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate performed calculations: 1.1 involving gear ratio 1.2 involving indexing problems 1.3 involving gearing problems 1.4 involving geometrical properties of angles, triangles and circles
2. Underpinning knowledge and attitude	2.1 English and metric system of measurements 2.2 Geometrical shapes 2.3 Gear types
3. Underpinning skills	3.1 Performing calculations using pen and paper or on a calculator 3.2 Reading and interpreting working drawings
4. Resource implications	The following resources **MUST** 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	Competency may be assessed through: 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 GAGES AND SURFACE TEXTURE COMPARATOR

UNIT CODE: MEE722210

UNIT DESCRIPTOR: This unit covers the competencies required to measure workpieces using fixed and adjustable gages.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Select and use fixed and adjustable gages	1.1 Appropriate ***gages*** are selected and used to undertake the required comparison or measurement using standard operating procedures. 1.2 Consistent and accurate ***measurements*** obtained conforms to drawing specification 1.3 Measuring technique used is correct and appropriate to the device used.
2. Perform surface texture measurements	2.1 Surface texture are measured according worksite procedures. 2.2 Measurements taken are within the level of accuracy required.
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. Gages	Fixed and adjustable gages include: 1.1 Gage blocks 1.2 Telescoping gages 1.3 Center gages 1.4 Thread gages 1.5 Dial bore gages 1.6 Height gages 1.7 Radius gages 1.8 Go-no-go gages 1.9 Depth gages
2. Measurements	Measurements undertaken may include: 2.1 Linear dimensions 2.2 Diameters 2.3 Depths 2.4 Fits 2.5 Tapers 2.6 Threads 2.7 Radius 2.8 Squareness 2.9 Surface texture etc

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Selected and used fixed and adjustable gages 1.2 Performed surface texture measurements 1.3 Cleaned and stored measuring instruments
2. Underpinning knowledge	2.1 Types and application of fixed and adjustable gages 2.2 Gage limits and accuracy 2.3 Techniques for measuring components 2.4 Care and storage procedure of measuring tools
3. Underpinning skills	3.1 Safe handling of measuring tools and materials 3.2 Verifying measurements with drawing specifications
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to the activity 4.2 Specimen component or part to the proposed activity 4.3 Drawing
5. Method of assessment	Competency may be assessed through: 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 CORRECTIVE MAINTENANCE

UNIT CODE: MEE722211

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

ELEMENTS	PERFORMANCE CRITERIA ***Italicized 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 recorded on proforma or reported orally according to worksite procedure.
2. Perform cleaning and lubricating of machine	2.1 ***Machines*** lubricated as per manufacturer's recommendation using appropriate ***tools and materials*** 2.2 Fluids and lubricants replaced and/or topped up according to prescribed schedule.
3. Perform minor machine repair and adjustments	3.1 Minor machine repairs performed according to manufacturer's instruction or worksite procedures. 3.2 Machine moving parts adjusted to manufacturer's specifications.
4. Maintain hand tools	4.1 Tool cutting ground to recommended specifications 4.2 Hand tools lubricated and stored according to prescribed procedure .

RANGE OF VARIABLES

VARIABLES	RANGE
1. Inspected	Inspected machine parts include: 1.1 V-belt 1.2 Bearing 1.3 Gears 1.4 Clutch 1.5 Drive pulley
2. Machines	Machine include but not limited to: 2.1 Lathe machine 2.2 Milling machine 2.3 Grinding machine
2. Tools and materials	Tools and materials used include: 3.1 Lubricants 3.2 Oil can 3.3 Grease gun 3.4 Oil 3.5 Coolant or compound

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that that the candidate: 1.1 Performed inspection of machine 1.2 Performed cleaning and lubricating of machine 1.3 Performed minor machine repairs and adjustments
2. Underpinning knowledge	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 Location of main switches of the machine 2.7 Handling and storage of tools 2.8 Checklist of safe working conditions 2.9 Procedures in cleaning and disposal of waste materials
3. Underpinning skills	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 odor of 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.
4. Resource Implications	The following resources **MUST** 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	Competency **may** be assessed through: 5.1 direct observation of activities 5.2 oral or written questioning
6. Context for Assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT TITLE	:	**OPERATE A PERSONAL COMPUTER**
UNIT CODE	:	ICT311201
UNIT DESCRIPTOR	:	This unit defines the competency required to operate a personal computer by: starting the PC, logging in, using and working with files, folders and programs, saving work, and closing down the PC.

ELEMENT	**PERFORMANCE CRITERIA** ***Italicized Bold*** terms are elaborated in the Range of Variables
1. Start the computer	1.1 The ***peripheral devices*** are properly connected 1.2 Power is checked and the ***computer*** and peripheral devices are switched on 1.3 Proper logging in and logging off is successfully done 1.4 The ***operating system*** features and functions are accessed and navigated 1.5 Hardware configuration and other ***system features*** are checked
2. Arrange and customize desktop display/ Windows settings	2.1 The desktop screen or Windows elements are changed as needed 2.2 Desktop icons are added, renamed, moved, copied or deleted 2.3 The ***online help functions*** are accessed or used as needed 2.4 Desktop icons of ***application programs*** are selected, opened and closed 2.5 ***Properties*** of icons are displayed 2.6 Computer or desktop settings are saved and restored
3. Work with files and folders (or directories)	3.1 A file or folder is created, opened, moved, renamed or copied 3.2 Files are located, deleted and restored 3.3 Details and properties of files and folders are displayed or viewed 3.4 ***Various files*** are organized for easy lookup and use 3.5 Files and information are searched 3.6 ***Disks*** are checked, erased or formatted as necessary
4. Work with user application programs	4.1 ***Application programs*** are added, changed, removed or ran 4.2 User software or application program are installed, updated and upgraded 4.3 Information/data are moved between documents or files
5. Print information	5.1 Printer is added or installed and correct ***printer settings*** is ensured 5.2 Default printer is assigned accordingly 5.3 Information or document is printed on the installed printer 5.4 Progress of print jobs are viewed and deleted as required
6. Shut down computer	6.1 All open application programs are closed 6.2 Computer and peripheral devices are properly shut down

RANGE OF VARIABLES

VARIABLE	RANGE
1. Peripheral device	This may include but is not limited to: 1.1 mouse 1.2 keyboard 1.3 monitor or visual display unit 1.4 printer 1.5 scanner
2. Computer	May include: 2.1 Laptops/notebooks 2.2 Workstations 2.3 Servers 2.4 other personal computer devices
3. Application programs	Can include: 3.1 user programs 3.2 database programs 3.3 word processors 3.4 email programs 3.5 Internet browsers 3.6 system browsers 3.7 spreadsheets
4. Operating system	May include but is not limited to the various versions and variants of: 4.1 Windows 4.2 NT 4.3 Mac OS 4.4 Linux 4.5 Solaris 4.6 Unix
5. System features	May include but is not limited to the operating system features and hardware features like: 5.1 memory size 5.2 disk capacities 5.3 video cards 5.4 USBs 5.5 Modems 5.6 1394 and LAN connectors 5.7 SD and PC cards 5.8 wireless and infrared connections.

VARIABLE	RANGE
6. Online help functions	6.1 An instruction manual, or a portion of the manual, integrated and accessible from within the program or software being used.
7. Properties	Indicates the description of the file or folder to include the: 7.1 file name 7.2 type of file 7.3 file size 7.4 date created and modified 7.5 attributes (hidden, read-only).
8. Various files	8.1 Documents 8.2 Records 8.3 Pictures 8.4 Music 8.5 Video
9. Disks	May include but is not limited to: 9.1 Floppy disks 9.2 CDs 9.3 CD-RW (Compact discs-Read/Write) 9.4 DVD RW 9.5 zip disks 9.6 flash drives 9.7 memory sticks 9.8 hard drives
10. Printer settings	The properties of the printer that enables it to work includes: 10.1 page layout 10.2 paper size 10.3 ink/cartridge type 10.4 number of copies 10.5 page orientation.

EVIDENCE GUIDE

1. Critical aspects of Competency	1.1 Assessment must confirm the ability to utilize software, navigate the desktop, using system features to perform tasks and save results of work.
2. Underpinning Knowledge	Knowledge includes: 2.1 Keyboard layout and functions 2.2 Computer functions 2.3 Basic parts of a computer and various hardware components 2.4 Storage devices and file concepts 2.5 Basic software operation and functionalities
3. Underpinning Skills	Skills include: 3.1 Saving and retrieving files to and from various folders or disk storage 3.2 Mouse and keyboarding skills for running software applications 3.3 Reading and writing at a level where basic workplace documents are understood 3.4 Clear ability to communicate with peers and supervisors 3.5 Interpretation of user manuals and help functions 3.6 The ability to carry out written and verbal instructions using a personal computer whether standalone or in a networked environment
4. Resource Implications	To demonstrate competence in this unit access to the following resources will be required: 4.1 A personal computer 4.2 A printer 4.3 Mouse and keyboard 4.4 Basic systems software
5. Methods of Assessment	Competency may be assessed through: 5.1 Observation in a workplace or simulated environment 5.2 Third party reports 5.3 Exams and tests 5.4 Demonstration of required skills 5.5 Interviews
6. Context for Assessment	6.1 Competency may be assessed in the workplace or in a simulated work environment.

CORE COMPETENCIES

UNIT OF COMPETENCY : **CREATE DRAWING USING CAD SOFTWARE**

UNIT CODE : **MEE312301**

UNIT DESCRIPTOR : This unit covers the skills required to create drawing using CAD. It details the requirements for creating drawings with the aid of computer software (CAD).

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Determine job requirements	1.1 ***Instructions and relevant materials*** are gathered and understood to produce CAD drawing.
2. Prepare the CAD environment	2.1 All relevant manuals, instructions and operating procedures for the CAD software are obtained in accordance with workplace procedures. 2.2 The CAD package is booted up in accordance with workplace procedures. 2.3 Screen display areas and ***basic parameters*** are set in accordance with instructions.
3. Produce basic drawing	3.1 ***Basic CAD drawings*** are created and guidance is sought as required. 3.2 Drawings are prepared in accordance with the existing standard. 3.3 CAD drawings are reviewed by ***concerned person*** in accordance with company procedures. 3.4 Reviewed CAD drawings are modified, if necessary.
4. Save and print drawing	4.1 Drawing files are saved in the designated folder in accordance with standard operating procedures. 4.2 Drawing files are ***printed*** out in accordance with standard operating procedures. 4.3 Programs and computer are shut-down in accordance with workplace procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Instructions and relevant materials	1.1 Instructions 1.2 Sample product/workpiece 1.3 Drawings and/or sketches 1.4 concept
2. Basic Parameters	May include but are not limited to the following: 1.1 Layer or level 1.2 Line types 1.3 Line width 1.4 Color and text format
3. Basic CAD Drawings	May include the following characteristics 2.1 lines 2.2 arcs 2.3 circles 2.4 polygons 2.5 ellipses 2.6 hatching or filling of areas 2.7 text dimensions 2.8 tangents
4. Concerned person	4.1 Supervisor 4.2 Designer 4.3 Draftsman 4.4 Production supervisor 4.5 Engineer 4.6 Customer
5. Printed	Drawing are printed using : 5.1 printers 5.2 plotters

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 prepared the CAD environment 1.3 produced basic drawing 1.4 saved and printed drawing
2. Underpinning knowledge and attitude	2.1 Computer hardware safety practices 2.1.1 Correct voltage supply to computer equipment 2.1.2 Use of voltage regulator and surge protector 2.1.3 Start up and shutdown procedures 2.1.4 Implementation of Housekeeping(5S) 2.1.5 Application of First-aid 2.1.7 Use of fire extinguishers 2.2 Drawing interpretation 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Orthographic projection (1st and 3rd angle) 2.2.3 Perspective 2.2.3.1 isometric 2.2.3.2 dimetric 2.2.3.3 cavalier 2.2.3.4 militar 2.2.4 Sections 2.2.4.1 full section 2.2.4.2 half section 2.2.4.3 partial or local section 2.2.4.4 revolve section 2.2.4.5 assembly and detailed drawings 2.2.5 Dimensioning 2.2.5.1 part dimension 2.2.5.2 location dimension 2.2.5.3 dimensioning techniques 2.2.6 Tolerances 2.2.6.1 bilateral tolerance 2.2.6.2 unilateral tolerance 2.2.6.3 ISO system of tolerance for hole and shaft 2.2.6.4 general tolerance 2.2.6.5 Geometrical Tolerances (form and position) 2.2.7 Surface condition (surface finish/texture) 2.2.8 Limits and fits 2.2.8.1 classification of fits 2.2.8.2 hole basis system of fits 2.2.8.3 shaft basis system of fits 2.3 Shop mathematics 2.3.1 Four fundamental operation 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Square and square root of numbers 2.3.5 Pythagorean theorem 2.2.6 Basic trigonometric function

	2.4 Use of Personal Computer Hard and Software 2.4.1 Windows operation 2.4.2 Connection to peripherals (Printer, plotter) 2.4.3 Printing and plotting operations 2.4.4 File management 2.5 Safe Computer Practices 2.5.1 Backing up files 2.5.2 Scanning for viruses 2.6 Knowledge in Mechanical drawing
3. Underpinning skills	3.1 Drafting skills 3.2 Communication skills
4. Resource implications	The following resources must be provided: 4.1 Computer equipment, printer/plotter, software and facilities appropriate to processes or activities 4.2 Sample part/model 4.3 Measuring instruments 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency must be assessed through: 5.1 Direct observation / demonstration of creation of 2D & 3D CAD drawings 5.2 Written exam 5.3 Demonstration
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY : **APPLY CAD/CAM PROGRAM**

UNIT CODE : **MEE821313**

UNIT DESCRIPTOR : This unit covers the outcomes required to apply CAD/CAM program for creation of CAD drawings and CNC programs based on drawing specifications. It details the requirements for creating drawings with the aid of computer software to generate simple and / or complex CNC machining programs for basic and advanced turning and milling.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Determine job requirements	1.1 Workpiece, drawing, model or a concept of a new design are analyzed to produce CAD drawing and CAM program. 1.2 ***System parameters*** are selected according to the requirements of the operation.
2. Create / import CAD drawing	2.1 Drawing reference point is established based on job requirement / workpiece. 2.2 Profile, shape, contour of the workpiece are created / imported using CAD according to job requirements and ***drawing standards.*** 2.3 Created / imported drawings are edited according to drawing standards. 2.4 Created / edited drawing are saved according to job requirements.
3. Set CAM parameters	3.1 ***CAM parameters*** are identified and set according to job requirements / part to be produced.
4. Create / edit CNC programs	4.1 ***Tools*** are created (if required) for the tool library and loaded based on job requirements. 4.2 Coordinates are set for tool path or machining functions based on the CAD drawing. 4.3 Workpiece Zero point identified based on the CAD drawing. 4.4 Tool paths generated in cycles format in accordance with the ***software*** used. 4.5 Tool paths are simulated in moderate speed to determine the correctness of the tool movements and other work parameters. 4.6 Cycles are edited if required. 4.7 CNC program generated through post processor in accordance with selected ***machine control*** standard.
5. Load and run program at CNC machine	5.1 Program is loaded using the appropriate devices. 5.2 Dry run is performed in the machine in accordance with established procedures. 5.3 Program is executed to produce part/ workpiece. 5.4 ***Problems encountered*** are documented, reported or referred to ***concerned personnel*** in accordance with worksite procedures.

Note: (Machine and workpiece are pre-set by the machine setter)

RANGE OF VARIABLES

VARIABLE	RANGE
1. System Parameters	May include but are not limited to the following: 1.1 Metric or English 1.2 Layers 1.3 Tool bars (dimensioning, line types, editing, hatching, etc.)
2. Drawing standards	Based on international accepted standard such as; 2.1 ISO 2.2 German (DIN) 2.3 Japanese (JIS) 2.4 American (ANSI) 2.5 And other existing standards
3. CAM Parameters	May include but are not limited to the following: 3.1 Machine type 3.2 Workpiece specification 3.3 Workpiece dimension 3.4 Tool geometry 3.5 Workpiece zero point 3.6 Machine zero point 3.7 Tool measurement (tool offset, tool wear) 3.8 Surface texture
4. Tools	Tools in the tool library but are not limited to the following cutting tools: 4.1 lathe machine 4.2 milling machine 4.3 wire cut (EDM) 4.4 Spark erosion machine
5. Software	Licensed software which is commonly used by the local industry such as: 5.1 Mastercam 5.2 Solid Works 5.3 Esprit 5.5 Goelan 5.6 Hypermill 5.7 Pro engineer 5.8 Surfcam 5.9 Unigraphics 5.10 Wincam 5.11 Heidenhein 5.12 Turbotek 5.13 CAM Concept 5.14 and other CAD/CAM software

6. Machine control	May include: 6.1 Heidenhein 6.2 Fanuc 6.3 Sentrol 6.4 Mazatrol 6.5 Sinumerik 6.6 And other existing controls
7. Problems encountered	May include products not within specifications: 7.1 Incorrect machine set-up 7.2 Incorrect parameter setting 7.3 Defective raw materials 7.4 And other related problems
8. Concerned personnel	May include: 8.1 Production supervisor 8.2 Programmer 8.3 Designer 8.4 Other operators 8.5 Client 8.6 Quality control inspector

EVIDENCE GUIDE

1. Critical aspects of evidence	Assessment requires evidence that the candidate: 1.1 Determined job requirements 1.2 Created / imported CAD drawing 1.3 Set CAM parameters 1.4 Created / edited CNC programs 1.5 Loaded and run program at CNC machine
2. Underpinning knowledge and attitude	2.1 Computer hardware safety practices 2.1.1 Correct voltage supply to computer equipment 2.1.2 Use of voltage regulator and surge protector 2.1.3 Start up and shutdown procedures 2.1.4 Implementation of Housekeeping(5S) 2.1.5 Application of First-aid 2.1.7 Use of fire extinguishers 2.2 Drawing interpretation 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Orthographic projection (1st and 3rd angle) 2.2.3 Perspective 2.2.3.1 isometric 2.2.3.2 dimetric 2.2.3.3 cavalier 2.2.3.4 militar 2.2.4 Sections 2.2.4.1 full section 2.2.4.2 half section 2.2.4.3 partial or local section 2.2.4.4 revolve section 2.2.4.5 assembly and detailed drawings 2.2.5 Dimensioning 2.2.5.1 part dimension 2.2.5.2 location dimension 2.2.5.3 dimensioning techniques 2.2.6 Tolerances 2.2.6.1 bilateral tolerance 2.2.6.2 unilateral tolerance 2.2.6.3 ISO system of tolerance for hole and shaft 2.2.6.4 general tolerance 2.2.6.5 Geometrical Tolerances (form and position) 2.2.7 Surface condition (surface finish/texture) 2.2.8 Limits and fits 2.2.8.1 classification of fits 2.2.8.2 hole basis system of fits 2.2.8.3 shaft basis system of fits 2.3 Shop mathematics 2.3.1 Four fundamental operation 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Square and square root of numbers 2.3.5 Pythagorean theorem 2.3.6 Basic trigonometric function

	2.4 Materials and related science 2.4.1 Classification and mechanical properties of engineering materials 2.5 Lathe and Milling machine operations 2.5.1 Lathe / milling types and specifications 2.5.2 Lathe / milling parts and functions 2.5.3 Setting cutting speed, rpm, feed rate 2.5.4 Work holding and tool holding devices 2.5.5 Turning / milling tools and tool geometry 2.5.6 Tooling, set up and parameters in turning / milling operations 2.5.7 Lathe / milling accessories, fixtures and attachments 2.6 Application of G – codes and M – codes 2.7 Use of Personal Computer Hardware and Software 2.7.1 Windows operation 2.7.2 Connection to peripherals (Printer, plotter, CNC machines) 2.7.3 Printing and plotting operations 2.7.4 File management 2.8 Safe Computer Practices 2.8.1 Backing up files 2.8.2 Scanning for viruses
3. Underpinning skills	3.1 Drafting and designing skills 3.2 Selection of cutting tools 3.3 Use of measuring instruments 3.4 Determination of workpiece specifications 3.5 Computation of feed, cutting speed and machine rpm 3.6 Application of G – codes and M – codes 3.7 Communication skills
4. Resource implications	The following resources must be provided: 4.1 Computer equipment, printer/plotter, software and facilities appropriate to processes or activities 4.2 Sample part/model 4.3 Measuring instruments 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency must be assessed through: 5.1 Direct observation / demonstration of creation of CAD drawings and CAM programs 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 CAD/CAM OPERATION NC III.

3.1 CURRICULUM DESIGN

Course Title: CAD/CAM OPERATION **NC Level:** NC III

Training Duration: **24** Hours (Basic)
130 Hours (Common)
80 Hours (Core)
234 Hours

Course Description:

This qualification is designed to develop knowledge, desirable attitudes and skills in CAD/CAM Operatin NC III.

It covers the competencies required to create drawing using CAD software and apply CAD/CAM program.

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. Lead workplace communication	1.1 Communicate information about workplace processes 1.2 Lead workplace discussions Identify and communicate issues arising in the workplace	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
2. Lead small teams	2.1 Provide team leadership 2.2 Assign responsibilities 2.3 Set performance expectations for team members 2.4 Supervised team performance	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
3. Develop and practice negotiation skills	3.1 Plan negotiations 3.2 Participate in negotiations	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
4. Solve problems related to work activities	4.1 Identify the problem 4.2 Determine fundamental causes of the problem 4.3 Determine corrective action 4.4 Provide recommendation/s to manager	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
5. Use mathematical concepts and techniques	5.1 Identify mathematical tools and techniques to solve problem 5.2 Apply procedure / solution 5.3 Analyze results	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
6. Use relevant technologies	6.1 Study / select appropriate technology 6.2 Apply relevant technology 6.3 Maintain / enhance relevant technology	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ questioning

COMMON COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Apply safety practices	1.1 Identify hazards 1.2 Use protective clothing and devices 1.3 Perform safe handling of tools, equipment and materials 1.4 Perform first aid 1.5 Use fire extinguisher	• Lecture • Group discussion • Interaction • Role playing / Simulation	• Observation • Demonstration • Interview / Questioning
2. Interpret working drawing and sketches	2.1 Interpret technical drawing 2.2 Prepare freehand sketch of parts 2.3 Interpret details from freehand sketch	• Lecture • Group discussion • Interaction	• Observation • Interview / Questioning
3. Select / cut workshop materials	3.1 Determine requirement 3.2 Select and measure materials 3.3 Cut materials	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
4. Perform shop computations (Basic)	4.1 Perform four fundamentals operations 4.2 Perform basic calculations involving fractions and decimals 4.3 Perform basic calculations involving percentages 4.4 Perform basic calculation involving ration and proportion 4.5 Perform calculations on algebraic expressions	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
5. Measure workpiece (Basic)	5.1 Select and use measuring tools 5.2 Clean and store measuring tools	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
6. Perform routine housekeeping	6.1 Organize work area 6.2 Clean Work area	• Lecture • Group discussion • Simulation • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
7. Perform Shop computations (Intermediate)	7.1 Perform calculations involving triangles 7.2 Calculate taper	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
8. Measure workpiece using angular measuring instruments	8.1 Select and use angular measuring tools 8.2 Maintain angular measuring tools Clean and store measuring Tools	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
9. Perform shop Computation (Advanced)	9.1 Calculate gear ratio 9.2 Solve indexing problems 9.3 Solve gearing problems 9.4 Use geometrical principles in the solution of problems	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
10. Measure workpiece using gages and surface texture comparator	10.1 Select and use fixed and adjustable gages 10.2 Perform surface texture measurements 10.3 Clean and store measuring tools	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
11. Perform preventive and corrective maintenance	11.1 Perform inspection of machine 11.2 Perform cleaning and lubricating of machine 11.3 Perform minor machine repair and adjustments 11.4 Maintain hand tools	• Lecture • Demonstration • Group discussion • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
12. Operate a personal computer	12.1 Start and shut down the computer 12.2 Arrange and customize desktop display/ Windows settings 12.3 Work with files and folders (or directories) 12.4 Work with user application programs 12.5 Print information 12.6 Shut down computer	• Group Discussion • Interaction • Lecture	• Demonstration • Observation • Interviews/ • Questioning • Written Exams

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Create drawing using CAD software	1.1 Prepare the CAD environment 1.2 Produce basic drawing 1.3 Modify existing CAD drawings 1.4 Produce drawing output 1.5 Save and print drawing	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview/ Questioning
2. Apply CAD/CAM program	2.1 Determine job requirements 2.2 Create/ import CAD drawing 2.3 Set CAM parameters 2.4 Create/ edit CNC programs 2.5 Load and run program at CNC Machine	• Lecture • Demonstration • Practical exercise	• 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
- Preferably with experience in drafting or related field; and
- Must be a holder of CNC Lathe/Milling NC II

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS CAD/CAM OPERATION NC III

Recommended list of tools, equipment and materials for the training of 10 trainees for CAD/CAM Operation NC III

EQUIPMENT			
QTY	**Description**	**QTY**	**Description**
1 unit	CNC Lathe	1 unit	CNC Milling
10 units	CNC CAD CAM System, Pentium PC with software	1 unit	OHP/LCD Projector
1 unit	Power hacksaw		

SUPPLIES AND MATERIALS					
QTY	**Description**	**QTY**	**Description**	**QTY**	**DESCRIPTION**
2 pcs.	Round bar CRS 38mm dia x 150mm	2 pcs.	Round bar CRS 25.4mm dia x 150mm	2 pcs.	Round Bar CRS 50mm dia. X 150mm
2 pcs.	Aluminum bar 22mm dia x 150mm	2 pcs.	Aluminum bar 30mm dia x 150mm	2 pcs.	Aluminum bar 45mm dia. X 150mm
2 pcs.	Aluminum bar 50x50mm x 150mm	2 pcs.	Aluminum bar 50 x100mm x 150mm	2 pcs.	Aluminum bar 120 x120mm x 5m
2 pcs.	Flat bar 101.6 x 100mm x 300mm	16 pcs.	Paint brush 2” width	3 boxes	Whiteboard marker Black, Blue and red color
10 reams	Bond paper sub. 20 A4	10 pcs.	256 mb flash drive		

TRAINING MATERIALS					
QTY	**Description**	**QTY**	**Description**	**QTY**	**DESCRIPTION**
8 pcs.	Teachers Guide	6 pcs.	Manuals	10pcs.	Simulation software
	Reference books		Catalogs		Brochures
	Modules/ LEs		CDs/ Video tapes		Handouts

TOOLS (Lathe)					
QTY	**Description**	**QTY**	**Description**	**QTY**	**DESCRIPTION**
8 pcs.	Dovetail cutter 60 deg., dia. 16mm	8 pcs.	Staggered tooth side cutter dia. 36mm x 5mm	32 pcs.	End Mill 4, 6, 8, 10, 12, 16 mm dia
8 pcs.	NC start drill 10mm dia.	8 pcs.	Face Mill, 16 x 20 x 40mm dia.	3 sets	Hand Tap M6, M8, M10, M12
16 pcs.	Center drill # 2	6 boxes	Drill bit Φ1mm-to13mm at 0 .5 increment set	8 pcs. each	Machine tap M3-M6, M8, M10 set
8 pcs.	Slot cutter dia. 16 mm	8 sets	Engraving Tool	8 sets	Needle File
1 set	Letter punch	8 pcs.	Flat File, 2nd cut, 150 mm	8 pcs.	Rubber mallet
2 pcs.	Ball peen hammer, 0.5 kgs				

TOOLS (Milling)					
				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. each	Ball nose endmill, 3, 6, 8, 10, 12mm
3 pcs. each	Face Mill, 40, 50, 63 mm dia.	3 sets	Hand Tap M6, M8, M10, M12	8 pcs.	NC start drill 10mm dia.
8 pcs.	Dovetail cutter, 16 mm dia.	6 boxes	Drill bit dia.1mm-13mm set	8 pcs. each	Machine tap M5, M6, M8, M10 , M12
16 pcs.	Center drill # 2	8 pcs.	Slot cutter dia. 16 mm	8 sets	Engraving Tool
8 pcs.	Edge finder	2 sets	Needle File	8 pcs.	Flat File, 2nd cut, 150 mm
8 pcs.	Rubber mallet	1 set	Letter punch	2 pcs.	Ball peen hammer, 0.5 kgs

MEASURING INSTRUMENTS					
QTY	**Description**	**QTY**	**Description**	**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.	Precision Bevel protractor	1 pc.	Thread pitch gage	1 set	Gage block (optional)
1 pc.	Vernier height gage with dial indicator (optional)	8 pcs.	Depth gage micrometer		

3.5 TRAINING FACILITIES
CAD/CAM OPERATION NC III

The CNC Machining workshop must be of concrete structure for 10 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 Training System (CNC/CAD/CAM room)	7.5M x 11.0M	82.5 sq.M	82.5 sq.M
• CNC Basic Milling workshop	10.0M x 5.5M	55 sq. M	55 sq. M
• CNC Basic Turning 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 x5.0M	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 CAD/CAM OPERATION NC III

TRAINER QUALIFICATION (TQ II)

- Must be a holder of CAD/CAM Operation NC III or equivalent qualification
- Must have undergone training on Training Methodology II (TM II) or equivalent in training experience
- Must be physically and mentally fit
- *Must have at least 2 years relevant 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 CAD/CAM Operation NC III, 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 CAD/CAM Operation NC III may be attained through:

4.2.1 Acquisition of COC in

4.2.1.1 Create drawing using CAD software

4.2.2 Demonstration of competence through project-type assessment covering the following units

4.2.2.1 Create drawing using CAD software
4.2.2.2 Apply CAD/CAM program

Note:

Candidates who are holders of unexpired COCs in Create drawing using CAD software (CAD Operation) leading to CAD/CAM Operation NC III may undergo only the assessment for the unit *Apply CAD/CAM program*. The assessor, however, may probe the candidate for his/her knowledge and skills on CAD operation, particularly along mechanical drafting.

4.3 Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

4.4 The following are qualified to apply for assessment and certification:

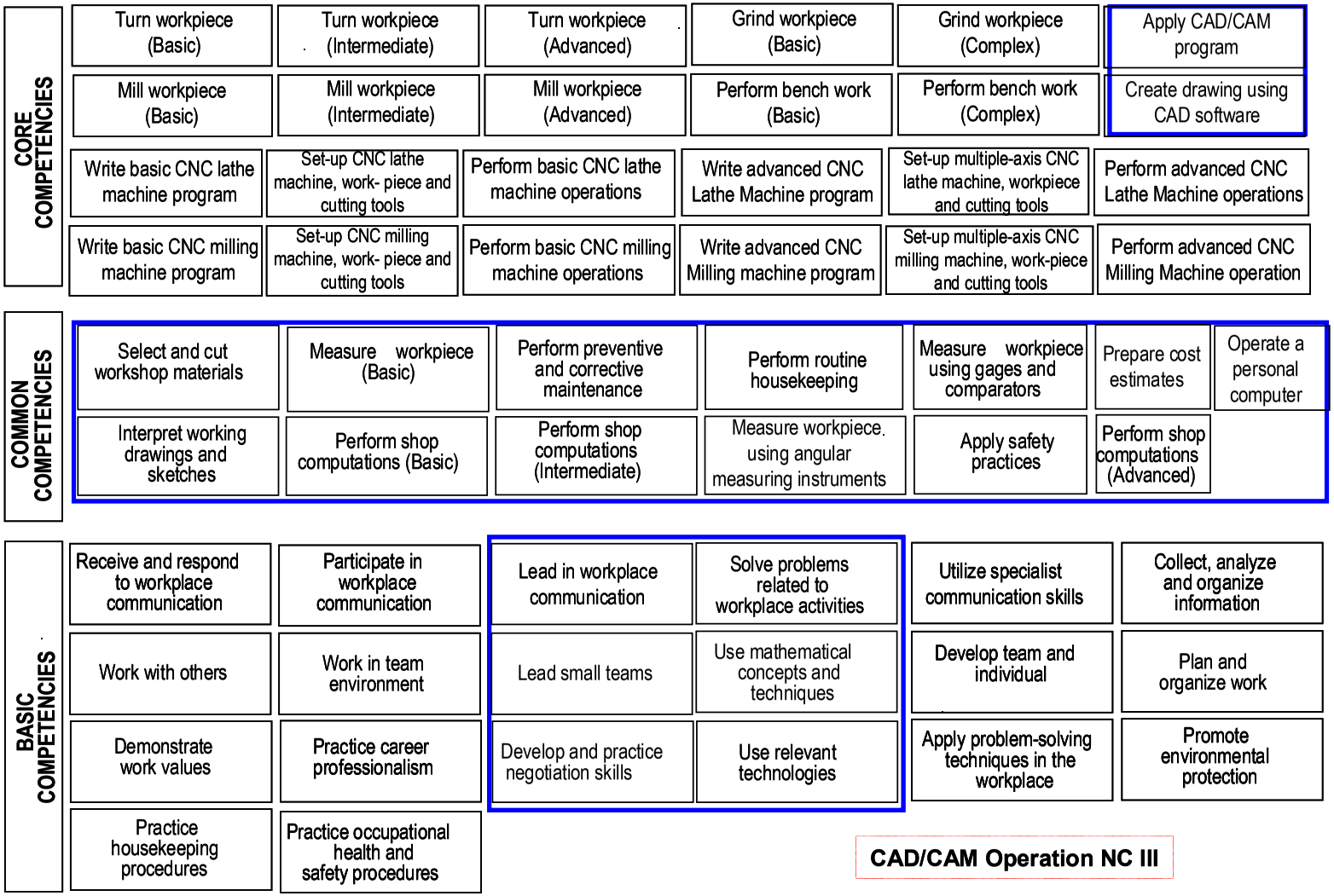
4.4.1. Graduate of formal, non-formal, and informal including enterprise-based training programs.

4.4.2. Experienced workers (wage employed or self employed)

4.5 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



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 scribling 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 **C**omputerized **N**umerically **C**ontrolled 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 **N**umerically **C**ontrolled machine tool
CAD	**C**omputer **A**ided **D**esign – the use of graphics-oriented computer software for designing and drafting applications
CAM	**C**omputer **A**ided **M**anufacturing- computer software that generates programs for the operation of NC (numerical control) machine tools

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