

**COMPETENCY BASED CURRICULUM**

**FOR**

**MECHANICAL PRODUCTION TECHNICIAN**

**LEVEL 5**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement Kenya’s development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this Curriculum has been developed.

It is my conviction that this curriculum will play a great role towards development of competent human resource for the Mechanical Engineering sector’s growth and sustainable development

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

Kenya Vision 2030 aims to transform the country into a newly industrializing, “middle-income country providing a high-quality life to all its citizens by the year 2030”. Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency Based Education and Training (CBET).

The Technical and Vocational Education and Training Act No. 29 of 2013 on Reforming Education and Training in Kenya, emphasized the need toreform curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) in conjunction with Mechanical Engineering Sector Skills Advisory Committee (SSAC) and other stakeholders have developed this curriculum.

This curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

The curriculum is designed and organized with an outline of learning outcomes; suggested delivery methods, training/learning resources and methods of assessing the trainee’s achievement. The curriculum is competency-based and allows multiple entry and exit to the course.

I am grateful to the Council Members, Council Secretariat, Mechanical Engineering SSAC, expert workers and all those who participated in the development of this curriculum.

**Prof CHARLES M. M. ONDIEKI, PhD, FIET (K), Con. EngTech.**

**CHAIRMAN, TVET CDACC**

# ACKNOWLEDGMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from various organizations.

I appreciate Mechanical Engineering Sector Skills Advisory Committee (SSAC) who enabled the development of this curriculum.

I recognize with appreciation the role of the SSAC in ensuring that competencies required by the industry are addressed in this curriculum. I also thank all stakeholders in the Mechanical Engineering sector for their valuable input and all those who participated in the process of developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workers in Mechanical Engineering sector acquire competencies that will enable them to perform their work more efficiently.

**Dr. LAWRENCE GUANTAI M’ITONGA, PhD**

**COUNCIL SECRETARY/CEO**

# ACRONYMS

AC Air conditioning

BC Basic Competency

CC Common Competency

CR Core Competency

CDACC Curriculum Development, Assessment and Certification Council

CPU Control Powering Unit

CU Curriculum

DTI Dial test indicator

ENG Engineering

FOT Fixed orifice tube

GPS Global positioning system

ICT Information and Communication Technology

IT Information Technology

KCSE Kenya Certificate of Secondary Education

MPE Mechanical Plant Engineering

KNQF Kenya National Qualification Framework

KPI King Pin inclination

OBD On-board diagnostics

OS Occupational Standards

PPE Personal protective equipment

SI Spark ignition

TVET Technical and Vocational Education and Training

TQM Total Quality Management

SOP Standard Operating Procedures

# **KEY TO UNIT CODE**

ENG/CU/ME/BC/01/5/A

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

Control Version

**TABLE OF CONTENTS**

[FOREWORD ii](#_Toc48140680)

[PREFACE iv](#_Toc48140681)

[ACKNOWLEDGMENT v](#_Toc48140682)

[ACRONYMS vii](#_Toc48140683)

[KEY TO UNIT CODE viii](#_Toc48140684)

[COURSE DESCRIPTION x](#_Toc48140685)

[BASIC UNITS OF LEARNING 1](#_Toc48140686)

[COMMUNICATION SKILLS 2](#_Toc48140687)

[DIGITAL LITERACY 5](#_Toc48140688)

[ENTREPRENEURIAL SKILLS 8](#_Toc48140689)

[EMPLOYABILITY SKILLS 11](#_Toc48140690)

[ENVIRONMENTAL LITERACY 15](#_Toc48140691)

[OCCUPATIONAL SAFETY AND HEALTH PRACTICES 19](#_Toc48140692)

[COMMON UNITS OF LEARNING 21](#_Toc48140693)

[TECHNICAL DRAWING 22](#_Toc48140694)

[METALLIC AND NON-METTALIC MATERIALS 26](#_Toc48140695)

[BENCH WORK OPERATIONS 30](#_Toc48140696)

[ENGINEERING MATHEMATICS 36](#_Toc48140697)

[MECHANICAL SCIENCE PRINCIPLES 40](#_Toc48140698)

[ELECTRICAL SCIENCE PRINCIPLES 44](#_Toc48140699)

[CORE UNITS OF LEARNING 46](#_Toc48140700)

[SHEET METAL FABRICATION 47](#_Toc48140701)

[GRINDING OPERATIONS 52](#_Toc48140702)

[LATHE OPERATIONS 57](#_Toc48140703)

[MILLING MACHINE OPERATIONS 63](#_Toc48140704)

# COURSE DESCRIPTION

The Mechanical production technician Level 5 qualification consists of competencies that a person must achieve to enable him/her to work in a production plant. It involves: fabricating sheet metal, producing components on lathe machine, producing surfaces using grinding machines and producing components on milling machines.

The units of competency comprising Mechanical Production Technician level 5 qualifications include the following basic, common and core competencies:

|  |  |  |  |
| --- | --- | --- | --- |
| **BASIC UNITS OF COMPETENCY** | | | |
| **Unit of Learning Code** | **Units of Learning Title** | **Duration in Hours** | **Credits Factors** |
| **ENG/CU/ME/BC/01/5/A** | Communication skills | 25 | 2.5 |
| **ENG/CU/ME/BC/02/5/A** | Digital literacy | 45 | 4.5 |
| **ENG/CU/ME/BC/03/5/A** | Entrepreneurial skills | 70 | 7.0 |
| **ENG/CU/ME/BC/04/5/A** | Employability skills | 50 | 5.0 |
| **ENG/CU/ME/BC/05/5/A** | Environmental literacy | 25 | 2.5 |
| **ENG/CU/ME/BC/06/5/A** | Occupational safety and health practices | 25 | 2.5 |
| **TOTAL** | | **240** | **24.0** |
| **ENG/CU/ME/CC/01/5/A** | Technical drawing | 100 | 10 |
| **ENG/CU/ME/CC/02/5/A** | Metallic and Non-metallic materials | 60 | 6 |
| **ENG/CU/ME/CC/03/5/A** | Bench work operations | 100 | 10 |
| **ENG/CU/ME/CC/04/5/A** | Engineering mathematics | 80 | 8 |
| **ENG/CU/ME/CC/05/5/A** | Mechanical science principles | 80 | 8 |
| **ENG/CU/ME/CC/06/5/A** | Electrical principles | 70 | 7 |
| **TOTAL** | | **490** | **49** |
| **CORE UNITS OF COMPETENCY** | | | |
| **ENG/CU/ME/CR/01/5/A** | Sheet metal Fabrication | 150 | 15 |
| **ENG/CU/ME/CR/02/5/A** | Grinding operations | 80 | 8 |
| **ENG/CU/ME/CR/03/5/A** | Lathe Operations | 150 | 15 |
| **ENG/CU/ME/CR/04/5/A** | Milling operations | 150 | 15 |
|  | Industrial attachment | 360 | 36 |
| **TOTAL** | | **890** | **89** |
| **GRAND TOTAL** | | **1620** | **162.0** |

1. **Entry Requirements**

An individual entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (K.C.S.E.) with a minimum mean grade of D (D plain)

**Or**

1. Level 4 certificate in a related course.

**Or**

1. Equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in a Mechanical engineering firm for a period of at least three (3) months. An individual enrolled in one of the units of learning will be required to undergo a one-month attachment in a Mechanical firm dealing with the relevant competency required. Attachment will be undertaken upon completion of the course or the unit of learning.

**Assessment**

The course will be assessed at two levels: internal and external.

1. **Internal assessment**: conducted continuously by the trainer (internal assessor) who is monitored by an accredited internal verifier.
2. **External assessment**: conducted by an external assessor who is monitored by an accredited external verifier.

The assessors and verifiers are registered by TVET CDACC which also coordinates external assessment.

**Certification**

A candidate will be issued with a Certificate of Competency on demonstration of competence in a unit of competency. To attain the qualification national certificate in Mechanical Production Level 5, the candidate must demonstrate competence in all the units of competency as given in qualification pack.

These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

## 

# COMMUNICATION SKILLS

**UNIT CODE:** ENG/CU/ME/BC/01/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Demonstrate communication skills**

**Duration of Unit:** 25 hours

**Unit Description**

This unit covers the competencies required to use specialized communication skills to meet specific needs of internal and external clients, contribute to development of communication strategies, conduct interviews, facilitate discussion with groups and represent the organization.

**Summary of Learning Outcomes**

1. Meet communication needs of clients and colleagues
2. Contribute to the development of communication strategies
3. Conduct interviews
4. Facilitate group discussion
5. Represent the organization

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Meet communication needs of clients and colleagues | * Communication process * Modes of communication * Medium of communication * Effective communication * Barriers to communication * Flow of communication * Sources of information * Organizational policies * Organization requirements for written and electronic communication methods * Report writing * Effective questioning techniques (clarifying and probing) * Workplace etiquette * Ethical work practices in handling communication * Active listening * Feedback * Interpretation * Flexibility in communication | * Observation * Oral * Written test * Practical tests |
| 1. Contribute to the development of communication strategies | * Dynamics of groups * Styles of group leadership * Openness and flexibility in communication * Communication skills relevant to client groups | * Observation * Oral * Written tests * Practical tests |
| 1. Conduct interviews | * Types of interview * Establishing rapport * Facilitating resolution of issues * Developing action plans | * Observation * Oral * Written test * Practical tests |
| 1. Facilitate group discussions | * Identification of communication needs * Dynamics of groups * Styles of group leadership * Presentation of information * Encouraging group members participation * Evaluating group communication strategies | * Observation * Oral * Written test * Practical tests |
| 1. Represent the organization | * Presentation techniques * Development of a presentation * Multi-media utilization in presentation * Communication skills relevant to client groups | * Observation * Oral * Written test * Practical tests |

**Suggested Delivery Methods**

* Interview
* Role playing
* Observation
* Viewing of related videos

**Recommended Resources**

* Desktop computers/laptops
* Internet connection
* Projectors
* Telephone

## 

**DIGITAL LITERACY**

**UNIT CODE:** ENG/CU/ME/BC/02/5/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate digital literacy

**Duration of Unit:** 45 hours

**Unit Description**

This unit describes competencies required to use a computer and other digital devices for the purposes of communication, work performance and management at the workplace.

**Summary of Learning Outcomes**

1. Identify computer software and hardware
2. Apply security measures to data, hardware, software in automated environment
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace
5. Apply desktop publishing in official assignments
6. Prepare presentation packages

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software | * Concepts of ICT * Functions of ICT * History of computers * Components of a computer * Classification of computers | * Written tests * Oral presentation * Observation |
| 1. Apply security measures to data, hardware and software | * Data security and control * Security threats and control measures * Types of computer crimes * Detection and protection against computer crimes * Laws governing protection of ICT | * Written tests * Oral presentation * Observation * Project |
| 1. Apply computer software in solving tasks | * Operating system * Word processing * Spread sheets * Data base design and manipulation * Data manipulation, storage and retrieval | * Oral questioning * Observation * Project |
| 1. Apply internet and email in communication at workplace | * Computer networks * Network configurations * Uses of internet * Electronic mail (e-mail) concept | * Oral questioning * Observation * Oral presentation * Written report |
| 1. Apply desktop publishing in official assignments | * Concept of desktop publishing * Opening publication window * Identifying different tools and tool bars * Determining page layout * Opening, saving and closing files * Drawing various shapes using DTP * Using colour pellets to enhance a document * Inserting text frames * Importing and exporting text * Object linking and embedding * Designing of various publications * Printing of various publications | * Oral questioning * Observation * Oral presentation * Written report * Project |
| 1. Prepare presentation packages | * Types of presentation packages * Procedure of creating slides * Formatting slides * Presentation of slides * Procedure for editing objects | * Oral questioning * Observation * Oral presentation * Written report * Project |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos
* Project
* Group discussions

**Recommended Resources**

* Desk top computers
* Laptop computers
* Other digital devices
* Printers
* Storage devices
* Internet access
* Computer software

# ENTREPRENEURIAL SKILLS

**UNIT CODE:** ENG/CU/ME/BC/03/5/A

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 70 hours

**Unit description**

This unit describes the competencies critical to demonstration of entrepreneurial capabilities. It involves, enhancing the entrepreneur’s business skills, fostering a culture of continuous improvement at individual and organization level, implementing appropriate internal controls for profitability, improving employed capital base and undertaking regional/county business expansion.

**Summary of Learning Outcomes**

1. Develop one’s business skill
2. Develop individual workers and teams
3. Expand markets and customers
4. Expand employed capital
5. Undertake regional/county business expansion
6. Develop business Innovative strategies
7. Develop new products/ markets

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Develop one’s business skill | * Entrepreneurial skills development * Market trends * Monitoring and anticipating market trends * New technologies in entrepreneurship * Products and processes in entrepreneurship * Linkages with other entrepreneurs * Business conventions ad exhibitions * Personal improvement and growth | * Observation * Case studies * Individual/group assignments * Projects * Written * Oral |
| 1. Develop individual workers and teams | * Good staff/workers * Team building and team work * Staff development and enhancement * Culture of continuous improvement * Increasing products and services * Marketing improvement * Intrapreneurship | * Observation * Case studies * Individual/group assignments * projects * Written * Oral |
| 1. Expand markets and customers base | * Maintaining appropriate cash flow in the organization * Internal controls * Business break-even point * Business profitability determinants * Prudent purchases in an enterprise * Reducing business expenses * Good staff/workers and customer relations * Identifying and maintain new customers and markets * Product/ service promotions * Products / services diversification * SWOT / PESTEL analysis * Conducting a business survey * Market expansion * Small business records management * Book keeping and auditing for small businesses * Business support services * Small business resources mobilization and utilization * Basic business social responsibility * Management of small business * Word processing concepts in small business management * Computer application software * Monitoring and controlling business operations | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Expand employed capital | * Employed capital in small businesses * Share holdings * Business expansion and diversification * Resources for growing small business * Small business Strategic Plan * Cooperate Social responsibility * Computer software in business development * ICT and business growth | * Observation * Case studies * Individual/group assignments * projects * Written |
| 1. Undertake county/regional business expansion | * Region identification process * Regional laws and regulation * Business regional expansion requirements | * Oral * Observation * Case studies * Individual/group assignments * projects * Written |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practice by trainee
* Role play
* Case study

**Recommended Resources**

* Case studies for small businesses
* Business plan templates
* Lap top/ desk top computer
* Internet
* Telephone
* Writing materials

**EMPLOYABILITY SKILLS**

**UNIT CODE:** ENG/CU/ME/BC/04/5/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 50 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating interpersonal communication, critical safe work habits, leading a workplace team, planning and organizing work, maintaining professional growth and development, demonstrating workplace learning, problem solving skills and managing ethical performance.

**Summary of Learning Outcomes**

1. Conduct self-management

2. Demonstrate interpersonal communication

3. Demonstrate critical safe work habits

4. Lead small teams

5. Plan and organize work

6. Maintain professional growth and development

7. Demonstrate workplace learning

8. Demonstrate problem solving skills

9. Demonstrate workplace ethics

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management | * Self-awareness * Formulating personal vision, mission and goals * Strategies for overcoming life challenges * Emotional intelligence * Assertiveness versus aggressiveness * Expressing personal thoughts, feelings and beliefs * Developing and maintaining high self-esteem * Developing and maintaining positive self-image * Articulating ideas and aspirations * Accountability and responsibility * Good work habits * Self-awareness * Self-development * Financial literacy * Healthy lifestyle practices | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate interpersonal communication | * Meaning of interpersonal communication * Listening skills * Types of audience * Writing skills * Reading skills * Meaning of empathy * Understanding customers’ needs * Establishing communication networks * Sharing information | * Observation * Written * Oral interview * Third party report |
| 1. Demonstrate critical safe work habits | * Stress and stress management * Punctuality and time consciousness * Leisure * Integratingpersonal objectives into organizational objectives * Resources utilization * Setting work priorities * HIV and AIDS * Drug and substance abuse * Handling emerging issues | * Observation * Written * Oral interview * Third party report |
| 1. Lead a small team | * Leadership qualities * Team building * Determination of team roles and objectives * Team performance indicators * Responsibilities in a team * Forms of communication * Complementing team activities * Gender and gender mainstreaming * Human rights * Maintaining relationships * Conflicts and conflict resolution | * Observation * Oral interview * Written * Third party report |
| 1. Plan and organize work | * Functions of management * Planning * Organizing * Time management * Decision making process * Task allocation * Evaluating work activities * Resource utilization * Problem solving * Collecting and organising information | * Observation * Oral interview * Written * Third party report |
| 1. Maintain professional growth and development | * Opportunities for professional growth * Assessing training needs * Licenses and certifications for professional growth and development * Pursuing personal and organizational goals * Identifying work priorities * Recognizing career advancement | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate workplace learning | * Managing own learning * Contributing to the learning community at the workplace * Cultural aspects of work * Variety of learning context * Application of learning * Safe use of technology * Identifying opportunities * Generating new ideas * Workplace innovation * Performance improvement * Handling emerging issues * Future trends and concerns in learning | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate problem solving skills | * Problem identification * Problem solving * Application of problem-solving strategies * Resolving customer concerns | * Observation * Oral interview * Written * Third party report |
| 1. Demonstrate workplace ethics | * Meaning of ethics * Ethical perspectives * Principles of ethics * Values and beliefs * Ethical standards * Organization code of ethics * Common ethical dilemmas * Organization culture * Corruption, bribery and conflict of interest * Privacy and data protection * Diversity, harassment and mutual respect * Financial responsibility/accountability * Etiquette * Personal and professional integrity * Commitment to jurisdictional laws * Emerging issues in ethics | * Observation * Oral interview * Written * Third party report |

**Suggested Methods of Delivery**

* Instructor lead facilitation of theory
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Projects
* Case studies
* Assignments

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors

**ENVIRONMENTAL LITERACY**

**UNIT CODE:** ENG/CU/ME/BC/05/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate environmental literacy

**Duration of Unit:** 25 hours

**Unit Description**

This unit describes the competencies required to control environmental hazard, control environmental pollution, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, identify environmental legislations/conventions for environmental concerns, implement specific environmental programs and monitor activities on environmental protection/programs.

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard | * Purposes and content of Environmental Management and Coordination Act 1999 * Purposes and content of Solid Waste Act * Storage methods for environmentally hazardous materials * Disposal methods of hazardous wastes * Types and uses of PPE in line with environmental regulations * Occupational Safety and Health Standards (OSHS) | * Written questions * Oral questions * Observation of work procedures |
| 1. Control environmental Pollution control | * Types of pollution * Environmental pollution control measures * Types of solid wastes * Procedures for solid waste management * Different types of noise pollution * Methods for minimizing noise pollution | * Written questions * Oral questions * Observation of work procedures * Role play |
| 1. Demonstrate sustainable resource use | * Types of resources * Techniques in measuring current usage of resources * Calculating current usage of resources * Methods for minimizing wastage * Waste management procedures * Principles of 3Rs (Reduce, Reuse, Recycle) * Methods for economizing or reducing resource consumption | * Written questions * Oral questions * Observation of work procedures * Role play |
| 1. Evaluate current practices in relation to resource usage | * Collection of information on environmental and resource efficiency systems and procedures, * Measurement and recording of current resource usage * Analysis and recording of current purchasing strategies. * Analysis of current work processes to access information and data * Identification of areas for improvement | * Written questions * Oral questions * Observation of work procedures * Role play |
| 1. Identify Environmental legislations/conventions for environmental concerns | * Environmental issues/concerns * Environmental legislations /conventions and local ordinances * Industrial standard /environmental practices * International Environmental Protocols (Montreal, Kyoto) * Features of an environmental strategy | * Written questions * Oral questions * Observation of work procedures |
| 1. Implement specific environmental programs | * Community needs and expectations * Resource availability * 5 s of good housekeeping * Identification of programs/Activities * Setting of individual roles /responsibilities * Resolving problems /constraints encountered * Consultation with stakeholders | * Written questions * Oral questions * Observation of work procedures * Role play |
| 1. Monitor activities on Environmental protection/Programs | * Periodic monitoring and Evaluation of activities * Gathering feedback from stakeholders * Analysing data gathered * Documentation of recommendations and submission * Setting of management support systems to sustain and enhance the program * Monitoring and reporting of environmental incidents to concerned /proper authorities | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Environmental Management and Coordination Act 1999
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE)
* ISO standards
* Ccompany environmental management systems (EMS)
* Montreal Protocol
* Kyoto Protocol

# OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/CU/ME/BC/06/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate occupational safety and health practices

**Duration of Unit:** 25 hours

**Unit Description**

This unit describes the competencies required to comply with regulatory and organizational requirements for occupational safety and health.

**Summary of Learning Outcomes**

1. Identify workplace hazards and risk
2. Identify and implement appropriate control measures to hazards and risks
3. Implement OSH programs, procedures and policies/guidelines

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify workplace hazards and risks | * Identification of hazards in the workplace and/or the indicators of their presence * Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace is conducted by * Authorized personnel or agency * Gathering of OHS issues and/or concerns raised | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Identify and implement appropriate control measure to hazards and risks | * Prevention and control measures, including use of PPE (personal protective equipment) for specific hazards are identified and implemented * Appropriate risk controls based on result of OSH hazard evaluation is recommended * Contingency measures, including emergency procedures during workplace incidents and emergencies are recognized and established in accordance with organization procedures | * Oral questions * Written tests * Practical test * Observation of implementation of control measures |
| 1. Implement OSH   programs, procedures  and policies/guidelines | * Providing information to work team about company OHS program, procedures and policies/guidelines * Participating in implementation of OSH procedures and policies/ guidelines * Training of team members and advice on OSH standards and procedures * Implementation of procedures for maintaining OSH-related records | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# COMMON UNITS OF LEARNING

# TECHNICAL DRAWING

**UNIT CODE:** ENG/CU/ME/CC/01/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Interpret technical drawings

**Duration of Unit:** 100 Hours

**Unit Description**

This unit covers the competencies required by a mechanical production technician to interpret technical drawings. It involves competencies to: select and use drawing instruments and materials, interpret plane geometry drawings, solid geometry drawings, pictorial and orthographic drawings and mechanical drawings to help in fabrication, production and finishing of mechanical components.

**Summary of Learning Outcomes**

1. Use drawing equipment and materials
2. Interpret plane geometry drawings
3. Interpret solid geometry drawings
4. Interpret orthographic and pictorial drawings
5. Produce assembly drawings
6. Perform Computer Aided Drafting

**Learning Outcomes, Content and Suggested Assessment Methods:**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use drawing equipment and materials | * drawing equipment and materials | * Observation * Oral questioning * Written tests |
| 1. Interpret plane geometry drawings | * Lettering in drawing * Types of lines in drawings * Construction of geometric forms * Construction of different angles * Measurement of different angles * Standard drawing conventions | * Oral questioning * Written tests * Observation |
| 1. Interpret solid geometry drawings | * geometrical drawings   + Cylinders   + Prisms   + Cones * Pattern Development for truncated solids * Pattern development for Interpenetrating solids   + Cylinder to cylinder,   + Cylinder to prism,   + Prism to prism of equal and unequal diameters | * Observation * Written tests * Oral questioning * Practical |
| 1. Interpret orthographic and pictorial drawings | * pictorial and orthographic drawings and sectioning * symbols and abbreviations * Drawing of isometric, oblique, axonometric, auxiliary and perspective views * Drawing of first and third angle projections * Sectioning of components * Free hand sketching of tools, equipment, components, geometric forms and diagrams | * Observation * Written test * Oral test * Practical |
| 1. Produce assembly drawings | * Exploded views of drawings * orthographic views of drawing * pictorial views * title block features * Production of sectional views | * Observation * Written test * Oral test * Practical |
| 1. Perform Computer Aided Drafting | * CAD System * Advantages of CAD as a drafting software * Starting CAD program * Create, save and open a drawing in CAD * CAD interface * CAD Workspace * CAD Tools: * Drawing tools, modify tools, * Dimensioning in CAD * Apply and edit various dimensioning tools * Use dimensioning tools to edit a drawing * Use dimensioning style manager * Types of dimensioning tools * Dimension style manager * Texting in CAD * Drawing and editing 2D geometric objects * AutoCAD scale: * Draw 2D objects to a scale of 1:1 * Edit the drawing properties 2D objects: * Draw tools and menu * Modify tools and menu * Command line * Zoom and pan * Layers and object properties * Create layers relevant to a given drawing * Apply and edit layers * Object properties * Layout and Plotting | * Observation * Written test * Oral test * Practical |

**Suggested Methods of Delivery**

* Projects
* Demonstration
* Practice by the trainee
* Field trips
* Group discussions
* Direct instructions

**Recommended Resources**

* + Drawing room
  + Computer lab
  + Drawing equipment and materials
  + Computers installed with CAD software
  + Overhead projector

# METALLIC AND NON-METTALIC MATERIALS

**UNIT CODE:** ENG/CU/ME/CC/02/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Use common metallic and non-metallic materials.

**Duration of Unit:** 60 hours

**Unit Description:**

This unit covers the unit of competency required by a mechanical production technician to use common metallic and non-metallic materials. It involves competencies required to: identify properties of engineering materials, identify ore extraction processes, identify methods of producing engineering materials, perform heat treatment and prevent material corrosion.

**Summary of Learning Outcomes**

1. Identify properties of engineering materials
2. Identify ore extraction processes of metallic materials
3. Identify methods of producing non-metallic materials
4. Perform heat treatment
5. Prevent material corrosion

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + Identify properties of engineering materials | * Classification of Engineering materials * Physical properties of engineering material * Mechanical properties of engineering materials * Crystalline structure of materials * Chemical properties of engineering materials * Forms of supply of engineering materials   + Sheets   + bars   + granules   + pellets | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * + Identify ore extraction processes of metallic materials | * Safety measures in metal extraction * Methods of metal extraction   + Reduction with carbon   + reduction by electrolysis   + reduction by more reactive metals * Procedure in metal extraction processes   + Iron   + copper   + aluminium * Ore smelting processes.   + Composition of iron ore   + Composition of copper ore   + Composition of aluminium ore * Refinement processes   + Alloy formation processes * Metal classification   + Ferrous   + Non ferrous   + Alloys * by-products of ore extraction * Storage of metal Extraction by- products * Disposal of extraction by- products | * Written tests * Oral questioning * Assignments * Supervised exercises |
| * + Identify methods of producing non-metallic materials | 1. Types of non-metallic materials e.g.  * Rubber * Glass * Ceramics * Wood * Plastics * Composite  1. Methods of material production/manufacture  * Polymerization * Vulcanization * Float glass process * Ceramic production  1. Finishing and Refinement processes of various types of materials  * Rolling * De-scaling * Galvanizing * Plating * Polishing | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Perform heat treatment | * + Safety practices and procedures   + Tools and equipment   + Heat treatment processes * Annealing * Tempering * Normalizing * Hardening * Case hardening | * Assignments * Supervised exercises * Written tests * Practical test |
| 1. Corrosion and its prevention | * Types of Corrosion * Causes of corrosion * Agents of corrosion * Methods of corrosion prevention   + - Painting     - Electroplating     - Galvanizing     - Cathodic     - Chromizing     - Plating | * Assignments * Supervised exercises * Written tests * Practical test |

**Suggested Delivery Methods**

* Demonstration by trainer
* Discussions
* Practical work by trainee(s)
* Exercises
* Industrial visits
* YouTube for teaching/learning and inspiration
* Simulation
* Power point presentation

**List of Recommended Resources**

**Recommended Resources**

Tools and equipment

* Heat treatment equipment (furnaces, oxy-fuel gas system etc)
* Material testing equipment
* Measuring tools and gauges
* Marking out tools
* Inspection tools and equipment
* Firefighting equipment

**Materials and supplies**

* PPEs –dust coat, dust masks, ear muffs, goggles
* First Aid kit
* Brooms and cleaning stuff
* Cleaning detergents
* Drawing papers

# BENCH WORK OPERATIONS

**UNIT CODE:** ENG/CU/ME/CC/03/4/A

**Relationship to Occupational Standards**:

This unit addresses the unit of competency: Perform bench work operations

Duration of Unit: 80 Hours

**Unit description**

The Mechanical production technician will be able to perform bench work operations using hand and power tools while observing occupational safety and health legislations, regulations and safe working practices. In the context of the standards, the learner is to plan work operations, mark out work pieces, set up work pieces on holding devices, assemble metal parts and their sub-assemblies, inspect finished work, perform maintenance and perform housekeeping.

**Summary of Learning Outcome**

1. Observe safety rules and regulations
2. Plan work operations
3. Mark out dimensions on work pieces
4. Set up work pieces on holding devices
5. Use hand tools
6. Use power tools, and machine
7. Assemble metal parts and sub-assemblies
8. Inspect finished work
9. Maintain hand tools and equipment
10. Perform housekeeping
11. Document report

**Learning Outcomes, Content and suggested assessment methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Observe safety rules and regulations | * Occupational safety health and regulations (OSHA) * Personal protective equipment * Machine safety * Environmental safety | * Administration of written and oral tests * Assessment of worksheet/ operation plans |
| 1. Plan work operations | * Work operation plan procedure * Time management * Work scheduling. * Format of work operation plan * Selection of tools as per the specific operation * Selection of material for the given component | * Observation * Administration of oral and written questions |
| 1. Mark out dimensions on work pieces | * Measuring tools:–   + types and use   + Inspecting and calibrating measuring tools * Marking-out tools * Laying out work piece(s) * Transfer of dimensions onto the work piece(s) | * Observation * practical * oral assessment * written assessment |
| 1. Set up workpiece on holding device | * Work holding devices and applications   + Bench vice   + V-Block   + Angle plate   + G-clamp   + Jigs and fixtures   + Hand vice | * Observation * Written assessment * Oral questioning * Practical |
| 1. Use hand tools | * Hand tools and their applications   + Files   + Saws   + Hammers   + Chisels   + Taps and dies | * Observation * Written assessment * Oral assessment * Practical projects |
| 1. Use power tools and, machines | * Categories of power tools and machines   + Drilling machine   + Power saw   + hand grinding machine   + Angle grinding machine   + Bending machine   + Guillotine   + Roll mill   + Belt sander * Types of drill bits * work holding devices for Drilling machine * Grinding operation * Drilling operations   + Counter sinking   + Counter boring   + Reaming   + Boring | * Observation * Written assessment * Oral questioning * Practical projects |
| 1. Assemble metal parts and sub-assemblies | * Parts joining methods   + mechanical fasteners   + adhesives   + Soldering   + Brazing   + Gas welding   + Manual metal arc welding | * Observation * Written assessment * Oral questioning * Practical project |
| 1. Inspect finished work | * Inspection tools * Inspection methods * Quality specifications   + Dimensions   + Tolerances   + Geometry   + Surface finish * Functionality | * Observation * Written assessment * Oral questioning * Practical |
| 1. Maintain hand tools and maintenance | * Servicing and maintenance of machine (lubrication, inspection, alignment and adjustment) * Machine maintenance activities * Preventive maintenance * Maintenance of hand and machine tools and equipment e.g. * Cleaning * Oiling * Painting * Basic inspection * Storage | * Written assessment * Oral questioning * Observation * Practical |
| 1. Perform house keeping | * Work place cleaning procedures * Waste segregation and disposal * Storage of tools and equipment | * Written assessment * Oral questioning * Observation * Practical |
| 1. Document report | * Defects/ deviations report * Cost variations report * Accidents and incidents report xxx | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Demonstration by trainer
* Discussions
* Projects
* Practical work by trainee(s)
* Exercises
* Industrials visits
* Internet.
* Simulation

**List of Recommended Resources**

**Tools and equipment suggested but not limited to:**

* Welding machines
* Drilling machines
* Vices
* Cutting tools
* Combination square
* Centre punch
* scribers
* callipers
* Dies and taps
* Surface plate
* V-blocks
* Dial gauge
* Die stock
* Engineer’s square
* File card
* hand Files
* Clamps
* vernier height gauge
* Vernier callipers
* Hammers
* Measuring tools
* Drill bits
* inspection tools and equipment
* Inspection and measuring tools, GO and NOT GO gauges
* Jigs and fixture
* Pliers
* Rotary disc abrasive grinder
* Reamers
* Saw
* Screwdrivers
* Spiral lowering
* Tap wrench
* Vacuum cleaners
* V-block
* Workbenches
* Fire fighting equipment
* First Aid kit

**Materials and supplies suggested but not limited to:**

* Personal safety gear:
* Goggles
* Safety shoes
* Overall
* Cap
* Ear Muffs
* Gloves
* Drawing papers
* Raw materials
* Mild steel plate
* Sheet metal
* Brass sheets
* Zinc sheets
* Aluminium sheets
* Bright Drawn Mild Steel
* Carbon steel
* Brass rods
* Aluminium rods
* Abrasive materials
* Grinding paste
* Cotton wastes
* Cleaning detergents
* Vacuum cleaners
* Mops/ Brooms and buckets

# ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/CU/ME/CC/04/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: **Apply engineering mathematics**

Duration of Unit: 80 hours

**Unit Description**

This unit describes the competencies required by a mechanical production technician in order to apply algebra, apply coordinate geometry, trigonometric functions, carry out mensuration, apply statistics, matrix methods and apply vector geometry.

**Summary of Learning Outcomes**

1. Apply Algebra
2. Apply Coordinate Geometry
3. Apply trigonometric functions
4. Carry out mensuration
5. Apply statistics
6. Apply matrix
7. Apply vectors

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| Learning Outcome | Content | Suggested Assessment Methods |
| 1. Apply Algebra | * Fundamental operations * Addition, * Subtraction, * Multiplication, * Division of positive and negative numbers * Fractions and decimals operations and conversions * Indices * Logarithms * Simultaneous equations * 2 unknowns * 3 Unknowns * Elimination method * Substitution method * Ratios and proportions * Meaning * Conversions into percentages * Direct and inverse proportions determination * Use of scientific calculator | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Apply Coordinate Geometry | * + Coordinates * Cartesian * Polar   + Polar equations   + Normal distribution curve   + Tangents | * Written tests * Oral questioning * Assignments * Supervised exercises |
| 1. Apply trigonometric functions | * Meaning of trigonometry * Pythagoras theorem * Trigonometry ratios of angles * Sine ratio * Cosine * Tangent * Cotangent * Cosecant * Secant | * Assignments * Oral questioning * Supervised exercises * Written tests |
| 1. Carry out mensuration | * Units of measurements and their symbols * Conversion of units of measurement * Calculation of length, width, height, perimeter, area and angles of figures * Measuring tools and equipment * Performing measurements and estimations of quantities | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Apply statistics | * + Classification of data * Grouped data * Ungrouped data   + Data collection * Importance of sampling * Errors in sampling * Types of sampling and their limitations   + Tabulation of data * Class intervals * Class boundaries * Frequency tables * Cumulative frequency   + Diagrammatic and graphical presentation of data e.g. * Histograms * Frequency polygons * Bar charts * Pie charts * Normal distribution curve   + Cumulative frequency curves   + Meaning of measures of central tendency   + Measures * Properties * Calculation and interpretation of mean, mode and median, Variance and standard deviation | * Assignments * Oral questioning * Practical tests * Observation * Supervised exercises * Written tests |
| 1. Apply matrix | * + Meaning of matrix   + Types of matrices   + Matrix operations * Compatibility * Addition * Subtraction * Multiplication   + Determination of inverse of a matrix   + Solution of simultaneous equations with two or three unknowns   + Applications of matrices | * Assignments * Supervised exercises * Written tests |
| 1. Apply vector geometry | * + Meaning of vector   + Representations of vectors   + Operations of vectors * Addition * Subtraction * Scalar and vector products   + Determination of angles   + Solutions on position vectors | * Assignments * Supervised exercises * Written tests |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Rulers, pencils, erasers
* Charts with presentations of data
* Graph books
* Dice
* Computers with internet connection

# MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE: ENG/CU/ME/CC/05/5/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Mechanical science principles

**Duration of Unit**: 90 hours

**Unit Description**

This unit describes the competencies required by a Mechanical Production Technician to apply mechanical science principles in their work. In the context of the standard the technician is to determine forces in a system, demonstrate understanding principles of moments, friction, concepts of motion as well as apply concepts of work, energy and power, perform machine calculations. In addition, the technician is able to demonstrate understanding of gas principles, apply heat, density and pressure concepts in producing components.

**Summary of Learning Outcomes**

1. Determine forces in a system
2. Demonstrate understanding of moments of forces
3. Demonstrate understanding of friction
4. Demonstrate motion concepts in engineering
5. Apply concepts of work, energy and power
6. Perform simple machine calculations
7. Demonstrate understanding of gas principles
8. Apply concepts of heat
9. Apply density principles
10. Apply pressure principles

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Determine forces in a system | * Definition of force and types of forces * Theorems of forces * Principles of forces * Resultant of coplanar forces Application of forces | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Demonstrate knowledge of moments of forces | * Definition of moments of forces * Calculation of moments of forces * principles of moments of forces * Determination of moment couples * Application of moments of forces in engineering | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Understand friction principles | * Definition of friction * Laws of friction * Calculation of limiting friction * Calculation of forces applied at an angle to a horizontal plane * Coefficient of friction * Advantages and disadvantages of friction * Applications of friction | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Understand motion in engineering | * Definition of linear motion * Definition of angular motion * Concepts of motion * Laws of motion * Displacement time graph * Applications of motion | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Demonstrate knowledge of work, energy and power | * Definitions of energy, work and power * Calculations of work -done * Calculations of energy * Calculations of power | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Perform simple machine calculations | * Definitions on simple machines * calculations on simple machines concepts * Law of machine * Mechanical advantage, velocity ratio and efficiency | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Demonstrate knowledge of gas principles | * Gas laws * Application of gas laws * Uses of gases in engineering systems | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Apply heat knowledge | * Definitions * Concepts of heat energy   + Heat transfer * Heat capacity   + Specific heat capacity | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Apply density knowledge | * Density terminologies * Density measurements * Applications of density concepts in engineering | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Apply pressure principles | * Concepts of Pressure * Pressure measurements * applications of Pressure concepts in engineering | * Written tests * Oral questioning * Assignments * Supervised exercises |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by the trainer
* Online video clips
* Power point presentation
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Relevant practical materials
* Computers with internet connection
* Handbook by Hillier and Hannah

# ELECTRICAL SCIENCE PRINCIPLES

**UNIT CODE: ENG/CU/ME/CC/06/5/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Electrical Science principles

**Duration of Unit**: 60 hours

**Unit Description**

This unit describes the competencies required by a mechanical production technician in order to apply a wide range of electrical principles in their work. In the context of the standard the technician is able to: apply concepts of electrical quantities, use the concepts of D.C and A.C circuits in electrical installation, use basic electrical machines, perform earthing in electrical installations and apply lightning protection measures

**Summary of Learning Outcomes**

1. Apply concepts of electrical quantities
2. Apply the concepts of D.C and A.C circuits in electrical installation
3. Apply basic electrical machines
4. Perform earthing in Electrical installations
5. Apply lightning protection measures

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply concepts of Electrical quantities | * Definition of electrical quantities * SI units in electrical * Quantities of charge, force, work and power * Calculations involving ohms law i.e resistance, current and voltage * measuring instruments for Electrical quantities | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Use the concepts of D.C and A.C circuits in electrical installation | * Definition of AC and DC circuits * Parallel and series circuits * Photovoltaic solar systems * AC to DC and DC to AC Conversions | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Use basic electrical machines | * Types of electrical machines * Single phase AC and DC motor operations * Three phase AC and DC motors operations. * Single phase AC transformer operations * three phase A.C transformers operations * Single phase and three phase generators and alternators * Applications of A.C and D.C Machines | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Perform earthing in Electrical installations | * Types of electrical earthing and their applications * Earthing points on electrical installations * Determination of Earthing requirements * Earthing system tests | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |
| 1. Apply lightning protection measures | * Types of lightning strikes * Components of lightning protection system * Lightning protection system tests * Application of lightning protection system | * Written tests * Oral questioning * Assignments * Supervised exercises * Practical exercises |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by the trainer
* Online video clips
* Power point presentation
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Electrical workshop
* Relevant practical materials
* Computers with internet connection

# CORE UNITS OF LEARNING

# 

SHEET METAL FABRICATION

**UNIT CODE:** ENG/CU/ME/CR/01/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Fabricate sheet metal parts

**Duration of Unit:** 200 hours

This unit covers the competencies required by a Mechanical production technician to fabricate sheet metal parts. It includes competencies that ensure the learner will: observe safety rules and regulations, identify sheet metal tools & equipment, read and interpret working drawings, mark out, set up sheet metal fabrication machines and equipment, fabricate sheet metal components, assess quality of components, maintain sheet metal fabrication tools, machine and equipment and perform housekeeping.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Use sheet metal machines, tools & equipment.
3. Plan work operation
4. Mark out work pieces
5. Set- up sheet metal machine and equipment
6. Fabricate component (s) according to specifications
7. Assess Quality of the fabricated component(s)
8. Maintain sheet metal machines, tools and equipment
9. Perform housekeeping
10. Document report

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Observe safety rules and regulations | * personal safety, * Machine safety * Safety regulations on OSH * safe working environment * Occupational hygiene * First aid * Fire fighting | * Oral questions * Written tests * Observation of trainees identify hazards and risks |
| 1. Use sheet metal machines, tools & equipment. | * Types of sheet metal machine tools ,equipment and their applications   + Rolling machine   + Bending machine   + Punching machine   + Shearing machine * Parts of sheet metal machine tools/ equipment and their functions * Sheet metal machine tools / equipment selection and usage. | * Oral questions * Written tests * Practical test * Observation |
| 1. Plan work operation | * Work plan procedure * Time management * Work scheduling. * Selection of tools Selection of materials | * Oral questions * Written tests * Practical test * Observation |
| 1. Mark out workpiece | * Selection of measuring and marking out tools * Dimensional specifications * Marking out * Pattern development * Templates | * Oral questions * Written tests * Practical test * Observation |
| 1. Set- up sheet metal machine | * Machine tool selection * Machine operational status * Mounting of machine tool/equipment attachment | * Oral questions * Written tests * Practical test * Observation |
| 1. Fabricate component (s) | * Aligning /clamping of sheet metal workpiece * Sheet metal machine accessories * Sheet metal jointing methods   + Soldering   + Adhesives   + mechanical fasteners   + Brazing   + gas welding   + resistance welding   + MMAW process | * Oral questions * Written tests * Practical test * Observation |
| 1. Assess Quality of the fabricated component(s) | * Cleaning of the finished work piece * Inspection of the finished work piece * Assessment of the finished work pieces and their function ability | * Oral questions * Written tests * Practical test * Observation |
| 1. Maintain sheet metal machines, tools and equipment | * Cleaning of the machine tools and equipment * Inspection of machine tools and equipment * Fault identification and reporting * servicing of machine tools/equipment & accessories | * Oral questions * Written tests * Practical test * Observation |
| 1. Perform housekeeping | * Work place cleaning procedures * Waste segregation and disposal * Storage of tools and equipment | * Oral questions * Written tests * Practical test * Observation |
| 1. Document report | * Defects/ deviations report * Cost variations report * Accidents and incidents report | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Field trips
* Viewing of related videos

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Head hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# GRINDING OPERATIONS

**UNIT CODE:** ENG/CU/ME/CR/02/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform grinding operations

**Duration of Unit:** 150 hours

**Unit Description**

This unit covers the competencies required by a mechanical production technician to perform grinding operations. In the context of the standard the technician is to: observe safety rules and regulations, identify grinding machine parts and accessories, prepare work operation plan, set up grinding machine, perform grinding operations, assess quality of finished work, maintain grinding machine and perform housekeeping.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Identify machine parts, accessories and their functions.
3. Identify types and features of grinding wheels
4. Prepare work operation plan
5. Set- up the grinding machine
6. Perform grinding operations
7. Assess quality of finished work
8. Maintain the grinding machine, tool and accessories
9. Perform Housekeeping
10. Document report

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * 1. 1. Observe safety rules and regulations | * Personal safety, PPEs in accordance to the work environment * Grinding machine tools safety precautions * Safety regulations on OSHA * Workplace procedures and environment measures | * Oral questions * Written tests * Observation |
| * 2. Identify machine parts, accessories and their functions | * Types of grinding machine tools / equipment * Surface grinding machine * Portable grinding machine * Cylindrical grinding machine * Parts of grinding machine tools/ equipment and their functions * Grinding machine tools / equipment selection and applications. | * Oral questions * Written tests * Practical test * Observation of implementation of control measures |
| 3. Identify types and features of grinding wheels | * Types of grinding wheels/stones * Grinding wheels/ stones defects   + Glazing   + Gumming * Wheel dressing * Grinding wheels calculation and geometry * Grinding wheel balancing * Abrasive materials principles * Abrasive materials identification | * Oral questions * Written tests * Practical test * Observation |
| 1. Prepare work operation plan | * Work plan procedure * Time management * Work scheduling. * Selection of tools * Selection of materials * Dimensions * Tolerances * Drawing standards * Geometric symbols and abbreviations * Operation plan development | * Oral questions * Written tests * Practical test * Observation |
| 1. Set- up the grinding machine | * Principle of operation * Grinding operation * Wheel/stones selection and mounting * Work piece securing/mounting | * Oral questions * Written tests * Practical test * Observation |
| 1. Perform grinding operations | * Grinding operations * Surface grinding * Portable grinding machine operation * Cylindrical grinding operation:   + External cylindrical grinding operation   + Internal cylindrical grinding operation * Centre-less grinding operation * Form grinding operation * Wet and dry grinding operations | * Oral questions * Written tests * Practical test * Observation |
| 1. Assess quality of finished work | * Dimensional accuracy analysis * Surface finish checks * Functionality checks * Inspection of the finished work piece | * Oral questions * Written tests * Practical test * Observation |
| 1. Maintain the grinding machine | * Cleaning of the machine tools and equipment * Inspection of machine tools and equipment * Fault identification and reporting * Servicing of the machine tools, equipment & accessories | * Oral questions * Written tests * Practical test * Observation |
| 1. Perform housekeeping | * Work place cleaning procedures * Waste segregation and disposal * Storage of tools and equipment | * Oral questions * Written tests * Practical test * Observation |
| 1. Document Report | * Defects/ deviations report * Cost variations report * Accidents and incidents report xxx | * Oral questions * Written tests * Practical test * Observation |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety boots
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# LATHE OPERATIONS

**UNIT CODE:** ENG/CU/ME/CR/03/5/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Produce components on lathe

**Duration of Unit:** 200 hours

**Unit Description**

This unit specifies the competencies required to produce components on lathe machine. These includes: observing safety rules and regulations, identify lathe machine parts accessories and their functions, prepare operation procedure sheet, mount work pieces, perform lathe machine operations, assess quality of finished work, organize work area and maintain machine tool and accessories while observing safety rules and regulations**.**

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Identify machine parts, tools, accessories and their functions
3. Prepare operation plan
4. Mount work piece
5. Perform machining to specifications
6. Assess quality of finished work
7. Maintain machine tool and accessories
8. Perform house keeping
9. Document report

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Observe safety rules and regulations | * Personal safety * Machine, tools and equipment safety * Machine guards * Operational procedures * Proper insulations * Recommended handling * Safe work environment * Avoid spills * Lighting * Aeration * Clear gang ways | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Identify machine parts, tools, accessories and their functions | * Lathe parts * Headstock * Tailstock * Guideways * Bed * Apron * Carriage * Cross and top slide * Chuck * Tools and accessories * Turning tools * Threading tools * Grooving tools * Boring tools and bars * Facing tools * Steadies * Faceplate * Taper turning attachment * Lathe dogs * Collets * Mandrels * Tool materials * Tool bars * Inserts * HSS * Diamond tip * Carbides | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Prepare operation plan | * Sequence of operations * Order of operation * Rough cuts * Finishing cuts * Number of cuts * Cutting data * Depth of cut * Length of cut * Feed rate * Cutting speed * Spindle speed * Cutting angle * Taper angle * Chamfer angle * Production time * Specific time per tasks * Total production time | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Mount work piece | * Work holding devices * Three jaws chuck * Four jaws chuck * Collets * Face plate * Tail stock centres * Steadies * Lathe dogs * Setting Up Workpiece * Tool below work centre * Tool above work centre * Tool chatter * Self-centring * Use of the scribing block and dial gauge * Effect of work wobbling | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Perform machining to specifications | * Lathe operations * Facing * Straight turning * Step turning * Grooving * Drilling * Boring * Threading * Chamfering * Knurling * Taper turning * Parting off * Eccentric turning * Cutting parameters * Depth of cut * Feed rate * Cutting speed * Spindle speed * Use of coolant * Types of chips * Continuous chips * Discontinuous chips * Continuous chips with a built-up edge | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Assess quality of finished work | * Dimensions and tolerances * Linear * Diameter * Pitch * Surface roughness * Measurement and inspection tools * Vernier calliper * Micrometer * Depth gauge * GO and NOT GO gauges * Surface analysers * Assembly * Functionality * Tolerances * Limits and fits * Geometry * Squareness * Concentricity * Angularity * Straightness |  Observation   Oral questioning   Practical tests   Written tests |
| 1. Maintain machine tool and accessories | * Cleaning * Removal of chips * Cleaning coolant spills * Cleaning tools and accessories * Oiling of surfaces and guide ways * Lubrication of moving parts * Inspection and reporting of faults | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Perform house keeping | * Cleaning * Removal of chips * Floor mopping * Waste sorting * Metallic waste * Rags * Plastics * Waste disposal * Recycling * Burning * Burying * Re-use | * Observation * Oral questioning * Practical tests * Written tests |
| 1. Document Report | * Defects/ deviations report * Cost variations report * Accidents and incidents report xxx | * Oral questions * Written tests * Practical test * Observation |

**Suggested Methods of Delivery**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions

**Recommended Resources**

* Lathe machine
* Lathe tools and accessories
* Measuring and inspection tools
* Coolant
* Work holding devices
* Work piece material
* Resource materials, manuals for cutting tools & lathe
* Work place procedures
* Calculator
* Projectors
* Computers
* Manuals
* Printers
* Internet simulation
* Occupational Safety and Health Act (OSHA)
* National Environmental Management Authority (NEMA) regulations
* Other relevant resources

# MILLING MACHINE OPERATIONS

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**UNIT CODE: ENG/CU/ME/CR/04/5/A**

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Produce components on a milling machine tool

**Duration of Unit:** 200 hours

**Unit Description**

The Mechanical production technician will be able to produce components on a milling machine tool while observing occupational safety and health legislations, regulations and safe working practices. In the context of the standards, the learner is to; identify parts of a milling machine, plan work operations, mark out workpieces, set up machine tool and perform machining, assess the quality of the machined parts as well as perform maintenance of the machine tools and housekeeping on the work area.

**Summary of Learning Outcomes**

1. Observe safety rules and regulations
2. Identify parts of a milling machine tool
3. Plan work operations
4. Mark out work piece
5. Set up milling machine tool for a specific operation
6. Perform machining as per the specifications
7. Assess quality of machined parts
8. Maintain machine tool and accessories
9. Perform housekeeping
10. Document report

**Learning Outcomes, Content and Suggested Assessment Methods:**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Observe safety rules and regulations | * Occupational safety and health regulations (OSHA) * Personal protective equipment * Machinery safety * Environmental safety * Occupational Hygiene * First aid * Fire fighting | * Observation * Oral questioning * Written tests |
| 1. Identify parts of a milling machine tool | * Types of milling machines   + Vertical   + Horizontal   + Universal * Parts of milling machine tool   + Functions * Milling machine accessories | * Observation * Oral questioning * Written tests |
| 1. Plan work operations | * Work plan procedure * Time management * Work scheduling. * Selection of tools * Selection of materials * Dimensions * Tolerances * Drawing standards * Geometric symbols and abbreviations * Operation plan development | * Observation * Oral questioning * Written tests * Practical exercise * Projects |
| 1. Mark out work piece | * Measuring tools   + Types   + Inspection   + calibration * Marking-out tools * Laying out work piece(s) * Transfer of dimensions onto the work piece(s) | * Observation * Oral questioning * Practical exercise * Written tests * Projects |
| 1. Set up milling machine tool for a specific operation | * Work holding devices and their applications   + Machine vice   + Machine spindle (arbor   + V-Block   + Angle plate   + Machine table   + Jigs and fixtures   + Indexing head * Workpiece set-up * Milling cutters   + Side and Face cutter   + End mill   + Slot cutter   + Gear cutter   + Boring tool   + Fly cutter * Speeds and feed rates   + Spindle speed   + Cross feed   + Transverse feed   + Vertical feed | * Observation * Oral questioning * Practical exercise * Written tests |
| 1. Perform machining as per the specifications | * Milling operations   + Slot cutting   + Gear cutting   + Boring   + Face milling   + Slab milling   + Indexing * Cutting fluids   + Types   + Properties   + Functions * Milling specification   + Dimensions and tolerances   + Geometry (Concentricity, Straightness, Flatness, Squareness and roundness)   + Surface finish | * Observation * Oral questioning * Practical exercise * Written tests * Projects |
| 1. Assess quality of machined parts | * Inspection tools * Inspection methods * Inspection specifications   + Dimensions and tolerances   + Geometry (Concentricity, Straightness, Flatness, Squareness and roundness)   + Surface finish   + Functionality | * Observation * Oral questioning * Practical exercise * Written tests |
| 1. Maintain machine tool and accessories | * Maintenance of machine and accessories * lubrication * inspection * alignment * adjustment * Servicing measuring tools and accessories e.g. * Cleaning * Oiling * Painting * Inspection of tools and accessories | * Observation * Oral questioning * Practical exercise * Written tests |
| 1. Perform housekeeping | * Cleaning of work environment (waste sorting and disposal) * Cleaning of tools * Storing of tools and equipment | * Observation * Oral questioning * Practical exercise * Written tests |
| 1. Document Report | * Defects/ deviations report * Cost variations report * Accidents and incidents report xxx | * Oral questions * Written tests * Practical test * Observation |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Simulations
* Field trips
* On-job training
* Discussions

**Recommended Resources**

* Milling machine
* Milling cutters
* Measuring tools
* Stock material
* Resource materials, manuals for cutting tools and milling machine
* Computers
* Projectors
* Manuals
* Printers
* Any other relevant resources
* Occupational safety and health act (OSHA)
* Work injury benefits act(WIBA)
* KEBS standards