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MINISTRY OF LABOR AND SKILLS

MACHINING
LEVEL – IV



CURRICULUM

Based on December, 2021 (V- III) Occupational Standard (OS)

March, 2022
Addis Ababa, Ethiopia

Preface

The reformed TVET-System is an outcome-based system. It utilizes the needs of the labor market and occupational requirements from the world of work as the benchmark and standard for TVET delivery. The requirements from the world of work are analyzed and documented – taking into account international benchmarking – as occupational standards (OS).

In the reformed TVET-System, curricula and curriculum development play an important role with regard to quality driven comparable TVET-Delivery. The Curricula help to facilitate the training process in a way, that trainees acquire the set of occupational competences (skills, knowledge and attitude) required at the working place and defined in the occupational standards (OS).

This curriculum has been developed by a group of professional experts from different Regional TVET Bureaus, colleges, Industries, Institutes and universities based on the occupational standard for Machining Level IV

The curriculum development process has been actively supported and facilitated by **Ministry of Labor and Skills.**

TVET-Program Design

1.1.TVET-Program Title: Machining Level IV

1.2.TVET-Program Description

The Program is designed to develop the necessary knowledge, skills and attitude of the trainees to the standard required by the occupation. The contents of this program are in line with the occupational standard. The Trainees who successfully completed the Program will be qualified to work as a **machinist** with competencies elaborated in the respective OS. Graduates of the program will have the required qualification to work in the **Industry** sector in the field of Machining. The prime objective of this training program is to equip the Trainees with the identified competences specified in the OS. Graduates are therefore expected to Supervise Detail Drafting Drawing, Supervise CIM Production Operations, Develop and Manufacture Precision Models, Perform Advanced Machine/Process Operation, Perform Multiple Spindle and/or Multiple Axis NC/CNC Machining, Manufacture Advance Press Tools, die and Moulds Manage Product Cost Estimation and Bill of Materials, Perform Process Planning and Production Scheduling, in accordance with the performance criteria and evidence guide described in the OS.

1.3.TVET-Program Training Outcomes

The expected outputs of this program are the acquisition and implementation of the following units of competences:

IND MAC4 01 1221 Supervise Detail Drafting Drawing
IND MAC4 02 1221 Supervise CIM Production Operations
IND MAC4 03 1221 Develop and Manufacture Precision Models
IND MAC4 04 1221 Perform Advanced Machine/Process Operation
IND MAC4 05 1221 Perform Multiple Spindle and/or Multiple Axis NC/CNC Machining
IND MAC4 06 1221 Manufacture Advance Press Tools, die and Moulds
IND MAC4 07 1221 Manage Product Cost Estimation and Bill of Materials
IND MAC4 08 1221 Perform Process Planning and Production Scheduling

1.4.Duration of the TVET-Program

The Program will have duration of **540 hours** including the on school/ Institution training and on-the-job practice or cooperative training time. Such cooperative training based on realities of the industry, nature of the occupation, location of the TVET institution, and other factors will be considered in the training delivery to ensure that trainees acquire practical and workplace experience.

S.No	Unit Competency	TVET Institution Training		Cooperative Training	Total Hours	Remarks
		Theory	Practical			
1.	Supervise Detail Drafting Drawing	18	30	12	60	
2.	Supervise CIM Production Operations	24	40	16	80	
3.	Develop and Manufacture Precision Models	18	30	12	60	
4.	Perform Advanced Machine/Process Operation	24	40	16	80	
5.	Perform Multiple Spindle and/or Multiple Axis NC/CNC Machining	24	40	16	80	
6.	Manufacture Advance Press Tools, die and Moulds	15	25	10	50	
7.	Manage Product Cost Estimation and Bill of Materials	15	25	10	50	
8.	Perform Process Planning and Production Scheduling	24	40	16	80	
Total Hours					**540 Hours**	

1.5.Qualification Level and Certification

Based on the descriptors elaborated on the Ethiopian National TVET Qualification Framework (NTQF) the qualification of this specific TVET Program is **Level IV.**

The trainee can exit after successfully completing the modules in one level and will be awarded the equivalent institutional certificate on the level completed. However, only institutional certificate of training accomplishment will be awarded.

1.6.Target Groups

Any citizen **with or without disability** who meets the entry requirements under items 1.7 and capable of participating in the training activities is entitled to take part in the Program.

1.7 Entry Requirements

The prospective participants of this program are required to possess the requirements or directive of the **Ministry of Labor and Skills**.

1.8 Mode of Delivery

This TVET-Program is characterized as a formal Program on middle level technical skills. The mode of delivery is co-operative training. The time spent by the trainees in the real work place/ industry will give them enough exposure to the actual world of work and enable them to get hands-on experience. The co-operative approach will be supported with school-based lecture-discussion, simulation and actual practice. These modalities will be utilized before the trainees are exposed to the industry environment.

Hence based on the nature of the occupation, location of the TVET institutions, and interest of the industry alternative mode of cooperative training such as apprenticeships, internship and traineeship will be employed. In addition, in the areas where industry is not sufficiently available the established production and service centers/learning factories in TVET institutions will be used as cooperative training places. The Training-Institution and identified companies have forged an agreement to co-operate with regard to the implementation of this program.

1.9 TVET-Program Structure

Unit of Competence	Module Code & Title	Training Outcomes	Duration (In Hours)
IND MAC4 01 1221 Supervise Detail Drafting Drawing	IND MAC4 M01 0322 Supervising Detail Drafting Drawing	• Confirm client or designer detail drafting briefs • Prepare a preliminary sketch/drawing/ specifications • Lead detail drafting project • Check detail drafting outcomes. • Monitor presentation of drawings	**60 hr.**
IND MAC4 02 1221 Supervise CIM Production Operations	IND MAC4 M02 0322 Supervising CIM Production Operations	• Interpret the design brief or scope of production including CIM system • Prepare production process including possible CIM system • Perform supervision of conventional and /or CIM supported production • Assure quality production process	**80hr**

IND MAC4 03 1221	Develop and Manufacture Precision Models	IND MAC4 M03 0322	Developing and Manufacture Precision Models	• Determine work requirements • Layout model • Manufacture model • Assure Quality	**60 hr.**
IND MAC4 04 1221	Perform Advanced Machine/Process Operation	IND MAC4 M04 0322	Performing Advanced Machine/Process Operation	• Determine work requirements • Investigate current practices in relation to resource usage. • Prepare pre-start processes • Perform machine process • Quality assure production process	**80hr**
IND MAC4 05 1221	Perform Multiple Spindle and/or Multiple Axis NC/CNC Machining	IND MAC4 M05 0322	Performing Multiple Spindle and/or Multiple Axis NC/CNC Machining	• Identify NC/CNC machine program elements • Write NC/CNC machine program and operation sheet • Trial program	80 hr.

IND MAC4 06 1221	Manufacture Advance Press Tools, die and Moulds	IND MAC4 M06 0322	Manufacturing Advance Press Tools, die and Moulds	• Identify and prepare work requirements • Manufacture tooling components • Assemble components • Assure quality	**50hr**
IND MAC4 07 1221	Manage Product Cost Estimation and Bill of Materials	IND MAC4 M 07 0322	Managing Product Cost Estimation and Bill of Materials	• Determine job requirements • Setup work-piece • Perform lathe operations • Check/Measure work piece	**60 hr.**
IND MAC4 08 1221	Perform Process Planning and Production Scheduling	IND MAC4 M08 0322	Performing Process Planning and Production Scheduling	• Plan and prepare for work • Develop estimated product / project costs • Analyze customer benefits and determine waste • Analyze production performance variance • Measure and check correct quantities of work • Maintain administrative control over resource acquisition process • Supervise the provision and	**80hr**

		withdrawal of resources • Assure quality and verify all data	

***The time duration (Hours) indicated for the module should include all activities in and out of the TVET institute**

1.10 Institutional Assessment

Two types of evaluation will be used in determining the extent to which training outcomes are achieved. The specific training outcomes are stated in the modules. In assessing them, verifiable and observable indicators and standards shall be used.

The **formative assessment** is incorporated in the training modules and form part of the training process. Formative evaluation provides the trainee with feedback regarding success or failure in attaining training outcomes. It identifies the specific training errors that need to be corrected, and provides reinforcement for successful performance as well. For the teacher, formative evaluation provides information for making instruction and remedial work more effective.

Summative Evaluation the other form of evaluation is given when all the modules in the program have been accomplished. It determines the extent to which competence have been achieved. And, the result of this assessment decision shall be expressed in the term of institutional Assessment implementation guidelines..

Techniques or tools for obtaining information about trainees' achievement include oral or written test, demonstration and on-site observation.

1.11 TVET Teachers Profile

The teachers conducting this particular TVET Program are **A Level** and above who have satisfactory practical experiences or equivalent qualifications.

LEARNING MODULE 01
TVET-PROGRAMME TITLE: Machining **Level IV**
MODULE TITLE: **Supervising Detail Drafting Drawing**
MODULE CODE: **IND MAC4 M01 0322**
NOMINAL DURATION: **60 Hours**
MODULE DESCRIPTION: This module covers the skills, knowledge and attitudes required to supervise work of other detail draftspersons to confirm drafting projects are accurate and complies and project briefs from clients and designers.

LEARNING OUTCOMES

At the end of the module the trainee will be able to:

LO1. Confirm client or designer detail drafting briefs

LO2. Prepare a preliminary sketch/drawing/ specifications

LO3. Lead detail drafting project

LO4. Check detail drafting outcomes**.**

LO5. Monitor presentation of drawings

MODULE CONTENTS:

LO1.Confirm client or designer detail drafting briefs

1.1 Interpreting and Verifying objectives, scope, parameters and drawing

1.2 Identifying and Addressing further Available information needs

1.21 Construction documents

1.22 Building and coordination information

1.23 Work specifications

1.24 Information for plant services equipment

1.25 Industry codes, standards and regulations

1.26 Design brief.

1.3 Identifying any regulatory and commercial requirements

1.4 Identifying additional expertise,

1.5 Identifying any additional skill or training needs

1.6 Identifying file and software.

LO2.Prepare a preliminary sketch/drawing/ specifications

2.1 Selecting appropriate basic components, assemblies and fasteners

2.2 Selecting where required, components and/or materials

2.3 Applying appropriate and relevant codes..

2.4 Approving the preliminary sketch/drawing/specification.

LO3.Lead detail drafting project

3.1 Confirming work plan, including timelines, roles and responsibilities

3.2 Identifying CAD software platform

3.3 Selecting organizational files, library, templates and symbols.

3.4 Checking information accuracy and generate requests.

3.5 Confirming other detail draft persons.

3.6 Understanding clarified documentation for detail drafting work

3.7 Liaising with engineers, design draftspersons and/or clients.

LO4. Check detail drafting outcomes.

4.1 Monitoring progress of drafting work

4.2 Providing support to detail drafting personnel,

4.3 Documenting Checked design.

4.4 Requiring review consistency of 3-D models and detail drawings.

4.5 Checking final models and drawings

4.6 Monitoring compliance.

4.7 Obtaining checked sign-off for drawings.

4.8 Storing and filing checked documents.

4.9 Providing detail draft feedback on project outcomes.

LO5. Monitor presentation of drawings

5.1 Presenting checked drawings and project brief.

5.2 Completing and presenting checked documentation.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in Audio/video ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop

		❖ Summarize main points		
Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare and submit the assignment in soft or hard copy	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

ASSESSMENT METHODS:				
Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges
Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the	❖ Provide activity based assessment

			exam	
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO.1. Confirm client or designer detail drafting briefs

- Objectives, scope, parameters and drawing requirements are interpreted and verified
- Further Available information needs are identified and addressed
- Any regulatory and commercial requirements are identified
- Whether project brief requires are identified additional expertise, or resource requirements
- Any additional skill or training needs to deliver detail drafting outcomes are identified
- File and software requirements are identified including requirements to transfer to other file formats, and any required customization

LO.2 Prepare a preliminary sketch/drawing/ specifications

- Appropriate basic components, assemblies and fasteners are selected to perform the required function.
- Where required, components and/or materials are
- Selected from supplier/manufacturer catalogues.
- Appropriate and relevant codes are applied to the sketch/drawing/specification in accordance with workplace procedures.
- The preliminary sketch/drawing/specification is approved in accordance with policy and procedures

LO.3 Lead detail drafting project

- Work plan, including timelines, roles and responsibilities are confirmed
- Identified CAD software platform to be used and conduct customization, as required.
- Organizational files, library, templates and symbols are selected as required for work.
- Information accuracy and generate requests are checked for further information (RFIs), as required.
- Other detail draft persons understand work requirements are confirmed clearly
- Clarified that documentation requirements for detail drafting work are understood by detail draftspersons.

- Liaised with engineers, design draftspersons and/or clients, as required, to provide progress updates, confirm detail design requirements and other details.

LO4. Check detail drafting outcomes.

- Monitor progress of drafting work against timelines and brief.
- Provide support to detail drafting personnel, as required
- Checked that design variations are documented
- Review consistency of 3-D models and detail drawings where multiple models or drawings are required
- Final models and drawings and specifications are checked
- Monitor compliance with workplace occupational health and safety (OHS) and environmental procedures.
- Checked that required sign-off for drawings is obtained.
- Check that project documents are stored and filed according to organizational procedures.
- Detail draft persons with feedback on project outcomes are provided

LO5. Monitor presentation of drawings

- Check that drawings are presented according to industry standard and that outcomes comply with the project brief.
- Check that all required documentation is completed and presented to engineers, designers and/or clients as required.

Annex: Resource Requirements

IND MAC2 M01 0322 **Supervising Detail Drafting Drawing**				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by the trainer	25	1:1
2.	Text Books	Any book Related to the UC		
3.	Reference Books	MAK 112E-4 Computer Aided Technical Drawing Dr C Erdem IMRAK @ 2002 Enginering Drawing Gills		
4.	Journals/Publication/Magazines			
B.	**Learning Facilities & Infrastructure**			
1.	Drawing Room	5m x 8m	1	1:25
2.	Clinic	Standard	1	1:25
C.	***Consumable Materials***			
1	Copy paper Drawing paper	A_4, ,	5packs	1:5
2	Drawing pencil	2H,6H,HB	25pcs	1:1
3	Masking tape	Pcs	25pcs	1:1
4	Eraser	Standard	25pcs	1:1
5	White Board Marker	Standard	1 pack	
	Tools and Equipment			
1.	T-square	Standard	25	1:1
2.	Drawing triangle	45^0 X 90^0	25	1:1
3.	Drawing triangle	30^0 X 60^0	25	1:1
4.	Compass	Standard	25	1:1
5.	Divider	Standard	25	1:1

6.	Mechanical Pencil	0.5 mm & 0.7 mm	25	1:1
7.	Drawing board	Standard	25	1:1
8.	scale	Standard	25	1:1
9.	White Board	1m x 1.5m	1	1:25
10.	LCD	055-inch.wide panel(D7)		1:25

LEARNING MODULE 02
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE : **Supervise CIM Production Operations**
MODULE CODE : **IND MAC4 M 02 0322**
NOMINAL DURATION : **80 Hours**
MODULE DESCRIPTION : This Modules deals with the skill, knowledge and attitudes required of supervising production operations including control of machine and processes and the capture of manufacturing data through conventional or computer-integrated Manufacturing (CIM) processes.
LEARNING OUTCOMES At the end of the module the trainee will be able to: **LO1.** Interpret the design brief or scope of production including CIM system **LO2.** Prepare production process including possible CIM system **LO3.** Perform supervision of conventional and /or CIM supported production **LO4.** Assure quality production process

MODULE CONTENTS:

LO1. Interpret the design brief or scope of production including CIM system

1.1.Establishing renquired features and extent of integration of the CIM system.

1.2.Establishing technical, commercial and environmental parameters

1.3.Cconsulting technical managers and senior design engineers.

1.4.Cconsidering OHS, regulatory requirements and enterprise procedures.

1.5.Ccollecting and presenting preliminary advice on feasibility of manual or possible CIM project.

LO2. Prepare production process including possible CIM system

2.1. Preforming iinvestigations and measurements.

2.2. Carraying out renquired modelling and calculations.

2.3. Genervating arrange of conventional and CIM production solutions.

2.4. Checking feasibility and evaluate solutions against design criteria.

2.5. Ddetermining Social and sustainability implications of solutions.

2.6. Rreviewing Concept proposals with client.

LO3. Perform supervision of conventional and /or CIM supported production.

3.1 Planning conventional production processes in comparison to CIM design.

3.2 Pproviding documentation, drawings, specifications and instructions.

3.3 Cconsulting Client and stakeholders.

3.4 Preparing aproved drafted production process for implementation.

LO4. Assure quality production process

4.1 Applying (preferable ISO 9001 and 14001…) Production standards during the manufacturing process.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in **Audio/video** ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop
		❖ Summarize main points		

Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare and submit the assignment in soft or hard copy	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

ASSESSMENT METHODS:

Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges
Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the exam	❖ Provide activity based assessment
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO1. Interpret the design brief or scope of production including CIM system

- Required features and extent of integration of the CIM system are established in consultation with the client based on applicable operational regulations
- Technical, commercial and environmental parameters are established to the scope of work in accordance with organizational procedures
- Technical managers and senior design engineers are consulted in determining a production process in compliance with engineering standards
- OHS, regulatory requirements and enterprise procedures relevant to scope of work are considered
- Preliminary advice on feasibility of manual or possible CIM project are collected and presented to client based on engineering environment

LO2. Prepare production process including possible CIM system

- Investigations and measurements are performed based on scope of work and operational standards
- Required modelling and calculations are carried out using appropriate software and validation techniques according to production specifications
- A range of conventional and CIM production solutions are generated using appropriate innovative and creative engineering specifications
- Feasibility and evaluate solutions are checked against design criteria ensuring conformity to standards and codes, technical, economic and OHS requirements
- Social and sustainability implications of solutions are determined according to organizational specifications
- Concept proposals is reviewed with client and identify preferred solution according to operational procedures

LO3. Perform supervision of conventional and /or CIM supported production

- Conventional production processes are planned in comparison to CIM design based on results of external feasibility study and organizational requirements
- Documentation, drawings, specifications and instructions are provided in accordance with industry standards
- Client and stakeholders are consulted in accordance with company procedures
- Approved drafted production process is prepared for implementation according to operational requirements and standards

LO4. Assure quality production process

- Production standards are applied (preferable ISO 9001 and 14001…) during the manufacturing process according to industry requirements.

Annex: Resource Requirements

IND MAC5 M02 0322 Supervise CIM Production Operations				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by Trainer	25	1:1
2.	Reference Books	CAD/CAM/ CIM 3rd edition By P.RADHAKRISHNAN and S.SUBRAMANYAN	5	1:5
B.	**Learning Facilities & Infrastructure**			
1.	Lecture room / work shop	Standard	1	1:25
2.	Library	With sufficient books	1	1:25
C.	**Consumable Materials**			
1.	White board Marker		pack	1:25
2.	Copy A4 paper	Double A		1:25
3.	CAD/ CAM Soft ware	STD	1	1:5
D.	**Tools and Equipment**			
1.	White Board	**STD**	1	1:25
2.	Desktop Computer	**Dell**	25	1:1
3.	CNC Machine with its Accessories	**Std**	5	1:5

LEARNING MODULE 03
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE : **Developing and Manufacture Precision Model**
MODULE CODE : **IND MAC4 M03 0322**
NOMINAL DURATION : **60 Hours**
MODULE DESCRIPTION : This Modules deals with the skill, knowledge and attitudes required in laying-out, manufacturing and finishing models.

LEARNING OUTCOMES

At the end of the module the trainee will be able to:

LO1. Determine work requirements

LO2. Layout model

LO3. Manufacture model

LO4. Assure Quality

MODULE CONTENTS:

LO1. Determine work requirements

1.1. Identifying requirements from design program and brief.

1.2. Interpreting drawings, instructions and specifications.

1.3. Selecting appropriate materials.

1.4. Preparing time schedule of specific work.

1.5. Studding functional and formal relationships.

1.6. Determined detail specifications.

LO2. Layout model

2.1. Conceptualizing and planning finished model design.

2.2.Accomplishing estimated cost calculation for models.

2.3.Calculating Contractions allowances, clearances, and tapers.

2.4.Designing and manufacturing datum boards, jigs and fixtures.

LO3. Manufacture model

3.1. Determining sequence of manufacture, including build-up on datum board, establishing datum's mark out of model and areas to be machined.

3.2. Selecting appropriate machines and machining processes to shape/produce model.

3.3. Selecting a range of hand- and hand-held power tools.

3.4. Undertaking appropriate measurement/calculations to check specifications,

3.5. Assembling all components.

LO4. Assure Quality

4.1.Testing functionality of model.

4.2.Recording where necessary, all deviations or modifications to original tooling design, prints or plans.

4.3.Compiling model documentation.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in **Audio/video** ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop
		❖ Summarize main points		

Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	

Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare and submit the assignment in soft or hard copy	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

ASSESSMENT METHODS:

Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges
Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖ Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the exam	❖ Provide activity based assessment
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖ Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO1. Determine work requirements

- Requirements are identified from design program and brief.
- Drawings, instructions and specifications are interpreted and understood based on standards
- Appropriate materials are selected to meet specifications.
- Time schedule of specific work to be performed is prepared considering available resources based on the program requirements
- Functional and formal relationships are studied with reference to the actual context and given specifications
- Detail specifications are determined based on scope of work

LO2. Layout model

- Finished model design is conceptualized and planned with reference to customer's specifications (written or verbal) for finish, quality and form, in accordance with operational procedures
- Estimated cost calculation for models are accomplished in compliance with organizational processes
- Contractions allowances, clearances, tapers etc. are calculated to establish model parameters due to engineering standards applied
- Datum boards, jigs and fixtures are designed and manufactured according to drawings

LO3. Manufacture model

- Sequence of manufacture, including build-up on datum board, establishing datum's mark out of model and areas to be machined, are determined with reference to operational procedures
- Appropriate machines and machining processes are selected
- to shape/produce model to specifications

- A range of hand- and hand-held power tools are selected and used utilizing acceptable techniques and procedures to shape model to fine tolerances according to specifications.
- Appropriate measurement/calculations are undertaken to check specifications, including coordinate measuring and machine checking as required
- All components are assembled according to drawings

LO4. Assure Quality

- Functionality of model is tested in accordance with specifications and test procedures
- Where necessary, all deviations or modifications to original tooling design, prints or plans, are recorded and reported consistent with standard operating procedures
- Model documentation is compiled according to operational requirements

Annex: Resource Requirements

IND MAC4 M03 0222 Developing and Manufacture Precision Model				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by Trainer	25	1:1
2.	Reference Books	B. H. Amstead, P. Ostwald, M.L.Begaman, Manufacturing Processes,(8 Edition)	5	1:5
B.	**Learning Facilities & Infrastructure**			
3.	Lecture room / work shop	Standard	1	1:25
4.	Library	With sufficient books	1	1:25
C.	**Consumable Materials**			
4.	White board Marker		pack	1:25
5.	Copy A4 paper	double A		1:25
D.	**Tools and Equipment**			
1	White board	**1000mmm*2000mm**	1	1:5
2	Lathe Machin	Standard as required	5	1:5
3	Milling Machine	Standard as required	5	1:5
4	Drilling Machine	Standard as required	5	1:5

LEARNING MODULE 04
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE : **Performing Advanced Machine/Process Operation**
MODULE CODE : **INDMAC4 04 0322**
NOMINAL DURATION : **80 Hours**
MODULE DESCRIPTION: This module covers skill, knowledge and attitudes required to perform and supervise advanced operation of a machine or process in a production environment required to effectively analyses the workplace in relation to environmentally sustainable work practices. It includes selecting raw material, process equipment and identifying deviations and faults of the machine or process.
LEARNING OUTCOMES At the end of the module the trainee will be able to: **LO1.** Determine work requirements **LO2.** Investigate current practices in relation to resource usage **LO3.** Prepare pre-start processes **LO4.** Perform machine process **LO5.** Quality assure production process

MODULE CONTENTS:

LO1. Determine work requirements

1.1 Interpreting drawings, work instructions, specifications understanding machine/process.

1.2 Checking safety equipment and guards.

1.3 Understanding and following emergency procedures.

LO2. Investigate current practices in relation to resource usage

2.1 Identifying and applying environmental regulations to the enterprise.

2.2 Assessing procedures for **c**ompliance.

2.2.1 Includes meeting relevant federal, state and local government laws, by-laws, regulations and codes of practice.

2.2.2 Performing all operations

2.3 Collecting and providing Information on environmental and resource efficiency.

2.4 Measuring and recording current resource usage

2.4.1. Material fed to/consumed by plant/equipment

2.4.2. Plant meters and gauges

2.4.3. Job cards including kanbans

2.4.4. Examination of invoices from suppliers

2.4.5. Measurements made under different conditions

2.4.6. Examination of relevant information and data

2.4.7. Others as appropriate to the specific industry contexts.

LO3. Prepare pre-start processes

3.1 Mounting work-piece

3.2 Undertaking programming operational maintenance.

3.3 Checking are undertaking pre-start.

3.4 Verifying equipment, raw material and tooling.

3.5 Planning and scheduling machining processes.

LO4. Perform machine process

4.1. Operating machine/process.

4.2. Loading and maintaining components/feed stock.

4.3. Removing machine/process output.

4.4. Handling and storing machine/process production.

4.5. Monitoring machine/process.

4.6. Recording production data.

LO5. Quality assure production process

5.1. Identifying product faults/deviations.

5.1.1. Deviations and faults of the machine

5.1.2. raw material and feeder process

5.1.3. Tools and equipment

5.1.4. Machining process

5.2. Rectifying product faults/ deviations.

5.3. Controlling and approving machined components.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in Audio/video ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop

		❖ Summarize main points		
Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare and submit the assignment in soft or hard copy	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

ASSESSMENT METHODS:				
Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges
Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the	❖ Provide activity based assessment

			exam	
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO1. Determine work requirements

- Drawings, work instructions and specifications are interpreted and task requirements are understood including machine/process selection, sequences and settings according to operational requirements
- Safety equipment and guards are checked for correct position and operation with references to health and safety regulations
- Emergency procedures are understood and followed in accordance with standard operating procedures

LO.2. Investigate current practices in relation to resource usage.

- Environmental regulations applying to the enterprise are identified.
- Procedures are assessed for assessing compliance with environmental regulations.
- Information on environmental and resource efficiency systems and procedures are collected, and provided to the work group where appropriate.
- Current resource usage is measured and recorded by members of the work group.
- Current purchasing strategies are analyzed and recorded.
- Current work processes are analyzed to access information and data and assisted in identifying areas for improvement.

LO3. Prepare pre-start processes

- Programmed operational maintenance is undertaken to standard operating procedures
- Pre-start checks are undertaken to standard operating procedures
- Equipment, raw material and tooling are verified to match task requirement
- Machining processes are planned and scheduled according to operational requirements

LO4. Perform machine process

- Machine/process is operated in accordance with scope of work and applied standard operating procedures
- Components/feed stock is loaded and maintained consistent based on production requirements.

- Machine/process output is removed safely compliant with standard operating procedure
- Machine/process production is handled and stored in a manner not likely to cause damage as required
- Machine/process is monitored for safe and correct operation
- Production data is recorded to standard operating procedures

LO5. Quality assure production process

- Product faults/deviations related to raw material, tool and equipment, machine process or other impacts are identified from standard operating procedures, work sheets or other documentation
- Product faults/ deviations are rectified in accordance with machine settings and adjustment, standard operating procedures, work sheets or other specifications
- Machined components are quality controlled and approved in accordance with to all set specifications

Annex: Resource Requirements

IND MAC2 M04 0322 Performing Advanced Machine/Process Operation				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by Trainer	25	1:1
2.	Reference Books	- El – Hoffy : Advance Machining Process, Mc Graw Hill Companies, 0.007-1466940, 2005	5	1:5
B.	**Learning Facilities & Infrastructure**			
1.	Lecture Room	Standard	1	1:25
2.	Library	Standard	1	1:25
3.	Work shop		1	1:25
C.	**Consumable Materials**			
1.	Paper	A4	1pac.	1:25
2.	Aluminum ingot	Dia.30-80x500mm	Each 5	1:5
3	Mild steel	Dia.20-50x6000mm	each1	1:25
4	Cutter	HSS(12x12x200,25x25x200) Carbide tip Parting tool6x25x200	20 pcs	1:5
5	Machine oil coolant	Litter 32 viscosity	100	1:5
D.	**Tools and Equipment**			
1	Vernier caliper	Out, inside	5 pcs	1:5
2	Dial indicator	STD	5 pcs	1:5
3	Micrometer	In-out, depth	5 pcs	1:5
4	Steel ruler	0.5m , 1m	5 pcs	1:5
5	Digital calipers	STD	5 pcs	1:5
7	Thread gauge.	STD	5 pcs	1:5
8	Dead center.	STD	5 pcs	1:5
9	Live center.	STD	5 pcs	1:5
10	Follow rest, steady rest etc.	STD	5 pcs	1:5
11	Lathe Machin	Standard as required	5	1:5
12	Milling Machine	Standard as required	5	1:5
13	Drilling Machine	Standard as required	5	1:5

LEARNING MODULE 06
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE : **Manufacture Advance Press Tools, die and Moulds**
MODULE CODE : **IND MAC4 06 0322**
NOMINAL DURATION : **50 Hours**
MODULE DESCRIPTION: This Module deals the knowledge, attitudes and skills required to manufacture press tools, die and plastic and rubber moulds. It includes assembly and test of manufactured tooling and components

LEARNING OUTCOMES

At the end of the module the trainee will be able to:

LO1. Identify and prepare work requirements

LO2. Manufacture tooling components

LO3. Assemble components

LO4. Assure quality

MODULE CONTENTS:

LO1. Identify and prepare work requirements

1.1 Interpreting and visualizing tools, die and mould type and design.

1.2 Conceptualizing and planning tool and mould type and design with reference.

1.3 Assessing production machine to be used to produce the components.

1.4 Selecting and obtaining appropriate materials to meet tool.

1.5 Developing Comprehensive plan to sequence and to perform manufacturing process

LO2. Manufacture tooling components

2.1 Selecting and using appropriate hand tools and hand-held power tools.

2.2 Selecting and processing appropriate machines.

2.3 Setting machining parameters.

2.4 Initiating, heat treatment where appropriate.

2.5 Observing Occupational health and safety procedures.

LO3. Assemble components

3.1. Examining and assembling tooling and die components.

LO4. Assure quality

4.1. Testing first-off production components.

4.2. Modifying and testing possible deviations.

4.3. Recording and reporting all deviations or modifications.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in **Audio/video** ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop

		❖ Summarize main points		
Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

	and submit the assignment in soft or hard copy			
ASSESSMENT METHODS:				
Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges
Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment

Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the exam	❖ Provide activity based assessment
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO1. Identify and prepare work requirements

- Tools, die and mould type and design are interpreted and visualized from tooling/ moulding drawings, prints or plan are/is checked against customer requirements
- Tool and mould type and design are conceptualized and planned with reference to customer's specifications numbers, finish, quality and material.
- Production machine to be used to produce the components is assessed considering tooling and mould design
- Appropriate materials are selected and obtained to meet tool and mould requirements due to specifications
- Comprehensive plan is developed to sequence and to perform manufacturing process

LO2. Manufacture tooling components

- Appropriate hand tools and hand held power tools are selected and used to specification
- Appropriate machines and processes are selected from a range of standard tool room machines based on required operation
- Machining parameters are set to produce components to specification
- Heat treatment is initiated, where appropriate according to specification
- Occupational health and safety procedures are observed throughout the manufacturing process

LO3. Assemble components

- Tooling and die components are examined and assembled correctly by applying acceptable tool making techniques and procedures to specification

LO4. Assure quality

- First-off production components are tested with precision instruments to ensure compliance with specification
- Possible deviations are modified and tested again to produce components to

specification

- All deviations or modifications to original tooling design, prints or plans are recorded and reported, where necessary, according to standard operating procedures

Annex: Resource Requirements

IND MAC4 M06 0322 Manufacture Advance Press Tools, die and Moulds				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by Trainer	25	1:1
2.	Reference Books	1. El – Hoffy : Advance Machining Process, Mc Graw Hill Companies, 0.007- 1466940, 2005 2. Machining process and machining tool Me305 manufacturing techniques fall 2016/17 week 10	5	1:5
B.	**Learning Facilities & Infrastructure**			
1.	Lecture room / work shop	Standard	1	1:25
2.	Library	With sufficient books	1	1:25
C.	**Consumable Materials**			
1.	White board Marker		pack	1:25
2.	Copy A4 paper	double A		1:25
D.	**Tools and Equipment**			
1.	White board	1000mmm*2000mm	1	1:5
2.	Press machine with Accessories	STD	2	2:12
3.	Set of files	Standard	Each set 5	5:25
4.	Hand Drill Machine	Standard	5	1:5
5.	Different type of pressing machines with accessories	Standard	1each	1:25
6.	Personal protective equipment's	Standard	25	1:1
7.	Angle plate	STD	5	1:5
8.	Steel rule	30,50,60 and 100mm	25	1:1
9.	Vernier height gage	STD	2	1:12

10.	Vernier caliper	0.02,0.05 and 0.1mm	5	1:5
11.	Set of twist drills	STD	5	1:5
12.	Allen wrench	STD	5	1:5
13.	Parallel set	STD	5	1:5
14.	Center punch	STD	5	1:5
15.	Vise with soft jaws	STD	5	1:5
16.	Scribers	STD	5	1:5
17.	Hand tap	STD	5	1:5
18.	Counter bore	STD	5	1:5

LEARNING MODULE 05
IND MAC4 05 1221 Perform Multiple Spindle and/or Multiple Axis NC/CNC Machining Centre
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE: **Performing Multiple Spindle and/or Multiple Axis NC/CNC Machining Centre**
MODULE CODE: **IND MAC4 M05 0322**
NOMINAL DURATION: **80 Hours**
MODULE DESCRIPTION: This module covers skill, knowledge and attitudes required to perform programming of advanced machine operations for multiple spindle and/or multiple axis NC/CNC machining centers. It includes preparing an operation sheet by writing programs in common M and G codes including tool paths for multiple spindles and/or multiple axis/B axis angular, multiple tool turrets, tool changers and may include component loaders of a pallet type.
LEARNING OUTCOMES At the end of the module the trainee will be able to: **LO1.** Identify NC/CNC machine program elements **LO 2.** Write NC/CNC machine program and operation sheet **LO 3.** Trial program
MODULE CONTENTS: **LO1. Identifying NC/CNC machine program elements** 1.1. Selecting Appropriate program elements for machines. **LO2.Write NC/CNC machine program and operation sheet** 2.1 Understudying Engineering drawings and interpreting to define machine function and tool path geometry due to standards 2.2 Calculating Coordinates required for tool path or machine functions. 2.3 Selecting advanced operations using canned cycles and sub-routines 2.4 Programing written in standard code format. 2.4.1M code 2.4.2 G code 2.4.3 S code 2.5 Producing operation sheets with standard operating procedures. **LO3. Trial program** 3.1 Operating Machines in manual mode to test and prove program

3.2 Programing edited if necessary to adjust operation to standard

3.3 Components are checked to conform to all specification

3.2.1 Machine axis movement,

3.2.2 Cutting speed,

3.2.3 Rotation of the spindle

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in **Audio/video** ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop

		❖ Summarize main points		
Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare and submit the assignment in soft or hard copy	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

ASSESSMENT METHODS:				
Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges
Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the exam	❖ Provide activity based assessment

	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO.1 Identify NC/CNC machine program elements

- Appropriate program elements are selected for machine controller based on applied standards.

LO.2 Write NC/CNC machine program and operation sheet

- Engineering drawings are understood and interpreted to define machine function and tool path geometry due to standards
- Coordinates are calculated as required for tool path or machine functions.
- Advanced operations are selected using canned cycles and sub-routines and applied appropriately based on requirements
- Program is written in standard code format in accordance with standard operating procedures
- Operation sheets are produced to specification in accordance with standard operating procedures

Lo3 Trial program

- Machine is operated in manual mode to test and prove program based on requirements
- Program is edited if necessary to adjust operation to standard
- Components are checked to conform to all specification

Annex: Resource Requirements

IND MAC4 M 05 0322 Performing Multiple Spindle and/or Multiple Axis NC/CNC Machining Centre				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by the trainer	25	1;1
2.	Reference Books	FANUC Series oi MODEL F for lath system operational system B-64604EN-1/01 CNC 8055 M Examples manual REF. 1010 FAGOR AUTOMATION		
B.	**Learning Facilities & Infrastructure**			
1.	Class room	$1.2m^2$	25	1
2.	lecture room	standard		
3.	Clinic	standard		
4	LCD	0.55-inch wide panel (D7)	1	1;25
C.	**Consumable Materials**			
1.	End mill	Ø6mm- Ø 20mm	5each	1;5
2.	White board marker	1.5mX1m	1pac	1;25
3.	Aluminum	Ø50mmx500mm	25	1;1
4.	Oil	Litter	25	
5.	Drills	Ø6mm-25mm	5 set	1:25
6.	Parting/Grooving tools	200mmx25xsmm	5	1;5
7.	Turning tool	20mmx20mmx150mm	5	1;5
8.	Threading tool	25mmx5mmx150mm	5	1;5
9.	Parting tool	25mmx5mmx150mm	5	1;5
D.	**Tools and Equipment's**			
1.	Lathe with its accessories	Standard	2	**1;12**
2.	Milling with its accessories	Standard	2	**1;12**

3.				

LEARNING MODULE 07
IND MAC4M 07 0322 Managing Product Cost Estimation and Bill of Materials
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE: **Managing Product Cost Estimation and Bill of Materials**
MODULE CODE: **IND MAC4 M 07 0322**
NOMINAL DURATION: **50 Hours**
MODULE DESCRIPTION: This module covers the skill, knowledge and attitudes required to manage the estimated manufacturing cost of products or projects and needed bill of materials. And cost estimation includes implementing identified changes that increase cost efficiency. The unit may be applied individually or in a team environment.
LEARNING OUTCOMES At the end of the module the trainee will be able to: **LO1.** Plan and prepare for work **LO 2.** Develop estimated product / project costs **LO 3.** Analyze customer benefits and determine waste **LO 4.** Analyze production performance variance **LO 5** Measure and check correct quantities of work **LO 6.** Maintain administrative control over resource acquisition process **LO 7.** Supervise the provision and withdrawal of resources **LO8.** Assure quality and verify all data

MODULE CONTENTS:

LO1. Planning and preparing for work

1.1 Performing and managing the work to be identified and clarified.

1.2 Preparing essential time scheduling , sequences of work and labors

1.3 Preparing Format (take off sheet) and materials bill of quantities.

1.4 Determining cost centers of all required resources .

1.5 Suppling information regarding remarks .

LO2. Develop estimated product / project costs

2.1 Selecting and Appling Appropriate labor rates and material costs

2.2 Determining and applying estimates of unit costs,

2.3 Identifying and applying costs to the project of work cover,

2.4 Applying overhead recovery and margins.

2.5 Calculating competed estimated project costs.

LO3. Analyze customer benefits and determine waste

3.1 Determining features/benefits perceived by customer.

3.2 Analyzing cost components

3.3 Analyzing waste cost components.

3.4 Determining alternative ways of reducing waste costs.

3.5 Selecting actions which maximize customer benefits and minimize costs.

L04 Analyse production performance variance

4.1 Analyzing required performance.

4.2 Determining actual cycle time and variability of cycle time .

4.3 Analyzing Cause of waste in through out

4.4 Analyzing costs and determining methods of reducing costs/waste

4.5 Taking actions required to achieve cost/waste reduction/s

L05 Measure and check correct quantities of work

5.1. Quantifying measurements item by item.

5.2. Doing computation of the work

5.3. Checking incorrect data and size of parameters.

5.4. Making corrections and adjustment.

5.5. Finalizing and documenting bill of quantities.

L06. Maintain administrative control over resource acquisition process

6.1. Procuring and acquiring the administration system and monitoring its effectiveness.

6.2. Exercising financial responsibility over the procurement and acquisition system and its maintenance.

6.3. Evaluating procurement reports .

6.4. Facilitating and conducting regular meetings.

L07. Supervise the provision and withdrawal of resources

5.1. Establishing and maintaining a system for the effective supply and withdrawal.

5.2. Managing and monitoring strategic information.

5.3. Establishing and maintaining communications principles and policies.

5.4. Obtaining and monitoring feedback.

L08.Assure quality and verify all data

8.1. Verifying completed estimated production or project costs.

8.2. Comparing actual costs with estimated cost.

8.3. Motivating or rectifying deviations.

8.4. Obtaining assistance/approval from management.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in **Audio/video** ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖ Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop

		❖ Summarize main points		
Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

	assignment questions ❖ Facilitate the trainees to prepare and submit the assignment in soft or hard copy			

ASSESSMENT METHODS:				
Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges

Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the exam	❖ Provide activity based assessment
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO.1 Plan and prepare for work

- The work to be performed and managed is identified and clarified according to work requirements and/or tender
- Essential time scheduling , sequences of work and labour are prepared based on available resources and specifications
- Format (take off sheet) and materials bill of quantities are prepared based on technical specifications
- Cost centres of all required resources in all respect of fields are determined according to operational specifications
- Information regarding remarks is supplied due to operational procedures

LO.2 Develop estimated product / project costs

- Appropriate labour rates and material costs are selected and applied based on operational specifications
- Estimates of unit costs, as appropriate, are determined and applied based on company reference data
- Costs to the project of work cover, environmental protection agency requirements, seeking approvals, waste management fees and other statutory or additional costs are identified and applied due to requirements
- Overhead recovery and margins are applied according to company policy
- Completed estimated project costs for inclusion in tender or bill are calculated based on organizational computer supported cost calculation formats

Lo3 Analyse customer benefits and determine waste

- Features/Benefits perceived by customer are determined in product
- Cost components are analyzed and those which deliver customer features/benefits and those which don't determined
- Waste cost components are analyzed
- Alternative ways of reducing waste costs are determined
- Actions which maximize customer benefits and minimize costs are selected

Lo4 Analyse production performance variance

- Required performance is analyzed to meet customer pull

- Actual cycle time and variability of cycle time are determined
- Cause of waste in throughput is analyzed
- Costs are analyzed and methods of reducing costs/waste determined
- Actions required is taken to achieve cost/waste reduction/s

Lo5 Measure and check correct quantities of work

- Measurements are quantified item by item according to technical specifications
- Computation of the work to prepare the bill of quantities is done based on company policies
- Incorrect data and size of parameters are checked as per accepted standards
- Corrections and adjustment are made within standard formats
- Bill of quantities is finalized and documented based on organizational requirements

Lo6 Maintain administrative control over resource acquisition process

- The administration system through which resources are procured and acquired is monitored for its effectiveness due to organizational regulations
- Financial responsibility is exercised over the procurement and acquisition system and its maintenance based on the cooperate procedures
- Procurement reports are evaluated in preparation for management team meetings due to requirements
- Regular meetings are facilitated and conducted between team members and the client to report on progress based on organizational regulations

Lo7 Supervise the provision and withdrawal of resources

- A system for the effective supply and withdrawal of resources is established and maintained based on company procedures
- Strategic information on the usage and movement of resources within the production area is managed and monitored based on company regulations
- Communications principles and policies between on-site personnel and providers of physical resources are established and maintained according to policies
- Feedback from the operators and production staff is obtained and monitored at commencement, during and on completion of the project based on organizational guidelines

Lo8 Assure quality and verify all data

- Completed estimated production or project costs for inclusion in a tender or bill are verified in compliance with a computer supported cost calculation format
- Actual costs are compared with estimated cost to identify deviations according to operational regulations and standards
- Deviations are motivated or rectified according to established organizational framework, procedures and routines.
- Assistance/approval from management is obtained based on company policies

Annex: Resource Requirements

IND MAC4M 07 0322 Managing Product Cost Estimation and Bill of Materials				
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by the trainer	25	1:1
2.	Reference Books	- Any books related to the Managing Product Cost Estimation and Bill of Materials	5	1:5
B.	**Learning Facilities & Infrastructure**			
1.	Class room	$1.2m^2$	25	1
2.	lecture room	standard		
3.	clinic	standard		
C.	**Consumable Materials**			
10	paper	A4andA3	5pack	1;5
11	White board marker	standard	1pack	1:25
D.	**Tools and Equipment's**			
4.	White board	standard	1	**1;25**
5.	LCD	stander	1	1;25

LEARNING MODULE 08
TVET-PROGRAMME TITLE: **Machining Level IV**
MODULE TITLE: **Performing Process Planning and Production Scheduling**
MODULE CODE: **IND MAC4 M08 0322**
NOMINAL DURATION: **80 Hours**
MODULE DESCRIPTION: This module covers the knowledge, skills and attitude required to determine production sequence, identify production requirements and capacities, work activities, production application and prepare production schedules of component / part. It includes the review of process specifications and continuous production improvements.

LEARNING OUTCOMES

At the end of the module the trainee will be able to:

LO1. Set objectives

LO2. Determine production sequence

LO3. Identify and analyse production requirements and capacities

LO4. Implement work plans**.**

LO5. Prepare schedule for production of a component/part

LO6. Review process specifications

LO7. Manage the process

LO8. Assure quality workplace operations

MODULE CONTENTS:

LO1.Set objectives

1.1 Planning objectives.

1.2 Stating Objectives

1.3 Reflecting support and commitment of team members.

1.4 Identifying realistic and attainable objectives

LO2. Determine production sequence

2.1 Identifying steps required for the process and flow charts

2.2 Preparing material and parts lists

2.3 Documenting tooling and/or equipment.

2.4 Documenting Process steps.

LO3.Identify and analyse production requirements and capacities

3.1 Identifying and obtaining engineering production data.

3.2 Identifying and obtaining inventory capacities and requirements.

3.3 Analysing and carrying out procurement and supply requirements and constraints..

3.4 Analysing and applying production capacity and constraints.

3.5 Identifying and obtaining standard times.

3.6 Obtaining production requirements with the existing resources and strategies.

LO4. Implement work plans

4.1.Identifying work methods and practices

4.1.1.Legislated regulations and codes of practice

4.1.2.Industry regulations and codes of practice

4.1.3. Occupational health and safety practices

4.2. Implementing work plans

4.2.1. Daily work plant

4.2.2. Project plans

4.2.3. Program plans

4.2.4. Resource plans

4.2.5. Skills development plans

4.2.6. Management strategies and objectives

LO5. Prepare schedule for production of a component/part

1.1 Scheduling Production of component

1.2 Documenting schedule.

LO6. Review process specifications

6.1 Analyzing and reviewing supporting engineering and production data

6.2 Determining the new production processes

6.3 Obtaining and examining specifications.

LO7. Manage the process

7.1 Allocating roles and responsibilities.

7.2 Monitoring and guidance provided technical

7.3 Monitoring process parameters.

7.4 Monitoring safety associated with chemical handling

LO8. Assure quality workplace operations

8.1 Supporting operations in the workplace

8.2 Identifying quality problems.

8.3 Improving procedures and systems.

8.4 Providing input

8.5 Identifying and addressing workplace challenges.

Learning Methods:				
For none impaired trainees	**Reasonable Adjustment for Trainees with Disability (TWD)**			
	Low Vision	**Deaf**	**Hard of hearing**	**Physical impairment**
Lecture discussion	❖ Provide large print text ❖ Prepare the lecture in **Audio/video** ❖ Organize the class room seating arrangement to be accessible to trainees ❖ Write short notes on the black/white board using large text ❖ Make sure the luminosity of the light of class room is kept ❖ Use normal tone of voice ❖ Encourage trainees to record the lecture in audio format ❖ Provide Orientation on the physical feature of the work shop ❖ Summarize main points	❖ Assign sign language interpreter ❖ Arrange the class room seating to be conducive for eye to eye contact ❖ Make sure the luminosity of the light of class room is kept ❖ Introduce new and relevant vocabularies ❖ Use short and clear sentences ❖ Give emphasis on visual lecture and ensure the attention of the trainees ❖ Avoid movement during lecture time ❖ Present the lecture in video format	❖Organize the class room seating arrangement to be accessible to trainees ❖Speak loudly ❖Ensure the attention of the trainees ❖Present the lecture in video format ❖Ensure the attention of the trainees	❖ Organize the class room seating arrangement to be accessible for wheelchairs users. ❖ Facilitate and support the trainees who have severe impairments on their upper limbs to take note ❖ Provide Orientation on the physical feature of the work shop

		❖ Summarize main points		
Demonstration	❖ Conduct close follow up ❖ Use verbal description ❖ Provide special attention in the process of guidance ❖ facilitate the support of peer trainees ❖ Prepare & use simulation	❖ use Sign language interpreter ❖ Use video recorded material ❖ Ensure attention of the trainees ❖ Provide structured training ❖ Show clear and short method ❖ Use gesture ❖ provide tutorial support (if necessary)	❖ Illustrate in clear & short method ❖ Use Video recorded material ❖ Ensure the attention of the trainees ❖ provide tutorial support (if necessary)	❖ Facilitate and support the trainees having severe upper limbs impairment to operate equipment / machines ❖ Assign peer trainees to assist ❖ Conduct close follow up ❖ provide tutorial support (if necessary
Group discussion	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member ❖ Brief the thematic issues of the work	❖ Use sign language interpreters ❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Facilitate the integration of trainees with group members ❖ Conduct close follow up ❖ Introduce the trainees with other group member	❖ Introduce the trainees with their peers

			❖ Inform the group members to speak loudly	
Exercise	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/practical training ❖ Introduce new and relevant vocabularies	❖ Conduct close follow up and guidance ❖ Provide tutorial support if necessary ❖ provide special attention in the process/ practical training	❖ Assign peer trainees ❖ Use additional nominal hours if necessary
Individual assignment	❖ prepare the assignment questions in large text ❖ Encourage the trainees to prepare and submit the assignment in large texts ❖ Make available recorded assignment questions ❖ Facilitate the trainees to prepare	❖ Use sign language interpreter ❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	❖ Provide briefing /orientation on the assignment ❖ Provide visual recorded material	

	and submit the assignment in soft or hard copy			

ASSESSMENT METHODS:				
Interview		❖Use sign language interpreter ❖Ensure or conform whether the proper communication was conducted with the trainee through the service of the sign language interpreter ❖Use short and clear questioning ❖Time extension	❖Speak loudly ❖Using sign language interpreter if necessary	❖ Use written response as an option for the trainees having speech challenges

Written test	❖ Prepare the exam in large texts ❖ Use interview as an option if necessary ❖ Prepare the exam in audio format ❖ Assign human reader ❖ (if necessary) ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, True or False, matching and short answers ❖ Avoid essay writing ❖ Time extension	❖ Prepare the exam using short sentences, multiple choices, true or false, matching and short answers if necessary.	❖Use oral response as an option to give answer for trainees having severe upper limb impairment ❖Time extension for trainees having severe upper limb impairment
Demonstration /Observation	❖ Brief the instruction or provide them in large text	❖Use sign language interpreter ❖Brief on the instruction of the	❖Provide activity based assessment ❖Brief on the instruction of the exam	❖ Provide activity based assessment
	❖ Time extension	❖Provide activity-based/ practical assessment method ❖Time extension	❖ Use loud voice ❖ Time extension	❖Conduct close follow up ❖Time extension

ASSESSMENT CRITERIA:

LO.1. Set objective

- Objectives are planned consistent with and linked to work activities in accordance with organizational aims.
- Objectives are stated as measurable targets with clear time frames.
- Support and commitment of team members are reflected in the objectives.
- Realistic and attainable objectives are identified.

LO.2 Determine production sequence

- Steps required for the process are identified and flow charts are produced where required in accordance with standard operating procedures
- Material and parts lists are prepared manually or with CAD in accordance with standard operating procedures
- Tooling and/or equipment requirements are documented in accordance with standard operating procedures.
- Process steps are documented and clearly represented in accordance with standard operating procedures...

LO.3. Identify and analyse production requirements and capacities

- Engineering production data are identified and obtained in accordance with workplace procedures.
- Inventory capacities and requirements are identified and obtained in accordance with workplace procedures.
- Procurement and supply requirements and constraints are analysed and carried out in accordance with workplace procedures.
- Production capacity and constraints are analysed and applied in accordance with workplace procedures.
- Standard times are identified and obtained in accordance with workplace procedures.
- Production requirements are obtained with the existing resources and strategies are evolved to fit with it based on technical specifications.

LO4. Implement work plans

- Work methods and practices are identified in consultation with personnel concerned.
- Work plans are implemented in accordance with set time frames, resources and standards.

LO5. Prepare schedule for production of a component/part

- .Production of component is scheduled in accordance with production, inventory, procurements, time constraints, supply and labour capacities according to operational requirements
- Schedule is documented in accordance with accepted organization procedures and quality management.and/or clients as required.

LO6. Review process specifications

- Supporting engineering and production data are analysed and reviewed where required according to organizational procedures
- The new production processes to be used are determined applying organizational guidelines
- Specifications are obtained and examined in accordance with operational procedures

LO7. Manage the process

- Roles and responsibilities are allocated, as required
- Technical process is monitored and guidance provided, where required
- Process parameters are monitored to ensure conformance to requirements
- Safety associated with the process including chemical handling is monitored

LO8. Assure quality workplace operations

- Operations in the workplace support overall enterprise goals and quality assurance initiatives
- Quality problems and issues are promptly identified and adjustments are made accordingly to company regulations
- Procedures and systems are improved in consultation with colleagues to enhance constantly efficiency and effectiveness based on Kaizen
- Input is provided to appropriate management regarding staffing needs according to labour laws
- Workplace challenges are promptly identified and addressed accordingly to

operational and customer service regulations

Annex: Resource Requirements

IND MAC4 M08 0322	Performing Process Planning and Production Scheduling			
Item No.	**Category/Item**	**Description/ Specifications**	**Quantity**	**Recommended Ratio (Item: Trainee)**
A.	**Learning Materials**			
1.	TTLM	TTTLM prepared by the trainer	25	1:1
2.	Text Books	Construction process planning and management 1st Edition-Elsevier	5	1:5
3.	Reference Books	Project planning scheduling and control –student Guide (Georgia)	5	1:5
B.	**Learning Facilities & Infrastructure**			
1.	Lecture Room	5m x 8m	1	1:25
2.	Clinic	Standard	1	1:25
C.	**Consumable Materials**			
1	Copy paper Drawing paper	A_4,	5packs	1:5
D	**Tools and Equipment**			
1	White Board	1m x 1.5m	1	1:25
8	LCD	Standard	1	1:25

Acknowledgement

The **Ministry of Labor and Skills and Federal TVET Institute (FTI)** wishes to thank and appreciation for the trainers who donated their effort and time to develop this outcome based curriculum for the TVET program machining LEVEL IVI. We also thank all regional TVET College, management institute at bishoftu programmers for active facilitation of their trainers for the development of this curriculum.

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