education

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NATIONAL CERTIFICATES (VOCATIONAL)

ASSESSMENT GUIDELINES

ENGINEERING PROCESSES

NQF Level 4

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ENGINEERING PROCESSES – LEVEL 4

CONTENTS

SECTION A: PURPOSE OF THE SUBJECT ASSESSMENT GUIDELINES

This document provides the lecturer with guidelines to develop and implement a coherent, integrated assessment system for Engineering Fundamentals, Engineering Practice and Maintenance and Engineering Processes in the National Certificates (Vocational). It must be read with the *National Policy Regarding Further Education and Training Programmes: Approval of the Documents, Policy for the National Certificates (Vocational) Qualifications at Levels 2 to 4 on the National Qualifications Framework (NQF)*. This assessment guideline will be used for National Qualifications Framework Levels 2-4.

This document explains the requirements for the internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Engineering Processes* to prepare for and deliver Engineering Processes. Lecturers should use a variety of resources and apply a range of assessment skills in the setting, marking and recording of assessment tasks.

SECTION B: ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

1 ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

Assessment in the National Certificates (Vocational) is underpinned by the objectives of the National Qualifications Framework (NQF). These objectives are to:

- Create an integrated national framework for learning achievements.
- Facilitate access to and progression within education, training and career paths.
- Enhance the quality of education and training.
- Redress unfair discrimination and past imbalances and thereby accelerate employment opportunities.
- Contribute to the holistic development of the student by addressing:
  - social adjustment and responsibility;
  - moral accountability and ethical work orientation;
  - economic participation; and
  - nation-building.

The principles that drive these objectives are:

- ***Integration***

To adopt a unified approach to education and training that will strengthen the human resources development capacity of the nation.

- ***Relevance***

To be dynamic and responsive to national development needs.

- ***Credibility***

To demonstrate national and international value and recognition of qualification and acquired competencies and skills.

- ***Coherence***

To work within a consistent framework of principles and certification.

- ***Flexibility***

To allow for creativity and resourcefulness when achieving Learning Outcomes, to cater for different learning styles and use a range of assessment methods, instruments and techniques.

- ***Participation***

To enable stakeholders to participate in setting standards and co-ordinating the achievement of the qualification.

- ***Access***

To address barriers to learning at each level to facilitate students' progress.

- ***Progression***

To ensure that the qualification framework permits individuals to move through the levels of the national qualification via different, appropriate combinations of the components of the delivery system.

- ***Portability***

To enable students to transfer credits of qualifications from one learning institution and/or employer to another institution or employer.

- ***Articulation***

To allow for vertical and horizontal mobility in the education system when accredited pre-requisites have been successfully completed.

- ***Recognition of Prior Learning***

To grant credits for a unit of learning following an assessment or if a student possesses the capabilities specified in the outcomes statement.

- ***Validity of assessments***

To ensure assessment covers a broad range of knowledge, skills, values and attitudes (SKVAs) needed to demonstrate applied competency. This is achieved through:

  - clearly stating the outcome to be assessed;
  - selecting the appropriate or suitable evidence;
  - matching the evidence with a compatible or appropriate method of assessment; and
  - selecting and constructing an instrument(s) of assessment.

- ***Reliability***

To assure assessment practices are consistent so that the same result or judgment is arrived at if the assessment is replicated in the same context. This demands consistency in the interpretation of evidence; therefore, careful monitoring of assessment is vital.

- ***Fairness and transparency***

To verify that no assessment process or method(s) hinders or unfairly advantages any student. The following could constitute unfairness in assessment:

  - Inequality of opportunities, resources or teaching and learning approaches
  - Bias based on ethnicity, race, gender, age, disability or social class
  - Lack of clarity regarding Learning Outcome being assessed
  - Comparison of students' work with other students, based on learning styles and language

- ***Practicability and cost-effectiveness***

To integrate assessment practices within an outcomes-based education and training system and strive for cost and time-effective assessment.

2 ASSESSMENT FRAMEWORK FOR VOCATIONAL QUALIFICATIONS

The assessment structure for the National Certificates (Vocational) qualification is as follows:

2.1 Internal continuous assessment (ICASS)

Knowledge, skills values, and attitudes (SKVAs) are assessed throughout the year using assessment instruments such as projects, tests, assignments, investigations, role-play and case studies. The internal continuous assessment (ICASS) practical component is undertaken in a real workplace, a workshop or a "Structured Environment". This component is moderated internally and externally quality assured by Umalusi. All internal continuous assessment (ICASS) evidence is kept in a Portfolio of Evidence (PoE) and must be readily available for monitoring, moderation and verification purposes.

2.2 External summative assessment (ESASS)

The external summative assessment is either a single or a set of written papers set to the requirements of the Subject Learning Outcomes. The Department of Education administers the theoretical component according to relevant assessment policies.

A compulsory component of external summative assessment (ESASS) is the **integrated summative assessment task (ISAT).** This assessment task draws on the students' cumulative learning throughout the year. The task requires **integrated application of competence** and is executed under strict assessment conditions. The task should take place in a simulated or "Structured Environment". The integrated summative assessment task (ISAT) is the most significant test of students' ability to apply acquired knowledge.

The integrated assessment approach allows students to be assessed in more than one subject with the same integrated summative assessment task (ISAT).

External summative assessments will be conducted annually between October and December, with provision made for supplementary sittings.

3 MODERATION OF ASSESSMENT

3.1 Internal moderation

Assessment must be moderated according to the internal moderation policy of the Further Education and Training (FET) college. Internal college moderation is a continuous process. The moderator's involvement starts with the planning of assessment methods and instruments and follows with continuous collaboration with and support to the assessors. Internal moderation creates common understanding of Assessment Standards and maintains these across vocational programmes.

3.2 External moderation

External moderation is conducted by the Department of Education, Umalusi and, where relevant, an Education and Training Quality Assurance (ETQA) body according to South African Qualifications Authority (SAQA) and Umalusi standards and requirements.

The external moderator:

- monitors and evaluates the standard of all summative assessments;
- maintains standards by exercising appropriate influence and control over assessors;
- ensures proper procedures are followed;
- ensures summative integrated assessments are correctly administered;
- observes a minimum sample of ten (10) to twenty-five (25) percent of summative assessments;
- gives written feedback to the relevant quality assuror; and
- moderates in case of a dispute between an assessor and a student.

Policy on inclusive education requires that assessment procedures be customised for students who experience barriers to learning, and supported to enable these students to achieve their maximum potential.

4 PERIOD OF VALIDITY OF INTERNAL CONTINUOUS ASSESSMENT (ICASS)

The period of validity of the internal continuous assessment mark is determined by the *National Policy on the Conduct, Administration and Management of the Assessment of the National Certificates (Vocational).*

The internal continuous assessment (ICASS) must be re-submitted with each examination enrolment for which it constitutes a component.

5 ASSESSOR REQUIREMENTS

Assessors must be subject specialists and should ideally be declared competent against the standards set by the ETDP SETA. If the lecturer conducting the assessments has not been declared a competent assessor, an assessor who has been declared competent may be appointed to oversee the assessment process to ensure the quality and integrity of assessments.

6 TYPES OF ASSESSMENT

Assessment benefits the student and the lecturer. It informs students about their progress and helps lecturers make informed decisions at different stages of the learning process. Depending on the intended purpose, different types of assessment can be used.

6.1 Baseline assessment

At the beginning of a level or learning experience, baseline assessment establishes the knowledge, skills, values and attitudes (SKVAs) that students bring to the classroom. This knowledge assists lecturers to plan learning programmes and learning activities.

6.2 Diagnostic assessment

This assessment diagnoses the nature and causes of learning barriers experienced by specific students. It is followed by guidance, appropriate support and intervention strategies. This type of assessment is useful to make referrals for students requiring specialist help.

6.3 Formative assessment

This assessment monitors and supports teaching and learning. It determines student strengths and weaknesses and provides feedback on progress. It determines if a student is ready for summative assessment.

6.4 Summative assessment

This type of assessment gives an overall picture of student progress at a given time. It determines whether the student is sufficiently competent to progress to the next level.

7 PLANNING ASSESSMENT

An assessment plan should cover three main processes:

7.1 Collecting evidence

The assessment plan indicates which Subject Outcomes and Assessment Standards will be assessed, what assessment method or activity will be used and when this assessment will be conducted.

7.2 Recording

Recording refers to the assessment instruments or tools with which the assessment will be captured or recorded. Therefore, appropriate assessment instruments must be developed or adapted.

7.3 Reporting

All the evidence is put together in a report to deliver a decision for the subject.

8 METHODS OF ASSESSMENT

Methods of assessment refer to who carries out the assessment and includes lecturer assessment, self-assessment, peer assessment and group assessment.

LECTURER ASSESSMENT	The lecturer assesses students' performance against given criteria in different contexts, such as individual work, group work, etc.
SELF-ASSESSMENT	Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc.
PEER ASSESSMENT	Students assess another student's or group of students' performance against given criteria in different contexts, such as individual work, group work, etc.
GROUP ASSESSMENT	Students assess the individual performance of other students within a group or the overall performance of a group of students against given criteria.

9 INSTRUMENTS AND TOOLS FOR COLLECTING EVIDENCE

All evidence collected for assessment purposes is kept or recorded in the student's PoE.

The following table summarises a variety of methods and instruments for collecting evidence. A method and instrument is chosen to give students ample opportunity to demonstrate the Subject Outcome has been attained. This will only be possible if the chosen methods and instruments are appropriate for the target group and the Specific Outcome being assessed.

	METHODS FOR COLLECTING EVIDENCE		
	Observation-based (Less structured)	**Task-based** (Structured)	**Test-based** (More structured)
Assessment instruments	• Observation • Class questions • Lecturer, student, parent discussions	• Assignments or tasks • Projects • Investigations or research • Case studies • Practical exercises • Demonstrations • Role-play • Interviews	• Examinations • Class tests • Practical examinations • Oral tests • Open-book tests
Assessment tools	• Observation sheets • Lecturer's notes • Comments	• Checklists • Rating scales • Rubrics	• Marks (e.g. %) • Rating scales (1-7)
Evidence	• Focus on individual students • Subjective evidence based on lecturer observations and impressions	**Open middle**: Students produce the same evidence but in different ways. **Open end**: Students use same process to achieve different results.	Students answer the same questions in the same way, within the same time.

10 TOOLS FOR ASSESSING STUDENT PERFORMANCE

Rating scales are marking systems where a symbol (such as 1 to 7) or a mark (such as 5/10 or 50%) is defined in detail. The detail is as important as the coded score. Traditional marking, assessment and evaluation mostly used rating scales without details such as what was right or wrong, weak or strong, etc.

Task lists and **checklists** show the student what needs to be done. These consist of short statements describing the expected performance in a particular task. The statements on the checklist can be ticked off when the student has adequately achieved the criterion. Checklists and task lists are useful in peer or group assessment activities.

Rubrics are a hierarchy (graded levels) of criteria with benchmarks that describe the minimum level of acceptable performance or achievement for each criterion. Using rubrics is a different way of assessing and cannot be compared to tests. Each criterion described in the rubric must be assessed separately. Mainly two types of rubrics, namely holistic and analytical, are used.

11 SELECTING AND/OR DESIGNING RECORDING AND REPORTING SYSTEMS

The selection or design of recording and reporting systems depends on the purpose of recording and reporting student achievement. **Why** particular information is recorded and **how** it is recorded determine which instrument will be used.

Computer-based systems, for example spreadsheets, are cost and time effective. The recording system should be user-friendly and information should be easily accessed and retrieved.

12 COMPETENCE DESCRIPTIONS

All assessment should award marks to evaluate specific assessment tasks. However, marks should be awarded against rubrics and not be simply a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes (SKVAs) that a student must demonstrate to achieve each level of the rating scale.

When lecturers or assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a Subject Outcome. The relevant Assessment Standard must be used to create the rubric to assess the task or question. The descriptions must clearly indicate the minimum level of attainment for each category on the rating scale.

13 STRATEGIES FOR COLLECTING EVIDENCE

A number of different assessment instruments may be used to collect and record evidence. Examples of instruments that can be (adapted and) used in the classroom include:

13.1 Record sheets

The lecturer observes students working in a group. These observations are recorded in a summary table at the end of each project. The lecturer can design a record sheet to observe students' interactive and problem-solving skills, attitudes towards group work and involvement in a group activity.

13.2 Checklists

Checklists should have clear categories to ensure that the objectives are effectively met. The categories should describe how the activities are evaluated and against what criteria they are evaluated. Space for comments is essential.

SECTION C: ASSESSMENT IN ENGINEERING PROCESSES

1 SCHEDULE OF ASSESSMENT

At NQF levels 2, 3 and 4, lecturers will conduct assessments as well as develop a schedule of formal assessments that will be undertaken in the year. All three levels also have an external examination that accounts for 50 percent of the total mark. The marks allocated to assessment tasks completed during the year, kept or recorded in a PoE account for the other 50 percent.

The PoE and the external assessment include practical and written components. The practical assessment in Engineering Processes must, where necessary, be subjected to external moderation by Umalusi or an appropriate Education and Training Quality Assurance (ETQA) body, appointed by the Umalusi Council in terms of Section 28(2) of the *General and Further Education and Training Quality Assurance Act, 2001 (Act No. 58 of 2001).*

2 RECORDING AND REPORTING

Engineering Practice and Maintenance, as is the case for all the other Vocational subjects, is assessed according to five levels of competence. The level descriptions are explained in the following table.

Scale of Achievement for the Vocational component

RATING CODE	RATING	MARKS %
5	Outstanding	80-100
4	Highly Competent	70-79
3	Competent	50-69
2	Not yet competent	40-49
1	Not achieved	0-39

The programme of assessment should be recorded in the Lecturer's Portfolio of Assessment for each subject. The following at least should be included in the Lecturer's Assessment Portfolio:

- A contents page
- The formal schedule of assessment
- The requirements for each assessment task
- The tools used for each assessment task
- Recording instrument(s) for each assessment task
- A mark sheet and report for each assessment task

The college must standardise these documents.

The student's PoE must include at least:

- A contents page
- The assessment tasks according to the assessment schedule
- The assessment tools or instruments for the task
- A record of the marks (and comments) achieved for each task

Where a task cannot be contained as evidence in the PoE, its exact location must be recorded and it must be readily available for moderation purposes.

The following units guide internal assessment in Engineering Processes Level 4:

NUMBER OF UNITS	ASSESSMENT	COVERAGE
2	Formal written tests	One or more completed topics
1	Internal written exams	All completed topics
3	Practical assessments	Must cover the related Subject Outcomes: For example assignments, projects in the engineering processes of the manufacturing engineering and technology industries.

ASSESSMENT OF ENGINEERING PROCESSES

LEVEL 4

3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN ENGINEERING PROCESSES - LEVEL 4

Topic 1: Mechanical component service

SUBJECT OUTCOME	
1.1 Prepare for service.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Workplace environment conditions are checked and are work friendly.	• Check that workplace environmental conditions are work-friendly.
• Replacement parts are inspected for quality and correctness.	• Inspect replacement parts for quality and correctness.
• Equipment and tools are selected correctly for the task at hand.	• Select correct equipment and tools for the task at hand.
• Disassembled component parts are placed in order and are visible for assembly clarity.	• Place the disassembled component parts in order and visible for assembly clarity.
• Component parts are examined for cleanliness.	• Examine component parts for cleanliness.
• Component functional operating position is checked where applicable.	• Check component functional operating position where applicable.
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Practical project. • Demonstration.	

SUBJECT OUTCOME	
1.2 Carry out service and record the results.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Service information is recorded. *Range: Date of service, parts replaced, replacement part information, and probable cause of breakdown.*	• Record service information. *Range: Date of service, parts replaced, replacement part information, and probable cause of breakdown.*
• Component manual is used for assembly.	• Use component manual for assembly.
• Internal inspection and examinations are applied to the assembly to avoid infringements. *Range: Motion inhibition of component, parts*.	• Apply internal inspections and examinations to the assembly to avoid infringements. *Range: Motion inhibition of component, parts.*
• Specified torque for tightening is applied.	• Tighten to specified torque.
• Component for operation is manually checked where applicable.	• Manually check component for operation where applicable.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Record sheets or log books. • Observation.	

SUBJECT OUTCOME	
1.3 Check quality of serviced components for compliance with servicing specification and store or move as instructed.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Information plate/tag is attached to component, where applicable, for future service reference.	• Attach (fit), where applicable, information plate/tag to component for future service reference.
• The replacement parts are suitable to performance and environmental conditions.	• Ensure that replacement parts are suitable to performance and environmental conditions.
• Lubricants meet operational conditions.	• Ensure that lubricants meet operational conditions.
• Storage is appropriate for the following expectations: *Range: Dry and free of humidity, dust free, component is correctly zoned, customer delivery note is attached, protective coating applied (grease paper wrapping, plastic wrapping) boxed or crated to customer needs.*	• Ensure that storage is appropriate for the following expectations: *Range: Dry and free of humidity, dust free, component is correctly zone, customer delivery note is attached, protective coating applied (grease paper wrapping, plastic wrapping) boxed or crated to customer needs.*
ASSESSMENT TASKS OR ACTIVITIES	
Practical project.	

Topic 2: Component dismantling and assembling

SUBJECT OUTCOME	
2.1 Dismantle and clean components.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The work area and conditions are free of obstacles. *Range: Lighting, ventilation, dust, dampness, hazards (flammable material, electrical, excessive movement, accessibility).*	• Ensure the work area and conditions are free of obstacles. *Range: Lighting, ventilation, dust, dampness, hazards (flammable material, electrical, excessive movement, accessibility).*
• The total make up of a component is scrutinized and memorised before sub disassembly.	• Scrutinize and memorise the total make up of a component before sub disassembly.
• Components are pre-cleaned using non-reactive cleaning solvents.	• Pre-clean using cleaning solvents that are non-reactive to components.
• Components are carefully inspected and diagnosed in disassembly. *Range: Positioning of parts, centre punch for clarity, tag for deeper clarity.* • Final cleaning operation is applied ensuring that all passages, crevices and surfaces are clean and free of any residue.	• Inspect and diagnose components carefully in disassembly. *Range: Positioning of parts, centre punch for clarity, tag for deeper clarity.* • Apply final cleaning operation ensuring that all passages, crevices and surfaces are clean and free of any residue.
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Demonstration. • Practical project.	

SUBJECT OUTCOME	
2.2 Inspect and replace components.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Components are examined for defects. *Range: Structural default, casting soundness, design error, wear, determine reasons for component faults.*	• Examine components for defects. *Range: Structural default, casting soundness, design error, wear, determine reasons for component fault.*
• Replacement parts are inspected for quality and correctness.	• Inspect replacement parts for quality and correctness.
• Component replacement is recorded with reasons.	• Record reasoning for component replacement.
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Report. • Demonstration. • Practical project.	

SUBJECT OUTCOME	
2.3. Assemble and test components.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The correct tools and equipment required for assembly are selected.	• Select the correct equipment and tools required for assembly.
• The component parts of the assembly are correctly selected and fitted within the specified time.	• Correctly select and fit the component parts of the assembly within the specified time.
• Assembly is checked and run and the results are recorded. *Range: Overheating, vibration, noise decibels, component expectancy, KW rating, performance.*	• Check and run assembly and record the results. *Range: Overheating, vibration, noise decibels, component expectancy, KW rating, performance.*
• Assembly is ensured to be cosmetically presentable.	• Ensure assembly is cosmetically presentable.
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Demonstration. • Practical project. • Simulation.	

Topic 3: Operating and monitoring an engineering machine and component production

SUBJECT OUTCOME	
3.1 Prepare to operate engineering machines. *Range: Machines include but not limited to hydraulic press, drill press.*	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Safety in the workplace is ensured.	• Ensure safety in the workplace.
• Understanding of verbal instructions is communicated.	• Communicate understanding of verbal instructions.
• Drawing information is read and understood.	• Read and understand drawing information.
• Drawing information is applied to task.	• Apply drawing information to task.
• Machine settings are adjusted for the required functions.	• Adjust machine settings for the required functions.
• Correct equipment and tools are selected for appropriate machining process.	• Select correct equipment and tools for appropriate machining process.
• The correct cutting tool is selected for machining operation.	• Select correct cutting tool for machining operation.
• Cutting tool edge are prepared to suit material to be machined.	• Prepare cutting tool edge to suit material to be machined.
• All significant points are lubricated in accordance with workplace procedures.	• Lubricate all significant points in accordance with workplace procedures.
• Verbal and written instructions are understood and followed in accordance with workplace procedures.	• Understand and follow verbal or written instructions in accordance with workplace procedures.
• Machinery is made safe for emergency shut down and other procedures are verified before starting with intended task. *Range: Guards, personal protective equipment*.	• Make sure that machinery is made safe for emergency shut down and verify other procedures before starting with intended task. *Range: Guards, personal protective equipment.*
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Demonstration. • Project. • Role play. • Simulation.	

SUBJECT OUTCOME	
3.2 Carry out machining processes.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Machine is started in accordance with workplace procedures.	• Start and run machine.
• Machine is monitored to ensure operational requirements are met. *Range: Soluble oil flow capacity, backlash of feed screw, vibration of unit, machine noise.*	• Ensure machine is functioning optimally. *Range: Soluble oil flow capacity, backlash of feed screw, vibration of unit, machine noise.*
• Components produced by the machine are inspected and out of tolerance items are identified. *Range: Visual, fixed gauge, direct reading measuring equipment*.	• Carry out machining process. *Range: Visual, fixed gauge, direct reading measuring equipment.*
• Measurements of machined components are checked against drawing information.	• Check measurements of machined components against drawing information.
• Computer program of machine component is checked against drawing measurements.	• Check computer program of machine component against drawing measurements.
• Corrections to computer program are made if necessary.	• Make corrections to computer program if necessary.
• Material level consumption is examined and replaced timeously.	• Examine material level consumption and replace timeously.
• Machine components in CAM are inspected.	• Inspect machine components in CAM.
• Machining faults are eliminated by correction through specific adjustments.	• Eliminate machining faults by correction through specific adjustments.
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Practical project. • Demonstration. • Simulation.	

SUBJECT OUTCOME	
3.3 Perform post machining functions.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Components are checked according to operating instructions. *Range: Accuracy pertaining to drawing, all facets are machined as indicated on drawings, surface protection of components is addressed.*	• Check components according to operating instructions. *Range: Accuracy pertaining to drawing, all facets are machined as indicated on drawings, surface protection of components is addressed.*
• Completed components are stored according to workplace procedures. *Range: Name of customer, address of customer, job number, delivery date.*	• Store completed components according to workplace procedures. *Range: Name of customer, address of customer, job number, delivery date.*
• Equipment is cleaned according to manufacturer's specifications.	• Clean applicable equipment according to manufacturer's specifications.
• Tools are returned to the store room.	• Return tools to store room.
• Work area is cleared of unnecessary clutter.	• Clear work area of unnecessary clutter.

ASSESSMENT TASKS OR ACTIVITIES
• Written test. • Demonstration. • Practical project.

Topic 4: Powered machinery used in cutting of materials

SUBJECT OUTCOME	
4.1 Prepare for mechanical cutting of materials.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The type of material and composition are identified.	• Identify the type of material and composition.
• The cutting process is selected. *Range: Mechanical cutting, gas cutting – oxygen and acetylene, plasma cutting, laser cutting*.	• Select the cutting process. *Range: Mechanical cutting, gas cutting – oxygen and acetylene, plasma cutting, laser cutting*.
• Correct cutting equipment is chosen for the material being cut.	• Choose correct cutting equipment for the material being cut.
• The cutting equipment is prepared. *Range: Cutting speed – meters/min, feed speed or pressure adjustment, number of teeth per inch of blade.*	• Prepare cutting equipment. *Range: Cutting speed – meters/min, feed speed or pressure adjustment, number of teeth per inch of blade.*
• Correct cutting fluid is chosen for the material being cut.	• Choose correct cutting fluid for the material being cut.
• Machines are inspected and checked in readiness to achieve job specifications.	• Inspect and check machines in readiness to achieve job specifications.
• Material characteristics are identified.	• Identify material characteristics.
• Cutting machines and lubricants are identified and selected in accordance with manufacturer's specifications.	• Identify and select cutting machines and lubricants in accordance with manufacturer's specifications.
ASSESSMENT TASKS OR ACTIVITIES	
• Written test. • Practical project. • Demonstration.	

SUBJECT OUTCOME	
4.2 Perform mechanical cutting of material.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Equipment is set up and adjusted for cutting operation.	• Set up and adjust equipment for cutting operation.
• Cutting coolant/lubrication is adjusted.	• Adjust cutting coolant/lubrication.
• Cutting operation is performed.	• Perform cutting operation.
• Cutting operation is checked. *Range: Check completed cut (cut is straight, cut is clean), shape cut conforms to profile shape and dimensions, cutting blade is cutting and not rubbing.*	• Check cutting operation. *Range: Check completed cut (cut is straight, cut is clean), shape cut conforms to profile shape and dimensions, cutting blade is cutting and not rubbing.*
• Materials are cut in accordance to job specifications.	• Cut materials in accordance to job specifications.
• Blade clearances are confirmed to achieve shearing consistent with job specifications.	• Confirm blade clearances to achieve shearing consistent with job specifications.
• Edges conform to job specification or workplace procedure is cut.	• Cut edges to conform to job specification or workplace procedure.

ASSESSMENT TASKS OR ACTIVITIES
• Practical project. • Demonstration. • Written test.

SUBJECT OUTCOME	
4.3 Verify mechanical cutting of material using powered machinery.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Cut materials are inspected and measured for compliance to job specifications.	• Inspect completed component. *Range: Verify finish with specification needs, verify accuracy with specification requirements (cutting edge is not compositionally influenced through cutting application)*.
• Non conformance to job specifications is identified and reported.	• Identify and report non conformance to job specifications.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Demonstration. • Written test.	

Topic 5: Produce components using computer aided machining (CAM) in materials technology

SUBJECT OUTCOME	
5.1 Prepare the computer aided machine (CAM) and equipment.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The necessary post processor is selected. *Range: Fanuc, Siemans, Heinaman.*	• Select the necessary post processor. *Range: Fanuc, Siemans, Heinaman.*
• Tools are selected for the CAM system from existing library.	• Select tools for the CAM system from existing library.
• The machining process is prepared by selecting the order of operation.	• Prepare the machining process by selecting the order of operation. *Range: Contour milling, drilling, pockets and islands.*
• Primary machining operation is assessed considering cutting allowance to suit material type and composition.	• Assess primary machining operation considering cutting allowance to suit material type and composition.
• Secondary machining operation is assessed to suit material type and composition.	• Assess secondary machining operation to suit material type and composition (this is finishing cut).
• Speeds and feeds are set reflective of material type and composition.	• Set speeds and feeds reflective of material type and composition.
• Program is assessed and configured to the design of the project, and to site requirements.	• Assess and configure program to the design of the project, and to site requirements.
• Machine tools are fitted to meet machine specifications to enable machining of the product.	• Fit machine tools to meet machine specifications to enable machining of the product.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Demonstration. • Simulation. • Written test.	

SUBJECT OUTCOME	
5.2 Test CAM specifications.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The programme to test for correct drawing dimensions, tooling effect and elimination of tool breakage is simulated.	• Simulate the programme to test for correct drawing dimensions, tooling effect and elimination of tool breakage.
• The programme is re-edited if adjustments are required.	• Re-edit the programme if adjustment is required.
• Programme is saved on a disk or hard drive of the computer.	• Save programme on a disk or hard drive of the computer.
• Cutting time is examined and the process is sped up if necessary.	• Examine cutting time, and speed up the process if necessary.
• The planned machining operation is converted into a set of instructions and the operation planning sheet is drawn up.	• Convert the planned machining operation into a set of instructions and draw up the operation planning sheet.
• Drawing of the outline for the manufacturing of the final product enables machining of the product.	• Draw the outline for the manufacturing of the final product enabling the machining of the product.
• The component surfaces are defined and verified on the drawn outline, if necessary, in accordance with the final design and site requirements.	• Define and verify the component surfaces on the drawn outline, if necessary, in accordance with the final design and site requirements.
• Tool processes are defined and verified on the drawn outline, if necessary, in accordance with the final design and site requirements.	• Define and verify tool processes on the drawn outline, if necessary, in accordance with the final design and site requirements.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Demonstration. • Simulation. • Written test.	

SUBJECT OUTCOME	
5.3 Manufacture components using CAM process.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The programme applied to the machine is compatible with the process and drip feeding.	• Apply to the machine a programme that is compatible with the process and drip feeding.
• The machine is prepared by setting the tools lengths and zeroing axes X, Y and Z.	• Prepare the machine by setting the tool lengths and zeroing axes X, Y and Z.
• The programme is simulated on the machine simulator, identifying infringements.	• Simulate the programme on the machine simulator, identifying infringements.
• Components are machined to drawing specifications.	• Machine components to drawing specifications.
• Components are examined for inaccuracies, making editing adjustments to programme until components meet requirements.	• Examine components for inaccuracies, making editing adjustments to programme until components meet requirements.
• The quality of completed components is measured, examined and recorded according to specified requirements.	• Measure, examine and record the quality of completed components according to specified requirements.
• Machining program is tested against the design specification prior to the manufacture of the final component, to determine conformity to the product design.	• Test machining program against the design specification prior to the manufacture of the final component, to determine conformity to the product design.
• Cutting lubrication to suit the material is set up and checked to determine conformity to CAM manufacturer's recommendations.	• Set up cutting lubrication to suit the material and check to determine conformity to CAM manufacturer's recommendations.
• The manufacturing of components complies with the design specifications, health and safety, and site requirements.	• Check that the manufacturing of components complies with the design specifications, health and safety requirements, and site requirements.
• Components are verified in relation to the design specifications, and CAM adjustments are made, where necessary, to achieve the specification.	• Verify components in relation to the design specifications, and adjust CAM, where necessary, to achieve the specification.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Demonstration. • Simulation. • Written test.	

Topic 6: Joining processes are selected and applied in materials technology

SUBJECT OUTCOME	
6.1 Identify different joining systems and select appropriate methods.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Joining systems identified to enable the design and product specifications to be met.	• Identify different joining methods or systems. *Range: Bolt and nut, welding, riveting, brazing, soldering, adhesives.*
• Selection of joining methods and materials enables the design and product specifications to be met.	• Choose correct joining methods. *Range: Component operational values, effects of environmental conditions, type of material, thickness of material, compositional mechanical impartation, design specification.*
• Economical reasoning is explained in exercising joining method.	• Explain economical reasoning in exercising joining method.
• Component cosmetic thinking is exercised.	• Exercise component cosmetic thinking.

ASSESSMENT TASKS OR ACTIVITIES
• Practical project. • Demonstration. • Simulation. • Written test.

SUBJECT OUTCOME	
6.2 Prepare for joining of materials and components.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Correct equipment and tools are selected for the task at hand.	• Select the correct equipment and tools for the task at hand.
• The correct joining material is selected. *Range: Composition, thickness, surface finish.*	• Select the correct joining material. *Range: Composition, thickness, surface finish.*
• Working area is ensured to be safe and conducive. *Range: Ventilation, lighting, dust free, working space, working table, lifting support mechanism, respiratory apparatus.*	• Ensure working area is safe and conducive *Range: Ventilation, lighting, dust free, working space, working table, lifting support mechanism, respiratory apparatus.*
• Material to be joined is cleaned.	• Clean material to be joined.
• Tools and work area are prepared to suit selected methods and to meet Occupational Health and Safety Act, and workplace safety requirements.	• Prepare tools and work area to suit selected methods and to meet Occupational Health and Safety Act, and workplace safety requirements.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Demonstration. • Simulation. • Written test.	

SUBJECT OUTCOME	
6.3 Carry out the joining process and test and evaluate the process.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Joining systems and process are applied in accordance with manufacturer's and site requirements.	• Apply joining systems and process in accordance with manufacturer's and site requirements.
• Joining techniques are used in accordance with design and product specifications.	• Use joining techniques in accordance with design and product specifications.
• The material is joined.	• Join the material.
• The joined material is examined to see if it conforms to the required standards. *Range: Fatigue point, bending behaviour, tension, compressions, pressure*.	• Examine if the joined material conforms to the required standards. *Range: Fatigue point, bending behaviour, tension, compressions, pressure.*
• The joining of material is inspected to see if it is cosmetically appealing.	• Inspect to see if joining of material is cosmetically appealing.
• The tempering process for stress release is explained.	• Explain the tempering process for stress release.
• The process to infuse metal properties is explained.	• Explain the process to infuse metal properties.
• The joining method for redress in design is assessed.	• Assess joining method for redress in design.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical project. • Demonstration. • Simulation. • Written test.	

4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN ENGINEERING PROCESSES - LEVEL 4

4.1 Integrated summative assessment task (ISAT)

A compulsory component of the external assessment (ESASS) is the **integrated summative assessment task (ISAT)**. The integrated summative assessment task (ISAT) draws on the student's cumulative learning achieved throughout the year. The task requires **integrated application of competence** and is executed and recorded in compliance with assessment conditions.

Two approaches to the integrated summative assessment task (ISAT) may be as follows:

- The students are assigned a task at the beginning of the year which they will have to complete in phases during the year to obtain an assessment mark. A final assessment is made at the end of the year when the task is completed.

OR

- Students achieve the competencies during the year but the competencies are assessed cumulatively in a single assessment or examination session at the end of the year.

The integrated summative assessment task (ISAT) is set by an externally appointed examiner and is conveyed to colleges in the first quarter of the year.

The integrated assessment approach enables students to be assessed in more than one subject with the same integrated summative assessment task (ISAT).

4.2 National Examination

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally. The following distribution of cognitive application is suggested:

LEVEL 4	**KNOWLEDGE AND COMPREHENSION**	**APPLICATION**	**ANALYSIS, SYNTHESIS AND EVALUATION**
	45%	35%	20%