



higher education  
& training

Department:  
Higher Education and Training  
REPUBLIC OF SOUTH AFRICA

## **NATIONAL CERTIFICATES (VOCATIONAL)**

### **ASSESSMENT GUIDELINES**

### **FITTING AND TURNING**

### **NQF LEVEL 4**

**IMPLEMENTATION: JANUARY 2015**

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## 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 *Fitting and Turning* 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 internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Fitting and Turning Level 4* to prepare for and deliver Fitting and Machining. 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 in order 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 components of the delivery system.

- **Portability**

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

- **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 assessment or if a student possesses the capabilities specified in the outcomes statement.

- **Validity of assessments**

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

- clearly stating the outcome to be assessed;
- selecting 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 ensure that 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 that of 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 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 paper(s) set to the requirements of the Subject Learning Outcomes. The Department of Higher Education and Training 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 ISAT is the most significant test of students’ ability to apply their acquired knowledge.

The integrated assessment approach allows students to be assessed in more than one subject with the same 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 Higher Education and Training (DHET), Umalusi and, where relevant, an Education and Training Quality Assurance (ETQA) body, according to the 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 that proper procedures are followed;
- ensures that 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 assurer; and
- moderates in case of a dispute between an assessor and a student.

Policy on inclusive education requires that assessment procedures for students who experience barriers to learning be customised and supported to enable these students to achieve to 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 ICASS must be re-submitted with each examination enrolment for which it constitutes a component.

#### **5 ASSESSOR REQUIREMENTS**

Assessors must be subject specialists and competent assessors.

#### **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 (KSVAs) that students bring to the classroom. This knowledge assists lecturers in planning 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 for making 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 achievement in 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.

<b>LECTURER ASSESSMENT</b>	The lecturer assesses students' performance against given criteria in different contexts such as individual work, group work, etc.
<b>SELF-ASSESSMENT</b>	Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc.
<b>PEER ASSESSMENT</b>	Students assess another student or group of students' performance against given criteria in different contexts, such as individual work, group work, etc.
<b>GROUP ASSESSMENT</b>	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 Portfolio of Evidence (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 that the Subject Outcome has been attained. This will only be possible if the chosen methods and instruments are appropriate for the target group and for the Specific Outcome being assessed.

	METHODS FOR COLLECTING EVIDENCE		
	Observation-based (Less structured)	Task-based (Structured)	Test-based (More structured)
<b>Assessment instruments</b>	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Class questions</li> <li>• Lecturer, student, parent discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Investigations or research</li> <li>• Case studies</li> <li>• Practical exercises</li> <li>• Demonstrations</li> <li>• Role-play</li> <li>• Interviews</li> </ul>	<ul style="list-style-type: none"> <li>• Examinations</li> <li>• Class tests</li> <li>• Practical examinations</li> <li>• Oral tests</li> <li>• Open-book tests</li> </ul>
<b>Assessment tools</b>	<ul style="list-style-type: none"> <li>• Observation sheets</li> <li>• Lecturer's notes</li> <li>• Comments</li> </ul>	<ul style="list-style-type: none"> <li>• Checklists</li> <li>• Rating scales</li> <li>• Rubrics</li> </ul>	<ul style="list-style-type: none"> <li>• Marks (e.g. %)</li> <li>• Rating scales (1-7)</li> </ul>
<b>Evidence</b>	<ul style="list-style-type: none"> <li>• Focus on individual students</li> <li>• Subjective evidence based on lecturer observations and impressions</li> </ul>	<p><b>Open middle:</b> Students produce the same evidence but in different ways.</p> <p><b>Open end:</b> Students use same process to achieve different results.</p>	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 that cannot be compared to tests. Each criterion described in the rubric must be assessed separately. Mainly, two types of rubrics are used, namely holistic and analytical.

## 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 as evaluation of specific tasks. However, marks should be awarded against rubrics and should not simply be a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes (SKVAs) 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 it 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 record observations of 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 which criteria they are evaluated. Space for comments is essential.

# **ASSESSMENT OF FITTING AND MACHINING LEVEL 4**

## SECTION C: ASSESSMENT IN FITTING AND TURNING- LEVEL 4

### 1. ASSESSMENT SCHEDULE AND REQUIREMENTS

Internal and external assessments are conducted and the results of both contribute to the final mark of the student in the subject.

The internal continuous assessment (ICASS) mark accounts for 50 percent and the external examination mark for 50 percent of the final mark. A student needs a minimum final mark of 50 percent to achieve a pass in the subject.

#### 1.1 Internal assessment

Lecturers must compile a detailed assessment plan and assessment schedule of internal assessments to be undertaken during the year in the subject (e.g. date, assessment task or activity, rating code/marks allocated, assessor, moderator).

All internal assessments are then conducted according to the plan and schedule using appropriate assessment instruments and tools for each assessment task (e.g. tests, assignments, practical tasks/projects and memoranda, rubrics, checklists).

The marks allocated to the minimum number of both practical and written assessment tasks conducted during the internal continuous assessment (ICASS) are kept and recorded in the Portfolio of Evidence (PoE) which is subject to internal and external moderation.

A year mark out of 100 is calculated from the ICASS marks contained in the PoE and submitted to the DHET on the due date towards the end of the year.

The following internal assessment units **GUIDE** the internal assessment of *Fitting and Turning Level 4*.

TASKS	Time-frame	Type of assessment activity	Minimum time and proposed mark allocation (*can be increased but not reduced)	Scope of assessment	% contribution to the year
				Do not confuse the weightings of topics in the Subject Guidelines with the % contribution to the year mark	
1	Term 1	Test	1 hour (50 marks)	Topics completed in Term 1	10
2	Term 1	Practical Assessment/ Assignment	Determined by the scope and nature of the task	One or more of the topics completed as an assignment	25
3	Term 2	Practical Assessment/ Assignment	Determined by the scope and nature of the task	One or more of the topics completed as an assignment	25
4	Term 2	Test*	1 hour (50 marks)	Topics completed in Term 1 and 2	10
5	Term 3	Internal Examination*	As per external examinations (P1 & P2 where applicable)	Topics completed to date (P1 =15 & P2=15, where applicable)	30
<b>TOTAL</b>					<b>100</b>

Specifications for internal assessment may change over time. A separate internal assessment guideline document '*Guidelines for the Implementation of Internal Continuous Assessment (ICASS) in the NC(V) qualifications at FET Colleges*' has been developed, and

is updated and available on the Departmental website. The conduct and administration of internal assessments must always comply with specifications contained in the most current version of the guideline document.

## 2 RECORDING AND REPORTING

Fitting and Turning 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 planned and scheduled assessment should be recorded in the lecturer's Portfolio of Assessment (PoA) for each subject. The minimum requirements for the **lecturer's Portfolio of Assessment** should be as follows:

- Lecturer information
- A contents page
- Subject and Assessment Guidelines
- A subject Year plan /Work scheme/Pace Setter
- A subject assessment plan
- Instrument(s) (tests, assignments, practical) and tools (memoranda, rubrics, checklists) for each assessment task
- A completed pre-moderation checklist for each of the ICASS tasks and their accompanying assessment tools
- A completed post-moderation checklist once the task has been administered and assessed
- Subject record sheets per level/class reflecting the marks achieved by students in the ICASS tasks completed
- Evidence of review – diagnostic and statistical analysis, including notes on improvement of the task for future use

The college could standardise these documents.

The minimum requirements for the **student's Portfolio of Evidence (PoE)** should be as follows:

- Student information/identification
- Declaration of authenticity form – duly completed (signed and dated)
- A contents page/list of content (for accessibility)
- A subject assessment schedule
- The evidence of marked assessment tasks and feedback according to the assessment schedule

- A summary record of results showing all the marks achieved per assessment for the subject
- Evidence of moderation (only where applicable for students whose tasks were moderated)

Where tasks cannot be contained as evidence in the Portfolio of Evidence (PoE), its exact location must be recorded and it must be readily available for moderation purposes.

### 3. INTERNAL ASSESSMENT OF OUTCOMES IN FITTING AND TURNING– LEVEL 4

#### SECTION A: FITTING

##### Topic 1: Pumps

<b>SUBJECT OUTCOME</b>	
<b>1.1 Explain correct safety procedures and care when installing / maintaining pumps</b>	
<p><i>Range:</i></p> <p><i>Safety procedures include excerpts from the Driven Machinery Regulations. Safety measures include the impact on human beings, machines, equipment, materials and the environment. Pump maintenance safety includes the application of personal protective equipment, assembly, dismantling start-up procedures, protective guards and other best practice procedures. Always use the manufacturers' service manual as a guide to the effective maintenance and installation procedures.</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Worksite health and safety practices are explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Explain worksite health and safety practices.</li> </ul>
<ul style="list-style-type: none"> <li>• The importance of a clean working area and good housekeeping are explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the importance of a clean working area and good housekeeping.</li> </ul>
<ul style="list-style-type: none"> <li>• The safety precautions before and after replacing pump components are explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the safety precautions before and after replacing pump components.</li> </ul>
<ul style="list-style-type: none"> <li>• The need for using the correct tools, equipment, cleaning materials and personal protective equipment are discussed and explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Describe the need for using the correct tools, equipment, cleaning materials and personal protective equipment.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>
<b>1.2 Demonstrate an understanding of pumps</b>
<p><i>Range:</i></p> <p><i>Pump classifications include: Centrifugal pumps - both single and multi-stage pumps; Rotary pumps - gear pump, helical screw gear pump, vane pump and flexible impeller pump; Reciprocating pumps - piston pump, plunger pump and steam and air-driven reciprocating pumps</i></p> <p><i>Centrifugal pump terminology – casing, impeller, vortex, vacuum, stuffing box assembly, bearings, shaft assembly, inlet, outlet, single-stage and multi-stage, balancing disc.</i></p> <p><i>Reciprocating pump terminology – single- and two-stage pumps; Single and double acting pumps, difference between plunger and piston, inlet and outlet valves, suction and delivery head, stuffing box assembly, plunger pump with external packing, plunger pump with internal packing, the application of air chambers and reasons for use.</i></p>

<i>Rotary pumps inlet, outlet rotor, direction of flow, partial vacuum, vanes, eccentric cam. A clear differentiation between positive and non positive displacement pumps is required and application (with examples).</i>	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>The function of pumps is explained and pump terminology is used applicable to classification.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the function of pumps and use pump terminology applicable to classification.</li> </ul>
<ul style="list-style-type: none"> <li>The working principles of the three classifications of pumps are identified, named and explained.</li> </ul>	<ul style="list-style-type: none"> <li>Identify, name and explain the working principles of the three classifications of pumps.</li> </ul>
<ul style="list-style-type: none"> <li>The functions of various components are explained from given drawings.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the functions of various components from given drawings.</li> </ul>
<ul style="list-style-type: none"> <li>The difference between positive and non positive displacement pumps is explained and their uses are indicated.</li> </ul>	<ul style="list-style-type: none"> <li>Differentiate between positive and non positive displacement pumps and indicate where they are used.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Knowledge questionnaire</li> <li>Assignment/presentation</li> <li>Interview (oral) in order to evaluate ability to recall information</li> </ul>	

SUBJECT OUTCOME	
1.3 Plan and prepare for pump installation / maintenance.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>Job card is read and interpreted, documentation obtained and engineering drawings interpreted.</li> </ul>	<ul style="list-style-type: none"> <li>Read and interpret job card, obtain documentation and interpret engineering drawings.</li> </ul>
<ul style="list-style-type: none"> <li>Personnel requirements are identified and maintenance procedures are scheduled.</li> </ul>	<ul style="list-style-type: none"> <li>Identify personnel requirements and schedule maintenance procedures.</li> </ul>
<ul style="list-style-type: none"> <li>The appropriate tools and equipment are selected.</li> </ul>	<ul style="list-style-type: none"> <li>Select appropriate tools and equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The complete assembly is cleaned and inspected.</li> </ul>	<ul style="list-style-type: none"> <li>Clean and inspect the complete assembly.</li> </ul>
<ul style="list-style-type: none"> <li>Potential areas of defect and wear are listed.</li> </ul>	<ul style="list-style-type: none"> <li>List the potential areas of defect and wear.</li> </ul>
<ul style="list-style-type: none"> <li>The equipment is electrically isolated from other energy sources.</li> </ul>	<ul style="list-style-type: none"> <li>Isolate equipment electrically from other energy sources.</li> </ul>
<ul style="list-style-type: none"> <li>The equipment is mechanically isolated from other energy sources.</li> </ul>	<ul style="list-style-type: none"> <li>Isolate equipment mechanically from other energy sources.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Knowledge questionnaire</li> <li>Assignment/presentation</li> <li>Interview (oral) in order to evaluate ability to recall information</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>1.4. Dismantle and assemble pumps</b>	
<p><i>Range:</i></p> <p><i>Dismantling and assembly is confined to a single stage centrifugal pump-type.</i></p> <p><i>Students are expected to recall pump faults including: Causes of pump slip, general maintenance, the elimination of end thrust, installation procedures, the reduction and elimination of water-hammer.</i></p> <p><i>Parts inspection is important at this stage</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The pump is disassembled.</li> </ul>	<ul style="list-style-type: none"> <li>• Disassemble the pump.</li> </ul>
<ul style="list-style-type: none"> <li>• The pump components are identified.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify pump components.</li> </ul>
<ul style="list-style-type: none"> <li>• The pump assembly is removed</li> </ul>	<ul style="list-style-type: none"> <li>• Remove the pump assembly</li> </ul>
<ul style="list-style-type: none"> <li>• The parts are inspected for non-conformances.</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect parts for non-conformances.</li> </ul>
<ul style="list-style-type: none"> <li>• The parts are cleaned.</li> </ul>	<ul style="list-style-type: none"> <li>• Clean parts.</li> </ul>
<ul style="list-style-type: none"> <li>• The pump and/or sub- components are assembled.</li> </ul>	<ul style="list-style-type: none"> <li>• Assemble the pump and/or sub-components.</li> </ul>
<ul style="list-style-type: none"> <li>• Cleaning and overhaul procedures are performed.</li> </ul>	<ul style="list-style-type: none"> <li>• Perform cleaning and overhaul procedures.</li> </ul>
<ul style="list-style-type: none"> <li>• The appropriate safety practices are applied during the process.</li> </ul>	<ul style="list-style-type: none"> <li>• Apply appropriate safety practices during the process.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>1.5. Perform quality checks and job completion procedures</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Quality checks are conducted.</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct quality checks.</li> </ul>
<ul style="list-style-type: none"> <li>• The replacement parts are measured and tested and performance evaluated.</li> </ul>	<ul style="list-style-type: none"> <li>• Measure and test replacement parts and evaluate performance.</li> </ul>
<ul style="list-style-type: none"> <li>• Information on completed job is accurately recorded.</li> </ul>	<ul style="list-style-type: none"> <li>• Accurately record information on completed job.</li> </ul>
<ul style="list-style-type: none"> <li>• A new file is opened and named or an existing file used, and information stored in a safe place.</li> </ul>	<ul style="list-style-type: none"> <li>• Open a new file and name it or use an existing file, and store information in a safe place.</li> </ul>
<ul style="list-style-type: none"> <li>• Equipment and tools are cleaned and</li> </ul>	<ul style="list-style-type: none"> <li>• Clean and maintain equipment and tools.</li> </ul>

maintained.	
<ul style="list-style-type: none"> <li>Defective tools and equipment are reported and discard procedures or repair facilitated.</li> </ul>	<ul style="list-style-type: none"> <li>Report on defective tools and equipment and facilitate discard procedures or repair.</li> </ul>
<ul style="list-style-type: none"> <li>Equipment and tools are stored in an authorised place.</li> </ul>	<ul style="list-style-type: none"> <li>Store equipment and tools in an authorised place.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

## Topic 2: Compressors

SUBJECT OUTCOME	
<b>2.1 Explain correct safety procedures and care for installing / maintaining compressors</b>	
<p><i>Range:</i></p> <p><i>Safety procedures include excerpts from the Driven Machinery Regulations. Safety measures include the impact on human beings, machines, equipment, materials and the environment.</i></p> <p><i>Compressor maintenance and safety includes the application of personal protective equipment, assembly, dismantling start-up procedures, protective guards and other best practice procedures.</i></p>	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>Worksite health and safety practices are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain worksite health and safety practices.</li> </ul>
<ul style="list-style-type: none"> <li>The importance of a clean working area and good housekeeping are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the importance of a clean working area and good housekeeping.</li> </ul>
<ul style="list-style-type: none"> <li>The safety precautions required before and after replacing compressor components are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the safety precautions required before and after replacing compressor components.</li> </ul>
<ul style="list-style-type: none"> <li>The need for using the correct tools, equipment, cleaning materials and personal protective equipment is explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the need for using the correct tools, equipment, cleaning materials and personal protective equipment.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

SUBJECT OUTCOME
<b>2.2 Demonstrate an understanding of compressors</b>

<p><i>Range:</i></p> <p><i>Compressor classifications include:</i></p> <p><i>Centrifugal compressors including single and multi-stage centrifugal compressors.</i></p> <p><i>Reciprocating pumps including single stage and multi-stage compressors, as well as single acting and double-acting compressors.</i></p> <p><i>Rotary compressors - including the vane compressor, rotary screw compressor, lobe compressor.</i></p> <p><i>Components of a compressor: pressure regulator switch, air receiver, air filters, intercooler, after-cooler, dryer, low pressure cylinder, high pressure cylinder, water separator, moisture trap, pressure gauge.</i></p>	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>The working principle and function of compressors are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the working principle and function of compressors.</li> </ul>
<ul style="list-style-type: none"> <li>The different types of compressors are identified, classified and named from given drawings, including the description and function of components.</li> </ul>	<ul style="list-style-type: none"> <li>Identify, classify and name the different types of compressors from given drawings, including the description and function of components.</li> </ul>
<ul style="list-style-type: none"> <li>The components of a compressed air system are identified and their functions are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Identify the components of a compressed air system and explain their functions.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Knowledge questionnaire</li> <li>Assignment/presentation</li> <li>Interview (oral) in order to evaluate ability to recall information</li> </ul>	

SUBJECT OUTCOME	
2.3 Plan and prepare for compressor installation / maintenance.	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>The job card is read and interpreted, documentation is obtained and engineering drawings are interpreted.</li> </ul>	<ul style="list-style-type: none"> <li>Read and interpret job card, obtain documentation and interpret engineering drawings.</li> </ul>
<ul style="list-style-type: none"> <li>Personnel requirements are identified and maintenance procedures are scheduled.</li> </ul>	<ul style="list-style-type: none"> <li>Identify personnel requirements and schedule maintenance procedures.</li> </ul>
<ul style="list-style-type: none"> <li>The appropriate tools and equipment are selected.</li> </ul>	<ul style="list-style-type: none"> <li>Select appropriate tools and equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The complete assembly is cleaned and inspected.</li> </ul>	<ul style="list-style-type: none"> <li>Clean and inspect the complete assembly.</li> </ul>
<ul style="list-style-type: none"> <li>The potential areas of defect and wear are listed.</li> </ul>	<ul style="list-style-type: none"> <li>List the potential areas of defect and wear.</li> </ul>
<ul style="list-style-type: none"> <li>The equipment is isolated electrically from other energy sources.</li> </ul>	<ul style="list-style-type: none"> <li>Isolate equipment electrically from other energy sources.</li> </ul>
<ul style="list-style-type: none"> <li>The equipment is isolated mechanically from other energy sources.</li> </ul>	<ul style="list-style-type: none"> <li>Isolate equipment mechanically from other energy sources.</li> </ul>

<b>ASSESSMENT TASKS OR ACTIVITIES</b>
<ul style="list-style-type: none"> <li>• Knowledge questionnaire</li> <li>• Assignment/presentation</li> <li>• Interview (oral) in order to evaluate ability to recall information</li> </ul>

<b>SUBJECT OUTCOME</b>
<b>2.4. Install / maintain compressors</b>

*Range:*

*This task may be simulated within a typical workshop training station OR a visit arranged to a facility on the premises which has a compressor.*

*A reciprocating compressor model may be used for this purpose.*

*Installation / maintenance includes: check crankcase oil levels, drain water from receiver, belt tension, belt quality and alignment, air filter replacement, bent / kinked piping, belt pulley groove condition, pressure regulator cut-out switch (pressure and operation).*

<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The compressor components are identified.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify compressor components.</li> </ul>
<ul style="list-style-type: none"> <li>• The parts are inspected for non-conformances.</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect parts for non-conformances.</li> </ul>
<ul style="list-style-type: none"> <li>• The parts are cleaned.</li> </ul>	<ul style="list-style-type: none"> <li>• Clean parts.</li> </ul>
<ul style="list-style-type: none"> <li>• Cleaning and overhaul procedures are conducted.</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct cleaning and overhaul procedures.</li> </ul>
<ul style="list-style-type: none"> <li>• Appropriate safety practices are applied during the process.</li> </ul>	<ul style="list-style-type: none"> <li>• Apply appropriate safety practices during the process.</li> </ul>

<b>ASSESSMENT TASKS OR ACTIVITIES</b>
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>

<b>SUBJECT OUTCOME</b>
<b>2.5. Perform quality checks and job completion procedures.</b>

*Range:*

*Quality checks include elimination of air leaks, checks on pressure regulator switch cut-off pressure, stability of pressure gauge reading, effective pressure build-up.*

*Recording information in compressor register.*

*Reporting of defects and replacement parts.*

<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Quality checks are conducted.</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct quality checks.</li> </ul>
<ul style="list-style-type: none"> <li>• Equipment and tools are cleaned and</li> </ul>	<ul style="list-style-type: none"> <li>• Clean and maintain equipment and tools.</li> </ul>

maintained.	
<ul style="list-style-type: none"> <li>Defective tools and equipment are reported discard procedures or repair facilitated.</li> </ul>	<ul style="list-style-type: none"> <li>Report on defective tools and equipment and facilitate discard procedures or repair.</li> </ul>
<ul style="list-style-type: none"> <li>The equipment and tools are stored in an authorised place.</li> </ul>	<ul style="list-style-type: none"> <li>Store equipment and tools in an authorised place.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

### Topic 3: Fluid power systems - Hydraulics

<b>SUBJECT OUTCOME</b>	
<b>3.1 Explain correct safety procedures and care when working with hydraulic equipment.</b>	
<p><i>Range:</i>            Safety procedures include excerpts from the Driven Machinery Regulations. Safety measures include the impact on human beings, machines, equipment, materials and the environment.            Hydraulic maintenance and safety includes the application of personal protective equipment, assembly, dismantling, start-up procedures, protective guards and other best practice procedures.</p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Worksite health and safety practices are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain worksite health and safety practices.</li> </ul>
<ul style="list-style-type: none"> <li>The importance of a clean working area and good housekeeping are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the importance of a clean working area and good housekeeping.</li> </ul>
<ul style="list-style-type: none"> <li>The safety precautions for working with hydraulic systems and related equipment are explained.</li> </ul>	<ul style="list-style-type: none"> <li>Explain the safety precautions for working with hydraulic systems and related equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The importance of using the correct tools, equipment, cleaning materials and personal protective equipment are described and explained.</li> </ul>	<ul style="list-style-type: none"> <li>Describe and explain the importance of using the correct tools, equipment, cleaning materials and personal protective equipment.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>3.2 Demonstrate an understanding of hydraulic systems.</b>	
<p><i>Range:</i>            Components of a typical reservoir must be identified, namely: weir, pump, suction, air filter, return line, inspection glass, fluid drain plug.            Students must be able to design a simple hydraulic circuit containing five basic components and to physically lay out and test the applicable circuit.</p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>The factors that determine the choice between hydraulic and pneumatic systems are described.</li> </ul>	<ul style="list-style-type: none"> <li>Describe the factors that determine the choice between hydraulic and pneumatic systems</li> </ul>
<ul style="list-style-type: none"> <li>Energy conversion is discussed and explained by using the electrical, mechanical and hydraulic energy elements</li> </ul> <p><i>Range:</i>            Hydraulic symbols include basic circuit symbols identified in ISO-1219, including: power pack / drive unit components, all valves (directional control-, flow- and pressure relief-), actuators (linear and rotary), actuation symbols. Students are expected to identify and explain the functions thereof. The concept of "normally open / closed" must be explained.</p>	<ul style="list-style-type: none"> <li>Explain and discuss energy conversion by using the electrical, mechanical and hydraulic energy elements</li> </ul>
<ul style="list-style-type: none"> <li>The standard ISO units of measurement used in hydraulic systems are listed and discussed.</li> </ul> <p><i>Range:</i>            Units of measurement include pressure, area, flow rate.</p>	<ul style="list-style-type: none"> <li>List and discuss the standard ISO units of measurement used in hydraulic systems.</li> </ul>
<ul style="list-style-type: none"> <li>The function of the five basic components of a hydraulic system are named and described.</li> </ul>	<ul style="list-style-type: none"> <li>Name and describe the function of the five basic components of a hydraulic system.</li> </ul>
<ul style="list-style-type: none"> <li>The application of hydraulic component ISO-symbols is described and symbols identified with the aid of suitable sketches.</li> </ul> <p><i>Range:</i>            The five basic components of a hydraulic system include: pump, reservoir, piping, valves, actuators.</p>	<ul style="list-style-type: none"> <li>Identify and explain the application of hydraulic component ISO-symbols with the aid of suitable sketches.</li> </ul>
<ul style="list-style-type: none"> <li>The main functions of hydraulic fluid / oil and the reservoir are stated.</li> </ul> <p><i>Range:</i>            A minimum of four (4) functions of hydraulic fluid / oil are included.</p>	<ul style="list-style-type: none"> <li>State the main functions of hydraulic fluid / oil and the reservoir.</li> </ul>
<ul style="list-style-type: none"> <li>The function of the different valves used in hydraulic systems is explained</li> </ul> <p><i>Range:</i>            Pressure reducer and pressure regulator valves are excluded at this level.</p>	<ul style="list-style-type: none"> <li>Explain the function of the different valves used in hydraulic systems.</li> </ul>
<ul style="list-style-type: none"> <li>A simple hydraulic circuit containing the five basic components is designed, laid out and tested.</li> </ul>	<ul style="list-style-type: none"> <li>Design, lay out and test a simple hydraulic circuit containing the five basic components.</li> </ul>

<p><i>Range:</i>  <i>Components of a typical reservoir must be identified, namely: weir, pump, suction, air filter, return line, inspection glass, fluid drain plug. Students must be able to design a simple hydraulic circuit containing five basic components and to physically lay out and test the applicable circuit.</i></p>	
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Knowledge questionnaire</li> <li>• Assignment/presentation</li> <li>• Interview (oral) in order to evaluate ability to recall information</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>3.3. Construct a basic hydraulic circuit.</b>	
<p><i>Range:</i>  <i>Components include a power pack / drive unit; throttle valve, check valves, directional control valves (2/2, 4/2, 4/3, 5/3-way valves), linear and rotary actuators, pressure relief valve, pressure gauges, regulator valves, flow control valves.</i>  <i>Actuation is limited to muscular action and excludes electrical (solenoid) and pilot-controlled directional control.</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Applicable consumables, lubricants and cleaning agents are obtained in the required quantities.</li> </ul>	<ul style="list-style-type: none"> <li>• Obtain applicable consumables, lubricants and cleaning agents in the required quantities.</li> </ul>
<ul style="list-style-type: none"> <li>• The components required for the layout of the circuit are identified.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify components required for the layout of the circuit</li> </ul>
<ul style="list-style-type: none"> <li>• The circuit is constructed without damage to the components.</li> </ul>	<ul style="list-style-type: none"> <li>• Construct the circuit without damage to the components.</li> </ul>
<ul style="list-style-type: none"> <li>• The circuit operates according to its original design functions.</li> </ul>	<ul style="list-style-type: none"> <li>• Operate the circuit in order to test the functionality of the design.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>3.4. Apply quality checks on completed work.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The fluid pressure in the system is checked to meet operational (circuit) requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Check fluid pressure in the system to meet operational (circuit) requirements.</li> </ul>

<ul style="list-style-type: none"> <li>• Pipe layout is inspected for kinks and neatness</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect pipe layout for kinks and neatness</li> </ul>
<ul style="list-style-type: none"> <li>• A visual system inspection is carried out according to manufacturer and / or job requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Carry out visual system inspection according to manufacturer and / or job requirements.</li> </ul>
<ul style="list-style-type: none"> <li>• System performance is confirmed to meet operational requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Confirm that system performance meets operational requirements.</li> </ul>
<ul style="list-style-type: none"> <li>• Hydraulic system report is accurate and clear.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that hydraulic system report is accurate and clear.</li> </ul>
<ul style="list-style-type: none"> <li>• Defective tools and equipment are reported and the discard or repair procedures are facilitated.</li> </ul>	<ul style="list-style-type: none"> <li>• Report on defective tools and equipment and facilitate discard procedures or repair.</li> </ul>
<ul style="list-style-type: none"> <li>• Tools and equipment are cleaned and stored after use and the system environment normalised (housekeeping).</li> </ul>	<ul style="list-style-type: none"> <li>• Clean and store tools and equipment after use and normalise the system environment (housekeeping).</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

#### Topic 4: Fluid power systems – Pneumatics

<b>SUBJECT OUTCOME</b>	
<b>4.1 Explain correct safety procedures and care when working with pneumatic equipment.</b>	
<p><i>Range:</i></p> <p><i>Safety procedures include excerpts from the Driven Machinery Regulations. Safety measures include the impact on human beings, machines, equipment, materials and the environment.</i></p> <p><i>Pneumatic maintenance and safety includes the application of personal protective equipment, assembly, dismantling, start-up procedures, protective guards and other best practice procedures.</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Worksite health and safety practices are explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Explain worksite health and safety practices.</li> </ul>
<ul style="list-style-type: none"> <li>• The importance of a clean working area and good housekeeping are explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the importance of a clean working area and good housekeeping.</li> </ul>
<ul style="list-style-type: none"> <li>• The safety precautions for working with pneumatic systems and related equipment are explained.</li> </ul>	<ul style="list-style-type: none"> <li>• Explain the safety precautions for working with pneumatic systems and related equipment.</li> </ul>
<ul style="list-style-type: none"> <li>• The importance of using the correct tools, equipment, cleaning materials and personal protective equipment are described.</li> </ul>	<ul style="list-style-type: none"> <li>• Describe and explain the importance of using the correct tools, equipment, cleaning materials and personal protective equipment.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	

- Observation
- Assignments or tasks
- Projects
- Practical exercises
- Demonstrations

<b>SUBJECT OUTCOME</b>	
<b>4.2 Demonstrate an understanding of pneumatics and pneumatic systems.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The factors that determine the choice between pneumatic and hydraulic systems are described</li> </ul>	<ul style="list-style-type: none"> <li>• Describe the factors that determine the choice between pneumatic and hydraulic systems</li> </ul>
<ul style="list-style-type: none"> <li>• Energy conversion is explained and discussed by using the electrical, mechanical and pneumatic energy elements</li> </ul>	<ul style="list-style-type: none"> <li>• Explain and discuss energy conversion by using the electrical, mechanical and pneumatic energy elements</li> </ul>
<ul style="list-style-type: none"> <li>• The standard ISO units of measurement in pneumatic systems are listed and discussed. <i>Range:</i> <i>Units of measurement include pressure, area, flow rate. These are also known as the factors which influence the speed of actuation.</i></li> </ul>	<ul style="list-style-type: none"> <li>• List and discuss the standard ISO units of measurement in pneumatic systems.</li> </ul>
<ul style="list-style-type: none"> <li>• The five basic components of a pneumatic system are named and their functions are described. <i>Range:</i> <i>The five basic components of a pneumatic system include: compressor, service unit, piping, valves, actuators.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Name and describe the functions of the five basic components of a pneumatic system.</li> </ul>
<ul style="list-style-type: none"> <li>• The application of pneumatic component ISO-symbols is identified and explained with the aid of suitable sketches. <i>Range:</i> <i>Pneumatic symbols include basic circuit symbols in terms of ISO-1219. They include: service unit components, all valves (directional control-, flow- and exhaust-), actuators (linear and rotary), actuation symbols.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Identify and explain the application of pneumatic component ISO-symbols with the aid of suitable sketches.</li> </ul>
<ul style="list-style-type: none"> <li>• The main functions of the pneumatic service unit are stated. <i>Range:</i> <i>Components of a typical service unit must be identified, namely: water trap, lubricator, pressure gauge and regulator.</i></li> </ul>	<ul style="list-style-type: none"> <li>• State the main functions of the pneumatic service unit.</li> </ul>
<ul style="list-style-type: none"> <li>• The function of the different valves used in pneumatic systems is explained. <i>Range:</i> <i>Students are expected to identify and explain the functions of the different valves (directional control-, flow- and exhaust-). "AND" and "OR", "normally open / closed" concepts must be</i></li> </ul>	<ul style="list-style-type: none"> <li>• Explain the function of the different valves used in pneumatic systems.</li> </ul>

<i>explained.</i>	
<ul style="list-style-type: none"> <li>A simple pneumatic circuit containing the five basic components is designed.</li> </ul> <p><i>Range:</i> Students must be able to design a simple pneumatic circuit containing five basic components and physically lay out and test the applicable circuit.</p>	<ul style="list-style-type: none"> <li>Design, lay out and test a simple pneumatic circuit containing the five basic components.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Knowledge questionnaire</li> <li>Assignment/presentation</li> <li>Interview (oral) in order to evaluate ability to recall information</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>4.3. Construct a basic pneumatic circuit.</b>	
<p><i>Range:</i> Components include a pressure source (compressor), service unit, throttle valve, directional control valves (2/2, 4/2, 4/3, 5/3-way valves) linear and rotary actuators, pressure gauges, regulator valves, flow control valves, piping. Actuation is limited to muscular action and/or cam-roller and excludes electrical (solenoid) control</p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Applicable consumables, lubricants and cleaning agents are obtained in preparation for the layout and construction of the circuit.</li> </ul>	<ul style="list-style-type: none"> <li>Obtain applicable consumables, lubricants and cleaning agents in preparation for the layout and construction of the circuit.</li> </ul>
<ul style="list-style-type: none"> <li>The components required for the layout of the circuit are identified.</li> </ul>	<ul style="list-style-type: none"> <li>Identify components required for the layout of the circuit.</li> </ul>
<ul style="list-style-type: none"> <li>The circuit is constructed correctly according to the circuit diagram.</li> </ul>	<ul style="list-style-type: none"> <li>Construct the circuit correctly according to the circuit diagram.</li> </ul>
<ul style="list-style-type: none"> <li>The circuit is constructed without damage to components</li> </ul>	<ul style="list-style-type: none"> <li>Construct the circuit without damage to the components.</li> </ul>
<ul style="list-style-type: none"> <li>The circuit operates according to its original design functions.</li> </ul>	<ul style="list-style-type: none"> <li>Operate the circuit in order to test the functionality of the design.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>4.4. Apply quality checks on completed work.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Fluid pressure in the system is checked to</li> </ul>	<ul style="list-style-type: none"> <li>Check fluid pressure in the system to meet</li> </ul>

meet operational (circuit) requirements.	operational (circuit) requirements.
<ul style="list-style-type: none"> <li>• Pipe layout is inspected for kinks and neatness</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect pipe layout for kinks and neatness</li> </ul>
<ul style="list-style-type: none"> <li>• Visual system inspection is carried out according to manufacturer and / or job requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Carry out visual system inspection according to manufacturer and / or job requirements.</li> </ul>
<ul style="list-style-type: none"> <li>• System performance is confirmed to meet operational requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that system performance meets operational requirements.</li> </ul>
<ul style="list-style-type: none"> <li>• The pneumatic system report is accurate and clear.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that the pneumatic system report is accurate and clear.</li> </ul>
<ul style="list-style-type: none"> <li>• Defective tools and equipment are reported</li> </ul>	<ul style="list-style-type: none"> <li>• Report on defective tools and equipment.</li> </ul>
<ul style="list-style-type: none"> <li>• Discard procedures or repair of defective tools and equipment are facilitated.</li> </ul>	<ul style="list-style-type: none"> <li>• Facilitate discard procedures or repair of defective tools and equipment</li> </ul>
<ul style="list-style-type: none"> <li>• Tools and equipment are stored and cleaned after use and the system environment is normalised (housekeeping).</li> </ul>	<ul style="list-style-type: none"> <li>• Clean and store tools and equipment after use and normalise the system environment (housekeeping).</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

## SECTION B: MACHINING

### Topic 5: Surface Grinding

<b>SUBJECT OUTCOME</b>	
<b>5.1. Follow safety rules and maintain safety procedures</b>	
<p><i>Range:</i></p> <p><i>Wear safety glasses</i></p> <p><i>Ensure that all guarding is in place - never remove guards</i></p> <p><i>Inspect the grinding wheels to ensure that they are not damaged</i></p> <p><i>Place the work piece on the magnetic chuck – check the clamping before grinding!</i></p> <p><i>When dressing the wheel make sure the hydraulic system is off – use hand wheel for sideways movements</i></p> <p><i>When dressing the wheel with diamond dresser make sure it's placed off center</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The appropriate clothing is worn</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that the clothing worn is appropriate</li> </ul>
<ul style="list-style-type: none"> <li>• The placement of machine guards is checked and correct</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure the machine guards are in place</li> </ul>
<ul style="list-style-type: none"> <li>• The work area is clean and free of chips, spills, fluids and is adequately spacious.</li> </ul>	<ul style="list-style-type: none"> <li>• Clear the work area.</li> </ul>

<ul style="list-style-type: none"> <li>The grinding wheel is checked for possible cracks or damage.</li> </ul>	<ul style="list-style-type: none"> <li>Check the grinding wheel for cracks or damage</li> </ul>
<ul style="list-style-type: none"> <li>The surface grinding machine is confirmed to be switched off before loading and unloading a work piece.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that the surface grinding machine is switched off when loading and unloading a work piece.</li> </ul>
<ul style="list-style-type: none"> <li>The exhaust system for the grinding machine is well maintained</li> </ul>	<ul style="list-style-type: none"> <li>Maintain the exhaust system for the grinding machine.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>5.2. Prepare operation sheet</b>	
<p><i>Range:</i>  Thumb rule for roughing side movement is <math>\frac{3}{4}</math> of the grinding stone's width per longitudinal stroke  Thumb rule for finishing is <math>\frac{1}{2}</math> to <math>\frac{1}{4}</math> side movement of the grinding stone's width per longitudinal stroke  Small depth of cuts, fast longitudinal movements with maximum side movements gives best grinding results for roughing  When doing finishing ensure that there are no more sparks when stopping</p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>The correct grinding wheel is selected</li> </ul>	<ul style="list-style-type: none"> <li>Select the correct grinding wheel</li> </ul>
<ul style="list-style-type: none"> <li>The sideways speed and movement of the table is determined</li> </ul>	<ul style="list-style-type: none"> <li>Determine the table's sideways speed and movement</li> </ul>
<ul style="list-style-type: none"> <li>The speed and length of the longitudinal table travel (stroke) is correctly determined</li> </ul>	<ul style="list-style-type: none"> <li>Determine speed and the length of the longitudinal table travel (stroke)</li> </ul>
<ul style="list-style-type: none"> <li>An appropriate working tolerance is specified as per the drawing (<math>\pm 0.05\text{mm}</math>).</li> </ul>	<ul style="list-style-type: none"> <li>Specify an appropriate working tolerance as per the drawing (<math>\pm 0.05\text{mm}</math>)</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>
<b>5.3. Prepare for work activity</b>
<p><i>Range:</i>  Most surface grinders are equipped with magnetic chuck – ensure that the clamping force is</p>

<p><i>adequate</i>  <i>Ensure the surface of the magnetic chuck is straight – use dial gauge</i>  <i>Prevent scratches by always using a piece of paper (old newspaper) under the work piece</i>  <i>Always do the ring test before mounting a new wheel</i>  <i>Never use grinding wheels with too small a diameter</i>  <i>Coolant is extremely important to the result and a solution of Oil 2% : Water 98% is commonly used</i></p>	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>Drawings and job instructions are correctly interpreted and sequence of operations is determined.</li> </ul>	<ul style="list-style-type: none"> <li>Interpret drawings and job instructions and determine sequence of operations</li> </ul>
<ul style="list-style-type: none"> <li>Tools and equipment required for surface grinding operations are selected</li> </ul>	<ul style="list-style-type: none"> <li>Select tools and equipment required for surface grinding operations.</li> </ul>
<ul style="list-style-type: none"> <li>The condition of the machine, tools and equipment are checked.</li> </ul>	<ul style="list-style-type: none"> <li>Check whether tools and equipment are in good working condition.</li> </ul>
	<ul style="list-style-type: none"> <li>Check whether the machine is in good working condition</li> </ul>
The availability of coolant is confirmed	<ul style="list-style-type: none"> <li>Check that coolant is available.</li> </ul>
<ul style="list-style-type: none"> <li>The correct wheel is selected for grinding operation and its condition is assessed.</li> </ul>	<ul style="list-style-type: none"> <li>Select correct wheel for grinding operation.</li> </ul>
	<ul style="list-style-type: none"> <li>Assess wheel condition.</li> </ul>
ASSESSMENT TASKS OR ACTIVITIES	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

SUBJECT OUTCOME	
5.4. Set surface-grinding machine	
<p><i>Range:</i>  <i>Most surface grinders are equipped with magnetic chuck – ensure the clamping force is adequate</i>  <i>Ensure the surface of the magnetic chuck is straight – use dial gauge</i>  <i>Prevent scratches by always using a piece of paper (old newspaper) under the work piece</i>  <i>Always do the ring test before mounting a new wheel</i>  <i>Never use grinding wheels with too small a diameter</i></p>	
ASSESSMENT STANDARDS	LEARNING OUTCOMES
<ul style="list-style-type: none"> <li>The wheel is dressed and balanced.</li> </ul>	<ul style="list-style-type: none"> <li>Dress and balance the wheel.</li> </ul>
<ul style="list-style-type: none"> <li>The height of the grinding wheel is adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>Adjust height of the grinding wheel.</li> </ul>
<ul style="list-style-type: none"> <li>The component is correctly positioned on surface-grinding table.</li> </ul>	<ul style="list-style-type: none"> <li>Position component correctly on surface-grinding table.</li> </ul>
<ul style="list-style-type: none"> <li>The component is fixed to grinding table using magnetic table or clamp.</li> </ul>	<ul style="list-style-type: none"> <li>Fix component to grinding table using magnetic table or clamp.</li> </ul>

<ul style="list-style-type: none"> <li>The automatic feed operation is adjusted to suit work piece parameters.</li> </ul> <p><i>Range:</i></p> <p><i>Thumb rule for roughing side movement is ¾ of the grinding stone's width per longitudinal stroke.</i></p> <p><i>Thumb rule for finishing is ¼ to ¼ side movement of the grinding stone's width per longitudinal stroke</i></p> <p><i>Small depth of cuts, fast longitudinal movements with maximum side movements gives best grinding results for roughing</i></p> <p><i>When doing finishing ensure that there are no more sparks before stopping</i></p>	<ul style="list-style-type: none"> <li>Adjust automatic feed and movements according to operation sheet.</li> </ul>
<ul style="list-style-type: none"> <li>The type of grinding operation (peripheral or facing) is identified.</li> </ul>	<ul style="list-style-type: none"> <li>Identify the type of grinding operation (peripheral or facing).</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>5.5 Perform surface-grinding operations.</b>	
<p><i>Range:</i></p> <p><i>Tolerance of the completed work should be within 0,05mm of specification</i></p> <p><i>The surface grinding task should be a rectangular flat piece of steel – ONLY</i></p> <p><i>Allow the surface grinder run idle for 5 minutes with spindle on and with table movements for oiling purpose and customising to the environment</i></p> <p><i>Coolant must always be used in order to prevent heating of work piece. A solution of Oil 2% : Water 98% is commonly used.</i></p> <p><i>Stop coolant before stopping the grinding wheel</i></p> <p><i>Always take small depth of cuts</i></p> <p><i>Always use maximum width of grinding wheel in order to engage maximum number of grinding grains</i></p> <p><i>Always dress the wheel with frequent intervals to release new grains and prevent heating</i></p> <p><i>Never leave the surface grinder when machining</i></p> <p><i>Be observant of any change or sound during grinding</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Automatic lubrication system is applied.</li> </ul>	<ul style="list-style-type: none"> <li>Apply automatic lubrication system.</li> </ul>
<ul style="list-style-type: none"> <li>The machine is started and depth is set.</li> </ul>	<ul style="list-style-type: none"> <li>Start the machine and set depth.</li> </ul>
<ul style="list-style-type: none"> <li>Automatic feed is engaged.</li> </ul>	<ul style="list-style-type: none"> <li>Engage automatic feed.</li> </ul>
<ul style="list-style-type: none"> <li>Lateral table movement is adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>Adjust lateral table movement.</li> </ul>

<ul style="list-style-type: none"> <li>Coolant is adjusted and work piece flooded where grinding wheel is engaged.</li> </ul>	<ul style="list-style-type: none"> <li>Adjust coolant and flood work piece where grinding wheel is engaged</li> </ul>
<ul style="list-style-type: none"> <li>The grinding is monitored and adjusted accordingly</li> </ul>	<ul style="list-style-type: none"> <li>Monitor the grinding and adjust accordingly</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Selection and preparation of measuring equipment is correct and precise.</li> <li>Component is measured according to specifications.</li> <li>The machined component, on completion of the grinding process, is correctly removed.</li> <li>Monitoring of surface grinding machine is done well according to manufacturer's specification.</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>5.6. Apply quality checks on machined component</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Correct tools and equipment for quality checking are selected</li> </ul>	<ul style="list-style-type: none"> <li>Select correct tools and equipment for quality checking.</li> </ul>
<ul style="list-style-type: none"> <li>Values for checking are identified and measured</li> </ul>	<ul style="list-style-type: none"> <li>Identify values to be checked.</li> </ul>
<ul style="list-style-type: none"> <li>The cutting surface finish is checked</li> </ul>	<ul style="list-style-type: none"> <li>Check the cutting surface finish</li> </ul>
<ul style="list-style-type: none"> <li>Machined component is checked against specifications.</li> </ul>	<ul style="list-style-type: none"> <li>Check machined component against specifications</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>5.7 Recognise and report problems, changes and / or malfunctions in operations</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Malfunctions, problems and changes in operations are recognised and reported.</li> </ul>	<ul style="list-style-type: none"> <li>Recognise and report malfunctions</li> </ul>
	<ul style="list-style-type: none"> <li>Recognise and report problems.</li> </ul>
	<ul style="list-style-type: none"> <li>Recognise and report changes</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

**Topic 6: Centre Lathe**

<b>SUBJECT OUTCOME</b>	
<b>6.1. Follow safety rules and maintain safety precautions</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Appropriate clothing is worn</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that appropriate clothing is worn</li> </ul>
<ul style="list-style-type: none"> <li>• The placement of machine guards is confirmed</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that the machine guards are in place</li> </ul>
<ul style="list-style-type: none"> <li>• The work area is cleaned and free of chips, spills, fluids and is adequately spacious</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure the work area is clear and adequately spacious</li> </ul>
<ul style="list-style-type: none"> <li>• The lathe machine is confirmed to be switched off before loading and unloading a work piece.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure the lathe machine is switched off before loading and unloading a work piece.</li> </ul>
<ul style="list-style-type: none"> <li>• A guard or shield is used to deflect chips</li> </ul>	<ul style="list-style-type: none"> <li>• Use a guard or shield to deflect chips</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Works in an area which is clean and free of spills and fluids</li> <li>• Use of guards, shields, wear goggles and appropriate clothing</li> <li>• Switch the machine off when loading and unloading work piece and taking measurements</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>6.2. Prepare operation sheet</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The proper machining sequence is identified</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the proper machining sequence</li> </ul>
<ul style="list-style-type: none"> <li>• The work piece material is identified</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the work piece material.</li> </ul>
<ul style="list-style-type: none"> <li>• The work piece diameter is determined</li> </ul>	<ul style="list-style-type: none"> <li>• Determine the work piece diameter</li> </ul>
<ul style="list-style-type: none"> <li>• The cutting tool is identified and the cutting speed is determined as per specifications.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the type of cutting tool to be used.</li> </ul>
	<ul style="list-style-type: none"> <li>• Identify the cutting speed as per the specifications</li> </ul>
<ul style="list-style-type: none"> <li>• Calculation of the RPM, depth of cut and feed rate cut is done according to manufacturer's specification for roughing / finishing.</li> </ul> <p><i>Range:</i>  <i>Finishing cut must be minimum nose radius.</i>  <i>Feed in finishing cut must be set according to surface specification.</i></p>	<ul style="list-style-type: none"> <li>• Calculate the RPM according to roughing / finishing</li> </ul>
	<ul style="list-style-type: none"> <li>• Calculate the depth of cut according to roughing / finishing</li> </ul>
	<ul style="list-style-type: none"> <li>• Calculate the feed rate cut according to roughing / finishing</li> </ul>
<ul style="list-style-type: none"> <li>• An appropriate tolerance is specified as per drawing (<math>\pm 0.05</math>)</li> </ul>	<ul style="list-style-type: none"> <li>• Specify an appropriate tolerance as per drawing (<math>\pm 0.05</math>)</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> </ul>	

- Practical exercises
- Demonstrations

<b>SUBJECT OUTCOME</b>	
<b>6.3. Prepare for work activity</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The tools and equipment required for lathe operation are identified.</li> </ul>	<ul style="list-style-type: none"> <li>• Select tools and equipment required for lathe operation.</li> </ul>
<ul style="list-style-type: none"> <li>• The tools and equipment are confirmed to be in good working condition.</li> </ul>	<ul style="list-style-type: none"> <li>• Check whether tools and equipment are in good working condition.</li> </ul>
<ul style="list-style-type: none"> <li>• The lathe is maintained, oiled and lubricated</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain, oil and lubricate lathe</li> </ul>
<ul style="list-style-type: none"> <li>• The machine is confirmed to be in good working condition.</li> </ul>	<ul style="list-style-type: none"> <li>• Check whether the machine is in good working condition.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Interpret drawings and job instructions</li> <li>• Prepare the machine for operation</li> <li>• Check materials and tools required at workstation.</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>6.4. Set lathe.</b>	
<p><i>Range</i>  <i>Work holding is confined to a 3-jaw chuck for the purpose of assessment. Lecturers may choose to use a 4-jaw independent chuck depending on the available time.</i>  <i>Finishing cut must be minimum nose radius</i>  <i>Feed in finishing cut must be set according to surface specification</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The selected cutter is fitted in tool post and cutter height adjusted</li> </ul>	<ul style="list-style-type: none"> <li>• Fit selected cutter in tool post and adjust cutter height.</li> </ul>
<ul style="list-style-type: none"> <li>• The graduated sleeve of the cross-slide is set to zero.</li> </ul>	<ul style="list-style-type: none"> <li>• Set the graduated sleeve of the cross-slide to zero.</li> </ul>
<ul style="list-style-type: none"> <li>• The compound slide graduated dial is set to zero.</li> </ul>	<ul style="list-style-type: none"> <li>• Set the compound slide graduated dial to zero.</li> </ul>
<ul style="list-style-type: none"> <li>• Carriage is positioned for cut.</li> </ul>	<ul style="list-style-type: none"> <li>• Position carriage for cut.</li> </ul>
<ul style="list-style-type: none"> <li>• The work piece is mounted in a three jaw chuck.</li> </ul>	<ul style="list-style-type: none"> <li>• Mount the work piece in a three jaw chuck.</li> </ul>
<ul style="list-style-type: none"> <li>• Clamp securely and check the set-up.</li> </ul>	<ul style="list-style-type: none"> <li>• Clamp work securely and check the set-up.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> </ul>	

- Demonstrations

<b>SUBJECT OUTCOME</b>	
<b>6.5. Perform turning operations</b>	
<p><i>Range:</i></p> <p><i>The turning task will include the machining of a standard metric v-thread. No left hand thread or nut is included in the minimum requirements for assessment.</i></p> <p><i>The task is to take the form of a typical spindle with a metric thread and shall include a parted groove to accommodate the thread up to the shoulder / step.</i></p> <p><i>Lecturers are to use this range as a guide to the development of the task in this subject outcome.</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Calculated RPM is adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust the calculated RPM.</li> </ul>
<ul style="list-style-type: none"> <li>• Feed rate is adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust feed rate.</li> </ul>
<ul style="list-style-type: none"> <li>• Cutter is set against work piece and cutting depth adjusted.</li> </ul>	<ul style="list-style-type: none"> <li>• Set cutter against work piece and adjust cutting depth.</li> </ul>
<ul style="list-style-type: none"> <li>• Automatic or manual feed is engaged.</li> </ul>	<ul style="list-style-type: none"> <li>• Engage automatic or manual feed.</li> </ul>
<ul style="list-style-type: none"> <li>• Facing, longitudinal turning (internal and external), knurling and grooving are performed.</li> </ul>	<ul style="list-style-type: none"> <li>• Perform facing, longitudinal turning (internal or external), knurling and grooving.</li> </ul>
<ul style="list-style-type: none"> <li>• Metric standard thread cutting is performed.</li> </ul>	<ul style="list-style-type: none"> <li>• Perform metric standard thread cutting</li> </ul>
<ul style="list-style-type: none"> <li>• The work piece is turned to a tolerance of <math>\pm 0.05</math>.</li> </ul>	<ul style="list-style-type: none"> <li>• Turn to the work piece to a tolerance of <math>\pm 0.05</math>.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>6.6. Apply quality checks on machined component.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Correct tools and equipment are selected for quality checking.</li> </ul>	<ul style="list-style-type: none"> <li>• Select correct tools and equipment for quality checking.</li> </ul>
<ul style="list-style-type: none"> <li>• Values are identified for checking according to specifications</li> </ul>	<ul style="list-style-type: none"> <li>• Identify values for checking.</li> </ul>
<ul style="list-style-type: none"> <li>• Cutting surface finish is checked according to specifications</li> </ul>	<ul style="list-style-type: none"> <li>• Check finish of the cut surface.</li> </ul>

<b>ASSESSMENT TASKS OR ACTIVITIES</b>
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>

<b>SUBJECT OUTCOME</b>	
<b>6.7. Recognise and report problems, changes and / or malfunctions while operating</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Malfunctions, problems and changes in operations are recognised and reported.</li> <li>• Conformance of component to specifications is documented.</li> </ul>	<ul style="list-style-type: none"> <li>• Recognise and report malfunctions</li> </ul>
	<ul style="list-style-type: none"> <li>• Recognise and report problems.</li> </ul>
	<ul style="list-style-type: none"> <li>• Recognise and report changes</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

### Topic 7: Milling Machine

<b>SUBJECT OUTCOME</b>	
<b>7.1. Follow safety rules and maintain safety precautions</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• Appropriate clothing is worn</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that appropriate clothing is worn</li> </ul>
<ul style="list-style-type: none"> <li>• The machine guards are confirmed to be in place</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that the machine guards are in place</li> </ul>
<ul style="list-style-type: none"> <li>• The work area is cleaned and free of chips, spills, fluids and is adequately spacious</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that the work area is clear and adequately spacious</li> </ul>
<ul style="list-style-type: none"> <li>• Gloves / hand protection are used when mounting milling cutters</li> </ul>	<ul style="list-style-type: none"> <li>• Use gloves / hand protection when mounting milling cutters</li> </ul>
<ul style="list-style-type: none"> <li>• The milling machine is confirmed to be switched off before loading or unloading a work piece.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that the milling machine is switched off before loading or unloading a work piece.</li> </ul>
<ul style="list-style-type: none"> <li>• A guard or shield is used to deflect chips</li> </ul>	<ul style="list-style-type: none"> <li>• Use a guard or shield to deflect chips</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> </ul>	

- Projects
- Practical exercises
- Demonstrations

<b>SUBJECT OUTCOME</b>	
<b>7.2. Prepare operation sheet</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
• The type of cutting tool to be use is identified.	• Identify the type of cutting tool to be used.
• The cutting speed is identified as per the specifications.	• Identify the cutting speed as per the specifications
• The RPM is calculated according to roughing / finishing.	• Calculate the RPM according to roughing / finishing
• The depth of cut is calculated according to roughing / finishing.	• Calculate the depth of cut according to roughing / finishing
• The feed rate cut is calculated according to roughing / finishing.	• Calculate the feed rate cut according to roughing / finishing
• The dividing head settings are determined for indirect indexing.	• Determine the dividing head settings for indirect indexing
• The proper machining sequence is identified.	• Identify the proper machining sequence
• The working tolerances are specified as per drawing ( $\pm 0.05$ ).	• Specify an appropriate tolerance as per the drawing ( $\pm 0.05$ ).
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>7.3. Prepare for work activity</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
• The machine is prepared for operation including lubrication, routine maintenance and pre-operational checks.	• Ensure machine is prepared for operation including lubrication, routine maintenance and pre-operational checks.
• The materials and tools are appropriate and available	• Ensure that the material and tools required are appropriate and available
• The cutting fluid is available	• Ensure that the cutting fluid is available
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> </ul>	

- Projects
- Practical exercises
- Demonstrations

<b>SUBJECT OUTCOME</b>	
<b>7.4. Set the milling machine</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
• The appropriate HM cutting tool is mounted	• Mount the appropriate HM cutting tool
• The clamping arrangement is set	• Set clamping arrangement.
• The work piece is mounted and positioned correctly (for either cutting or indirect indexing).	• Mount and position the work piece correctly (for cutting or indirect indexing)
• The table X and Y axes are confirmed to be perpendicular to the spindle axis.	• Check that the table X and Y axes are perpendicular to spindle axis.
• The fixed jaw of the vice is confirmed to be parallel to the X axis.	• Ensure that the fixed jaw of the vice is parallel to the X axis
• The work piece is mounted.	• Mount the work piece
• Cutting speeds and feeds are selected and set according to the operation sheet.	• Select and set cutting speeds and feeds according to operation sheet
• The dividing head is adjusted for indirect indexing	• Adjust the dividing head for indirect indexing
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Observation</li> <li>• Assignments or tasks</li> <li>• Projects</li> <li>• Practical exercises</li> <li>• Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>7.5. Perform milling operations</b>	
<p><i>Range:</i></p> <p><i>The milling task must include a 5- or 7-side flat which may be included in the turning task above. This can be accommodated by allowing the spindle to have a 5 or 7-flat head.</i></p> <p><i>The tolerance shall be 0.1 mm for milled flats.</i></p> <p><i>All machining shall be 0.05 mm in order to give the student the opportunity to test the aptitude for precision.</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
• The cutter is positioned and cutting depth and width are set	• Position cutter and set cutting depth and width.
• The graduated dials are set to zero.	• Set graduated dials to zero.

<ul style="list-style-type: none"> <li>The speeds and feeds are adjusted</li> </ul>	<ul style="list-style-type: none"> <li>Adjust the speeds and feeds.</li> </ul>
<ul style="list-style-type: none"> <li>Automatic or manual feed is used</li> </ul>	<ul style="list-style-type: none"> <li>Use automatic or manual feed.</li> </ul>
<ul style="list-style-type: none"> <li>Flat and slot are milled within a tolerance of <math>\pm 0.05</math>.</li> </ul>	<ul style="list-style-type: none"> <li>Mill flat and slot within a tolerance of <math>\pm 0.05</math></li> </ul>
<ul style="list-style-type: none"> <li>The work piece is removed after machining</li> </ul>	<ul style="list-style-type: none"> <li>Remove the work piece after machining</li> </ul>
<ul style="list-style-type: none"> <li>The milling machine is cleaned after the job is done</li> </ul>	<ul style="list-style-type: none"> <li>Clean the milling machine after completing the job.</li> </ul>
<ul style="list-style-type: none"> <li>The dividing head is adjusted according to the number of sides to be cut</li> </ul> <p><i>Range:</i></p> <p><i>Ensure the dividing head is properly adjusted and aligned before use.</i></p> <p><i>Use hole-plate indexing and remember to tighten the head after each indexing.</i></p>	<ul style="list-style-type: none"> <li>Adjust the dividing head according to the number of sides to be cut</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>7.6. Apply quality checks and provide report on machined component.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Correct tools and equipment for quality checking are selected.</li> </ul>	<ul style="list-style-type: none"> <li>Select correct tools and equipment for quality checking.</li> </ul>
<ul style="list-style-type: none"> <li>Values for checking are identified.</li> </ul>	<ul style="list-style-type: none"> <li>Identify values for checking.</li> </ul>
<ul style="list-style-type: none"> <li>Cutting surface finish is checked.</li> </ul>	<ul style="list-style-type: none"> <li>Check cutting surface finish.</li> </ul>
<ul style="list-style-type: none"> <li>The machined component is checked for conformance to the specifications as per assessment sheet and drawing</li> </ul>	<ul style="list-style-type: none"> <li>Check that the machined component conforms to the specifications as per assessment sheet and drawing</li> </ul>
<ul style="list-style-type: none"> <li>Problems, changes and / or malfunctions while operating the machine are identified and reported.</li> </ul>	<ul style="list-style-type: none"> <li>Identify and report problems, changes and / or malfunctions while operating the machine.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

**Topic 8: CNC Lathe (Turning)**

<b>SUBJECT OUTCOME</b>	
<b>8.1. Follow safety rules and maintain safety precautions</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Personal Protection Equipment (PPE) are used to reduce the chance of injuries</li> </ul> <p><i>Range:</i> <i>Includes no loose clothing, jewellery and must wear long hair protection hat.</i></p>	<ul style="list-style-type: none"> <li>Use Personal Protection Equipment (PPE) to reduce the chance of injuries</li> </ul>
<ul style="list-style-type: none"> <li>Protective clothing should always be worn.</li> </ul> <p><i>Range:</i> <i>Including but not limited to soundproof buds or head phones, gloves, eye protection and closed-toed boots or shoes</i></p>	<ul style="list-style-type: none"> <li>Always wear gloves, eye protection and closed-toed boots or shoes</li> <li>Wear hearing protection such as soundproof buds or headphones to prevent cumulative hearing damage from loud noises</li> </ul>
<ul style="list-style-type: none"> <li>Part programme is checked and simulated in pc / controller before execution</li> </ul>	<ul style="list-style-type: none"> <li>Check and simulate part programme before execution</li> </ul>
<ul style="list-style-type: none"> <li>Cutting tools' length / radius measurements are checked and assigned tool numbers are correct</li> </ul>	<ul style="list-style-type: none"> <li>Check cutting tools' length / radius measurements and correct assigned tool numbers</li> </ul>
<ul style="list-style-type: none"> <li>Assigned programme zero to fixture offset is checked</li> </ul>	<ul style="list-style-type: none"> <li>Check assigned programme zero to fixture offset</li> </ul>
<ul style="list-style-type: none"> <li>Software safety guard on tool movement is checked.</li> </ul>	<ul style="list-style-type: none"> <li>Check software safety guard on tool movement</li> </ul>
<ul style="list-style-type: none"> <li>Equipment, materials and machines are cleaned after use.</li> </ul>	<ul style="list-style-type: none"> <li>Clean equipment, materials and machines after use.</li> </ul>
<ul style="list-style-type: none"> <li>Work area is cleaned after working.</li> </ul>	<ul style="list-style-type: none"> <li>Clean work area after working.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>8.2. Prepare operation sheet</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>The correct machining sequence of processes is identified</li> </ul>	<ul style="list-style-type: none"> <li>Identify the proper machining sequence</li> </ul>
<ul style="list-style-type: none"> <li>The type of HM cutting tools to be used is identified</li> </ul>	<ul style="list-style-type: none"> <li>Identify the type of HM cutting tool to be used.</li> </ul>

<ul style="list-style-type: none"> <li>The cutting speed is identified as per specifications</li> </ul>	<ul style="list-style-type: none"> <li>Identify the cutting speed as per the specifications</li> </ul>
<ul style="list-style-type: none"> <li>The RPM is calculated according to roughing or finishing</li> </ul>	<ul style="list-style-type: none"> <li>Calculate the RPM according to roughing or finishing</li> </ul>
<ul style="list-style-type: none"> <li>The depth of cut and feed rate are calculated according to roughing or finishing</li> </ul>	<ul style="list-style-type: none"> <li>Calculate the depth of cut according to roughing or finishing</li> </ul>
	<ul style="list-style-type: none"> <li>Calculate the feed rate cut according to roughing or finishing</li> </ul>
<ul style="list-style-type: none"> <li>An appropriate tolerance is specified as per the drawing</li> </ul>	<ul style="list-style-type: none"> <li>Specify an appropriate tolerance as per the drawing</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Observation</li> <li>Assignments or tasks</li> <li>Projects</li> <li>Practical exercises</li> <li>Demonstrations</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>8.3. Write and simulate part programme.</b>	
<p><i>Range:</i></p> <p><i>The part programming conforms to ISO 841</i></p> <p><i>The part programme must be simulated using pc based software such as CNCEDIT before transferring to CNC controller</i></p> <p><i>All part programming</i></p>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>The tool offset is programmed on two axes and the work piece's zero point.</li> </ul>	<ul style="list-style-type: none"> <li>Programme tool offset on two axes and the work piece's zero point</li> </ul>
<ul style="list-style-type: none"> <li>The zero reference point is programmed for two axis machining</li> </ul>	<ul style="list-style-type: none"> <li>Programme the zero reference point for two axis machining</li> </ul>
<ul style="list-style-type: none"> <li>Understanding of the coordinate system of a two axis CNC turning centre is demonstrated</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate understanding of the coordinate system of a two-axis CNC turning centre</li> </ul>
<ul style="list-style-type: none"> <li>A part programme is produced using geometrical data and technological data</li> </ul>	<ul style="list-style-type: none"> <li>Use geometrical data and technological data to produce a part programme</li> </ul>
<ul style="list-style-type: none"> <li>M- and G codes are used in a part programme</li> </ul>	<ul style="list-style-type: none"> <li>Use M codes and G codes in a part programme</li> </ul>
<ul style="list-style-type: none"> <li>Radius Compensation is used in a part programme</li> </ul>	<ul style="list-style-type: none"> <li>Use Radius Compensation in a part programme</li> </ul>
<ul style="list-style-type: none"> <li>Fixed work cycles are used in a part programme</li> </ul> <p><i>Range:</i></p>	<ul style="list-style-type: none"> <li>Use fixed work cycles in a part programme.</li> </ul>

<i>Roughing; finishing; threading</i>	
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Write a part programme using x,y, z coordinates, M and G Codes and fixed cycles</li> <li>• Simulate and check a 2D ISO 841 part programme</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>8.4. Set machine to perform the specified work.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• CNC Turning Center is set with prober tools and fixture</li> </ul>	<ul style="list-style-type: none"> <li>• Select the correct HM cutting tools and fixtures for machining operations.</li> </ul>
<ul style="list-style-type: none"> <li>• Programme zero is set with appropriate assigned nominated reference tools T01 on the work piece</li> </ul>	<ul style="list-style-type: none"> <li>• Use reference tool T01 to assign programme zero to work piece offset zero point</li> </ul>
<ul style="list-style-type: none"> <li>• The lengths and radius of tools selected are measured and the values are assigned to the corresponding offset.</li> </ul>	<ul style="list-style-type: none"> <li>• Measure tool lengths and radius and assign the values to the correct offset addresses.</li> </ul>
<ul style="list-style-type: none"> <li>• A part programme transferred from a PC to CNC controller</li> </ul>	<ul style="list-style-type: none"> <li>• Transfer a part programme from a PC to CNC controller</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Set the machine turning centre with correct measured cutting tools</li> <li>• Set the programme zero point correctly according to the zero point of the fixture</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>8.5. Operate the CNC turning centre</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• A simple part programme is written on CNC controller</li> </ul>	<ul style="list-style-type: none"> <li>• Write a simple part programme on CNC controller</li> </ul>
<ul style="list-style-type: none"> <li>• A part programme on CNC controller is changed and edited</li> </ul>	<ul style="list-style-type: none"> <li>• Change and edit part programme</li> </ul>
<ul style="list-style-type: none"> <li>• The part programme is dry run and adjusted</li> </ul>	<ul style="list-style-type: none"> <li>• Simulated and dry run a part programme</li> </ul>
<ul style="list-style-type: none"> <li>• A part programme is executed and tested block by block</li> </ul>	<ul style="list-style-type: none"> <li>• Test a part programme block by block</li> </ul>
<ul style="list-style-type: none"> <li>• The programme is executed in auto mode</li> </ul>	<ul style="list-style-type: none"> <li>• Run a part programme in auto mode</li> </ul>
<ul style="list-style-type: none"> <li>• CNC machine parameters are adjusted</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust CNC machine parameters</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Simulate, edit and change the programme as per operation sheet and drawing.</li> <li>• Operated the CNC Centre to produce one work piece</li> <li>• Assess the produced work piece and adjust CNC machine parameters accordingly</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>8.6. Apply quality checks and provide report on machined component</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>The machined component surface is checked for conformance to the specifications.</li> </ul>	<ul style="list-style-type: none"> <li>Check that the machined component surface conforms to the specifications.</li> </ul>
<ul style="list-style-type: none"> <li>Appropriate measuring equipment is selected and prepared.</li> </ul>	<ul style="list-style-type: none"> <li>Select and prepare appropriate measuring equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The component is measured.</li> </ul>	<ul style="list-style-type: none"> <li>Measure component</li> </ul>
<ul style="list-style-type: none"> <li>Problems, changes and / or malfunctions while operating the machine are identified and reported.</li> </ul>	<ul style="list-style-type: none"> <li>Identify and report problems, changes and / or malfunctions while operating the machine.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Select appropriate measuring equipment to meet job requirements.</li> <li>Check the component against specifications.</li> <li>Recognise and report malfunctions.</li> <li>Take correct measurements.</li> </ul>	

### Topic 9: CNC Milling

<b>SUBJECT OUTCOME</b>	
<b>9.1. Follow safety rules and maintain safety precautions</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Personal Protection Equipment (PPE) are used and worn to reduce the chance of injuries</li> </ul> <p><i>Range:</i>  <i>Includes no loose clothing, jewellery and must wear long hair protection hat.</i>  <i>Including but not limited to soundproof buds or headphones, gloves, eye protection and closed-toed boots or shoes</i></p>	<ul style="list-style-type: none"> <li>Use Personal Protection Equipment (PPE) and wear appropriate clothing to reduce the chance of injuries</li> </ul>
<ul style="list-style-type: none"> <li>Part programme is checked and simulated in PC or controller before execution</li> </ul>	<ul style="list-style-type: none"> <li>Check and simulate part programme in PC or controller before execution</li> </ul>
<ul style="list-style-type: none"> <li>The cutting tools' length and radius measurements and the correctness of assigned tool numbers are checked before use</li> </ul>	<ul style="list-style-type: none"> <li>Check cutting tools' length and radius measurements and correctness of assigned tool numbers</li> </ul>
<ul style="list-style-type: none"> <li>Assigned programme zero point is checked to fixture offset</li> </ul>	<ul style="list-style-type: none"> <li>Check assigned programme zero to fixture offset</li> </ul>
<ul style="list-style-type: none"> <li>Worksite health and safety practices are applied.</li> </ul>	<ul style="list-style-type: none"> <li>Apply worksite health and safety practices.</li> </ul>
<ul style="list-style-type: none"> <li>Equipment, materials and machines are</li> </ul>	<ul style="list-style-type: none"> <li>Clean equipment, materials and machines</li> </ul>

cleaned after use.	after use.
<ul style="list-style-type: none"> <li>Work area is cleaned after working.</li> </ul>	<ul style="list-style-type: none"> <li>Clean work area after working.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Check and verify the program, tools and fixture zero point.</li> <li>Use safeguards, correct coolant and appropriate personal protective equipment and store correctly after use.</li> <li>Illustrate workshop safety practises.</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>9.2. Prepare an Operation Sheet</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>The correct machining sequence of processes is identified.</li> </ul>	<ul style="list-style-type: none"> <li>Identify the proper machining sequence of processes</li> </ul>
<ul style="list-style-type: none"> <li>The type of HM cutting tool to be used is identified</li> </ul>	<ul style="list-style-type: none"> <li>Identify the type of HM cutting tool to be used.</li> </ul>
<ul style="list-style-type: none"> <li>Correct cutting speed is identified according to specifications</li> </ul>	<ul style="list-style-type: none"> <li>Identify the cutting speed as per the specifications</li> </ul>
<ul style="list-style-type: none"> <li>The RPM is calculated according to roughing or finishing</li> </ul>	<ul style="list-style-type: none"> <li>Calculate the RPM according to roughing or finishing</li> </ul>
<ul style="list-style-type: none"> <li>The depth of cut is calculated according to roughing or finishing</li> </ul>	<ul style="list-style-type: none"> <li>Calculate the depth of cut according to roughing or finishing</li> </ul>
<ul style="list-style-type: none"> <li>The feed rate cut is calculated according to roughing or finishing</li> </ul>	<ul style="list-style-type: none"> <li>Calculate the feed rate cut according to roughing or finishing</li> </ul>
<ul style="list-style-type: none"> <li>An appropriate tolerance is specified as per the drawing</li> </ul>	<ul style="list-style-type: none"> <li>Specify an appropriate tolerance as per the drawing</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Prepare an operation sheet giving instruction for step by step machining using correct HM tools, speed, feed and sequencing of machining.</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>9.3. Prepare and write a programme.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Programme tool offset is produced on two axes and the work piece's zero point</li> </ul>	<ul style="list-style-type: none"> <li>Produce programme tool offset on two axes and the work piece's zero point</li> </ul>
<ul style="list-style-type: none"> <li>Programme reference zero point is produced for two-axis machining</li> </ul>	<ul style="list-style-type: none"> <li>Produce programme reference zero point for two-axis machining</li> </ul>
<ul style="list-style-type: none"> <li>Knowledge of the coordinate system on a two-axis CNC turning centre is demonstrated</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate knowledge of the coordinate system on a two-axis CNC turning centre</li> </ul>
<ul style="list-style-type: none"> <li>A part programme is produced using geometrical data and technological data</li> </ul>	<ul style="list-style-type: none"> <li>Produce a part programme using geometrical data and technological data</li> </ul>
<ul style="list-style-type: none"> <li>A part programme is produced using M- and G-codes</li> </ul>	<ul style="list-style-type: none"> <li>Produce a part programme using M- and G-codes</li> </ul>
<ul style="list-style-type: none"> <li>A part programme is produced with the use of radius compensation.</li> </ul>	<ul style="list-style-type: none"> <li>Produce part programme with the use of radius compensation</li> </ul>
<ul style="list-style-type: none"> <li>A part programme is written using fixed cycles roughing or finishing or threading</li> </ul>	<ul style="list-style-type: none"> <li>Write a part programme using fixed cycles (for roughing, finishing or threading)</li> </ul>

<b>ASSESSMENT TASKS OR ACTIVITIES</b>
<ul style="list-style-type: none"> <li>• Write a part programme using HM cutting tools, x,y, z coordinates, M - and G-codes, radius compensation and fixed cycles</li> <li>• Simulate and check a 2½ D ISO 841 part programme</li> </ul>

<b>SUBJECT OUTCOME</b>	
<b>9.4. Set the machine to perform the specified work.</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The correct cutting tools and fixtures are selected for machining operations.</li> </ul>	<ul style="list-style-type: none"> <li>• Select the correct cutting tools and fixtures for machining operations.</li> </ul>
<ul style="list-style-type: none"> <li>• Programme zero is assigned to fixture offset</li> </ul>	<ul style="list-style-type: none"> <li>• Assign programme zero to fixture offset</li> </ul>
<ul style="list-style-type: none"> <li>• Tool offsets / radius are measured and the values assigned to correct offsets addresses</li> </ul>	<ul style="list-style-type: none"> <li>• Measure tool offsets / radius and assign the values to correct offsets addresses</li> </ul>
<ul style="list-style-type: none"> <li>• A part programme is transferred from a PC to CNC controller.</li> </ul>	<ul style="list-style-type: none"> <li>• Transfer a part programme from a PC to CNC controller.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Set the machine milling centre with correct measured cutting tools</li> <li>• Set the programme zero point correctly according to the zero point of the fixture</li> <li>• Transfer the part programme to CNC controller</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>9.5. Operate the CNC milling centre</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>• The part programme is written directly on the controller</li> </ul>	<ul style="list-style-type: none"> <li>• Write the part programme directly on the controller</li> </ul>
<ul style="list-style-type: none"> <li>• A part programme is changed and edited on CNC controller</li> </ul>	<ul style="list-style-type: none"> <li>• Change and edit a part programme on CNC.</li> </ul>
<ul style="list-style-type: none"> <li>• The part programme is simulated and dry run.</li> </ul>	<ul style="list-style-type: none"> <li>• Simulated and dry run a part programme</li> </ul>
<ul style="list-style-type: none"> <li>• A part programme is tested block by block</li> </ul>	<ul style="list-style-type: none"> <li>• Test a part programme block by block</li> </ul>
<ul style="list-style-type: none"> <li>• The part programme is run in auto mode</li> </ul>	<ul style="list-style-type: none"> <li>• Run a part programme in auto mode</li> </ul>
<ul style="list-style-type: none"> <li>• CNC machine parameters are adjusted</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust CNC machine parameters</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>• Simulate, edit and change a programme as per operation sheet and drawing.</li> <li>• Operate the CNC milling centre and produce one work piece</li> <li>• Assess the produced work piece and adjust the CNC machine parameters accordingly</li> </ul>	

<b>SUBJECT OUTCOME</b>	
<b>9.6. Apply quality checks and provide a report on machined component</b>	
<b>ASSESSMENT STANDARDS</b>	<b>LEARNING OUTCOMES</b>
<ul style="list-style-type: none"> <li>Machined component surface is checked for conformance to the specifications.</li> </ul>	<ul style="list-style-type: none"> <li>Check that the machined component surface conforms to the specifications.</li> </ul>
<ul style="list-style-type: none"> <li>Appropriate measuring equipment is selected and prepared.</li> </ul>	<ul style="list-style-type: none"> <li>Select and prepare appropriate measuring equipment.</li> </ul>
<ul style="list-style-type: none"> <li>The component is measured.</li> </ul>	<ul style="list-style-type: none"> <li>Measure component</li> </ul>
<ul style="list-style-type: none"> <li>Problems, changes and / or malfunctions while operating the machine are identified and reported.</li> </ul>	<ul style="list-style-type: none"> <li>Identify and report problems, changes and / or malfunctions while operating the machine.</li> </ul>
<b>ASSESSMENT TASKS OR ACTIVITIES</b>	
<ul style="list-style-type: none"> <li>Select appropriate measuring equipment to meet the job requirements.</li> <li>Report correct measurements and deviation</li> <li>Check the component for conformance to specifications.</li> <li>Recognise and report malfunctions.</li> </ul>	

#### 4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN FITTING AND TURNING– 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 students' 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 throughout 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 throughout the year but the competencies are assessed cumulatively in a single assessment or examination session at the end of the year.

The 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 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 should be followed:

<b>LEVEL 4</b>	<b>KNOWLEDGE</b>	<b>COMPREHENSION AND APPLICATION</b>	<b>ANALYSIS, SYNTHESIS AND EVALUATION</b>
	40%	50%	10%

