



**education**

Department:  
Education  
REPUBLIC OF SOUTH AFRICA

# **NATIONAL CERTIFICATE (VOCATIONAL)**

## **SUBJECT GUIDELINES**

### **FITTING AND TURNING**

#### **NQF Level 4**

September 2007



# **FITTING AND TURNING – LEVEL 4**

## **CONTENTS**

### **INTRODUCTION**

#### **1 DURATION AND TUITION TIME**

#### **2 SUBJECT LEVEL FOCUS**

#### **3 ASSESSMENT REQUIREMENTS**

3.1 Internal assessment

3.2 External assessment

#### **4 WEIGHTED VALUES OF TOPICS**

#### **5 CALCULATION OF FINAL MARK**

#### **6 PASS REQUIREMENTS**

#### **7 SUBJECT AND LEARNING OUTCOMES.**

7.1 Diagnose and repair faults on equipment and machinery during production/operation

7.2 Maintain fluid power / pneumatic systems

7.3 Produce complex components using lathes

7.4 Produce complex components using milling machines

7.5 Produce complex components by performing internal and external grinding operations

7.6 Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

#### **8 RESOURCE NEEDS FOR THE TEACHING OF FITTING AND TURNING - LEVEL 4.**

8.1 Physical resources

8.2 Human resources

8.3 Financial resources

8.4 Learning materials

## INTRODUCTION

### A. What is Fitting and Turning?

Fitting and Turning is widely applied to engineering technology, such as in machining, maintenance and assembly situations or circumstances. It deals with the various processes involved in making or producing components required in the manufacturing, engineering and technological environment. Fitting and Turning covers land, sea, air and space technology and helps to develop and expand the global economy.

### B. Why is Fitting and Turning important in the Engineering and Related Design programme?

Fitting and Turning takes creativity and visionary ideology and makes it a practical reality. Through its application, Fitting and Turning expands new design technology and urges science to create new material compositions.

### C. Links between the Learning Outcomes for Fitting and Turning and the Critical and Development Outcomes

- **Thinking and problem-solving skills:**

Identify and solve problems in which responses display that responsible decisions, using critical and creative thinking, have been made.

- Use different functions and make corrective adjustments in problematic situations.

- **Independence and self-management skills:**

Organise and manage oneself and one's activities responsibly and effectively.

- Plan sequence of operations based on job instructions and adjust equipment appropriately.

- **Research skills:**

Collect, analyse, organise and critically evaluate information.

- Examine work piece for machining and non-conformance with specifications.
- Measure work piece for accuracy.

- **Learning skills:**

Reflect on and explore a variety of strategies to learn more effectively.

- Gain experience and knowledge through application of different machining.

- **Employment seeking skills:**

Explore education and career opportunities.

- Assure the confidence to succeed by understanding the practical application.

- **Entrepreneurship:**

Develop entrepreneurial opportunities.

- Produce a sense of self worth through confidence.

## 1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided the candidate meets all the assessment requirements.

Course preparation should consider students with special education needs.

## 2 SUBJECT LEVEL FOCUS

- Explain and use engineering and related design tools, equipment, methods and processes to maintain components.

*Range: Tools, equipment and machinery to range from Fitting and Turning purposes.*

- Explain and apply professional conduct and principles in an engineering context

*Range: ethics.*

## 3 ASSESSMENT REQUIREMENTS

### 3.1 Internal assessment (50 percent)

#### 3.1.1 Theoretical components,

The theoretical component will form 40 percent part of internal assessment.

Internal assessment of the theoretical component of Fitting and Turning level 4 will take the form of observation, class questions, group work, (informal group competitions with rewards), individual discussions with students, class, topic and semester tests, internal examinations. Daily observation can be done when marking exercises of the previous day and class questions.

Assignments, case studies and tests can be done at the end of a topic. Tests and internal examinations must form part of internal assessment.

#### 3.1.2 Practical Component

The practical component will form 60 percent part of internal assessment.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE).

Internal assessment of the practical component of Fitting and Turning Level 4 will take the form of assignments, practical exercises, case studies, practical examinations in a simulated business environment.

Students may complete practical exercises on a daily basis. Assignments and case studies can be done at the end of a topic. Practical examination can form part of internal practical assessment.

- **Some examples of practical assessments include, but are not limited to:**
  - Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role play, self activity, judging and evaluation).
  - Aids
  - Exhibitions by students
  - Visits undertaken by students based on a structured assignment task
  - Research
  - Task performance in a simulated or structured environment

- **Definition of the term “Structured environment”**

“Structured environment” for the purposes of assessment refers to an actual or simulated workplace, or workshop environment.

It is advised that a practicum room is available on each campus for practical assessment.

Evidence of this practical component must be provided in the form of a logbook with a clear listing of the competencies to be assessed. The following information must be contained in the logbook:

- Dates of start and completion
- Project title and nature of work
- Summary of tasks, Duties and Responsibilities
- Number of weeks spent in each category
- Supervisors Name and Signature

For the logbook to be regarded as valid evidence it must be signed off by an assigned supervisor.

#### • Evidence in practical assessments

All evidence pertaining to evaluation of practical work must reflect in the student's PoE. The tools and instruments used for the purpose of conducting such assessments must be part of the PoE.

#### 3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment.

#### 3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to both internal and external moderation procedures as contained in the *National Examinations Policy for FET College Programmes*.

### 3.2 External assessment (50 percent)

A national examination is conducted annually in October or November by means of a paper set externally and marked and moderated externally.

## 4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUES
1. Diagnose and repair faults on equipment and machinery during production/operation	20%
2. Maintain fluid power / pneumatic systems	20%
3. Produce complex components using lathes	20%
4. Produce complex components using milling machines	20%
5. Produce complex components by performing internal and external grinding operations	10%
6. Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine	10%
<b>TOTAL</b>	<b>100</b>

## 5 CALCULATION OF FINAL MARK

Continuous assessment: Student's mark/100 x 50/1 = a mark out of 50 (a)

Theoretical examination mark: Student's mark/100 x 50/1 = a mark out of 50 (b)

**Final mark: (a) + (b) = a mark out of 100**

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purpose of moderation and verification, as well as purposes of reporting.

## 6 PASS REQUIREMENTS

The student must obtain at least fifty (50) percent in ICASS and fifty percent (50) in the examination.

## **7 SUBJECT AND LEARNING OUTCOMES.**

On completion of Fitting and Turning Level 4 the student should have covered the following topics:

Topic 1:	Diagnose and repair faults on equipment and machinery during production/operation
Topic 2:	Maintain fluid power / pneumatic systems
Topic 3:	Produce complex components using lathes
Topic 4:	Produce complex components using milling machines
Topic 5:	Produce complex components by performing internal and external grinding operations
Topic 6:	Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine

### **7.1 Topic 1: Diagnose and repair faults on equipment and machinery during production/operation**

**7.1.1 Subject Outcome 1:** Monitor the performance of equipment and machinery during operation.

**Learning Outcome:**

- Identify recurrent equipment.
- Identify machinery faults.
- Identify machinery and equipment root causes.

**7.1.2 Subject Outcome 2:** Perform minor repairs on line.

**Learning Outcomes:**

- Do minor repairs accurately.
- Do maintenance accurately.
- Do minor repairs and maintenance timeously to avoid production problems and delays.

**7.1.3 Subject Outcome 3:** Determine major equipment and machinery component repairs.

**Learning Outcomes:**

- Identify equipment components for major repair.
- Identify machinery components for major repair.
- Remove machinery and equipment components for major repair with minimal disruption to production process.

**7.1.4 Subject Outcome 4:** Work safely with due care for self, fellow workers, machines, equipment, materials and environment.

**Learning Outcomes:**

- Clean work environment.
- Dispose of waste materials.
- Apply health, safety and environmental procedures.
- Carry out work safely in accordance with schedules and manufacturer specifications.

**7.1.5 Subject Outcome 5:** Explain and discuss potential operational and maintenance problems in the plant.

**Learning Outcomes:**

- Adhere to the operational procedures.
- Make decisions appropriate to the task.

## **7.2 Topic 2: Maintain fluid power / pneumatic systems**

### **7.2.1 Subject Outcome 1:** Plan and prepare for fluid power / pneumatic system maintenance.

#### **Learning Outcomes:**

- Determine fluid power / pneumatic system maintenance requirements.
- Identify applicable system for closing down.
- Interpret engineering drawings.
- Adhere to the manufacturer specifications.
- Select appropriate tools.
- Isolate system.
- Depressurise the system.

### **7.2.2 Subject Outcome 2:** Prepare site and equipment for maintenance activity.

#### **Learning Outcomes:**

- Prepare site for fluid power / pneumatic system maintenance.
- Depressurise system according to manufacturer specification.
- Isolate system.
- Implement provisions for working in a hazardous location according to regulations and worksite procedures.

### **7.2.3 Subject Outcome 3:** Maintain fluid power / pneumatic system.

#### **Learning Outcomes:**

- Acquire applicable consumables, lubricants and cleaning agents in the required quantities.
- Identify components requiring service.
- Remove components requiring service without damage to the system.
- Service removed components using appropriate tools and equipment.
- Replace maintained components without damage to the system.

### **7.2.4 Subject Outcome 4:** Apply quality checks on completed work.

#### **Learning Outcomes:**

- Verify completion of maintenance.
- Check fluids in the system to meet operational requirements.
- Check levels in the system to meet operational requirements.
- Check accumulator pre-charge pressures.
- Carry out visual plant care inspection according to manufacturer.
- Confirm system performance to meet operational requirements.

### **7.2.5 Subject Outcome 5:** Conduct post-repair activities.

#### **Learning Outcomes:**

- Identify problems
- Report accurately and clearly.

### **7.2.6 Subject Outcome 6:** Care for and store system maintenance tools and equipment.

#### **Learning Outcomes:**

- Store compressor maintenance tools and equipment.
- Care for compressor maintenance tools and equipment.



**7.2.7 Subject Outcome 7:** Report on fluid power / pneumatic system condition.

**Learning Outcomes:**

- Adhere to the operational procedures.
- Make decisions appropriate to the task.
- Ensure that no delays are caused as a result of poor planning for replacing seals and identifying problems.
- Ensure that fluid power/pneumatic system report is accurate and clear.

**7.2.8 Subject Outcome 8:** Discuss and explain incidents and problems related to system maintenance.

**Learning Outcomes:**

- Clean work environment.
- Dispose waste materials.
- Apply health, safety and environmental procedures.
- Carry out work safely in accordance with schedules and manufacturer specifications.

*Range: Work safely with due care for self, fellow workers, machines, equipment, materials and environment*

**7.3 Topic 3: Produce complex components using lathes**

**7.3.1 Subject Outcome 1:** Prepare for work activity.

**Learning Outcomes:**

- Bring tools and equipment required for the job in the work area.
- Check whether tools and equipment are in good working condition.
- Check whether the machine is in good working condition.
- Check whether the safety signs are appropriately placed.
- Interpret drawings and job instructions and determine sequence of operations
- Prepare machine for operation including lubrication, routine maintenance and pre-operational checks.

**7.3.2 Subject Outcome 2:** Set lathe.

**Learning Outcomes:**

- Set the gearbox to the correct pitch.
- Set the graduated sleeve of the cross-slide.
- Set the compound slide to zero.
- Return the carriage to the starting position.
- Mount the work piece in a three-or four-jaw chuck.
- Mount the work piece on the lathe spindle.
- Mount the headstock centre in the spindle.
- Set the venire height gauge.
- Clamp securely and check the set-up.

**7.3.3 Subject Outcome 3:** Perform turning operations.

**Learning Outcomes:**

- Select the correct tool for machining operations.
- Calculate the RPM.
- Calculate the cutting speed.
- Start up and shut down lathe.
- Monitor lathe while in operation, making adjustments to speeds and feeds where required.
- Remove machined component on completion of turning process.
- Clean lathe.

**7.3.4 Subject Outcome 4:** Apply quality checks on machined component.

**Learning Outcomes:**

- Select correct tools and equipment for checking.
- Identify items to be checked.
- Measure component.
- Write a report.

**7.3.5 Subject Outcome 5:** Record information on work done.

**Learning Outcomes:**

- Name the file.
- Record information.
- Save the file.
- Check machined component against specifications.

**7.3.6 Subject Outcome 6:** Recognise and report problems, changes and / or malfunctions while operating.

**Learning Outcomes:**

- Report malfunctions.
- Recognise malfunctions.

**7.3.7 Subject Outcome 7:** Work safely with due care for self, fellow workers, machines, equipment, materials and environment.

**Learning Outcomes:**

- Apply worksite health and safety practices.
- Clean equipment, materials and machines after use.
- Wear safety clothes.
- Clean work area after working.
- Apply good housekeeping.

**7.4 Topic 4: Produce complex components using milling machines**

**7.4.1 Subject Outcome 1:** Prepare for work activity.

**Learning Outcomes:**

- Bring tools and equipment required for the job in the work area.
- Check whether tools and equipment are in good working condition.
- Check whether the machine is in good working condition.
- Check whether the safety signs are appropriately placed.
- Interpret drawings and job instructions and determine sequence of operations.
- Prepare machine for operation including lubrication, routine maintenance and pre-operational checks.
- Mark out components if required.

#### **7.4.2 Subject Outcome 2:** Set milling machine.

##### **Learning Outcomes:**

- Identify type of cutting tool.
- Make calculations on the diameter and type of cutter.
- Make calculations regarding R.P.M
- Make calculations regarding the depth of cut.
- Make calculations regarding the feed rate.
- Calculate indexing.
- Set clamping arrangement.
- Set angle plate.
- Position the work piece correctly.
- Select and install required accessories and work holding fixtures.
- Select, prepare and install required tools.
- Select and set cutting speeds and feeds.

#### **7.4.3 Subject Outcome 3:** Perform milling operations.

##### **Learning Outcomes:**

- Choose the correct cutter.
- Centre cutter accurately.
- Offset cutter for spline milling.
- Start up and shut down milling machine.
- Monitor milling machine while in operation, making adjustments to speeds and feeds where required.
- Remove machined component on completion of milling process.
- Clean milling machine.

#### **7.4.4 Subject Outcome 4:** Apply quality checks on machined component.

##### **Learning Outcomes:**

- Check that the machined component surface conforms to the specifications.
- Select and prepare appropriate measuring equipment.
- Measure component.

#### **7.4.5 Subject Outcome 5:** Recognise and report problems, changes and / or malfunctions while operating.

##### **Learning Outcomes:**

- Recognise problems.
- Report problems.
- Recognise changes.
- Report changes.
- Recognise and report malfunctions.

#### **7.4.6 Subject Outcome 6:** Record information on work done.

##### **Learning Outcomes:**

- Name the file.
- Record information.
- Save the file.

**7.4.7 Subject Outcome 7:** Work safely with due care for self, fellow workers, machines, equipment, materials and environment.

**Learning Outcomes:**

- Apply worksite health and safety practices.
- Clean equipment, materials and machines after use.
- Wear safety clothes.
- Clean work area after working.
- Apply good housekeeping.

**7.5 Topic 5: Produce complex components by performing internal and external grinding operations**

**7.5.1 Subject Outcome 1:** Prepare for work activity.

**Learning Outcomes:**

- Select tools and equipment required for the job in the work area.
- Check whether tools and equipment are in good working condition.
- Check whether the machine is in good working condition.
- Check whether the safety signs are appropriately placed.
- Interpret drawings and job instructions and determine sequence of operations.
- Prepare machine for operation including lubrication, routine maintenance and pre-operational checks.
- Check that materials and tools required are at workstation.
- Mark out components if required.

**7.5.2 Subject Outcome 2:** Set grinding machine.

**Learning Outcomes:**

- Select the correct type of wheel for the specific operation.
- Test the wheel for cracks.
- Ensure that wheel speed does not to exceed that recommended by the manufacture.
- Dress and balance the wheel.
- Adjust height of grinding wheel.
- Position component correctly on surface grinding table.
- Select and install required accessories and work holding fixtures.
- Select, prepare and install required tools.
- Select and set cutting speeds and feeds.

**7.5.3 Subject Outcome 3:** Perform surface grinding operations.

**Learning Outcomes:**

- Categorise grinding operation application.
- *Range: Off-hand, automatic machines, tool making, tool and cutter.*
- Identify the type of grinding operations.
- *Range: Peripheral, orbital, face.*
- Apply external and internal grinding operations.
- Know the pneumatic, electrical and mechanical grinding operations.
- Start up and shut down surface grinding machine.
- Monitor surface grinding machine while in operation, making adjustments to speeds and feeds where required.
- Remove machined component on completion of milling process.
- Clean surface grinding machine.

**7.5.4 Subject Outcome 4:** Apply quality checks on machined component.

**Learning Outcomes:**

- Select correct tools and equipment for checking.
- Identify items to be checked.
- Write a report.
- Select and prepare appropriate measuring equipment.
- Measure component.

**7.5.5 Subject Outcome 5:** Record information on work done.

**Learning Outcomes:**

- Name the file.
- Record information.
- Save the file.

**7.5.6 Subject Outcome 6:** Recognise and report problems, changes and/or malfunctions while operating.

**Learning Outcomes:**

- Recognise problems.
- Report problems.
- Recognise changes.
- Report changes.
- Recognise and report malfunctions.

**7.5.7 Subject Outcome 7:** Work safely with due care for self, fellow workers, machines, equipment, materials and environment.

**Learning Outcomes:**

- Apply worksite health and safety practices.
- Clean equipment, materials and machines after use.
- Wear safety clothes.
- Clean work area after working.
- Apply good housekeeping.

**7.6 Topic 6: Write simple computer numerical controlled (CNC) programmes and set and operate a CNC machine**

**7.6.1 Subject Outcome 1:** Prepare and write programme.

**Learning Outcome:**

- Select speeds, feeds and depth of cut in programme appropriate to produce optimum metal removal rates with material used.

**7.6.2 Subject Outcome 2:** Prepare to set machine.

**Learning Outcome:**

- Select accessories and work holding fixtures appropriate to task.

**7.6.3 Subject Outcome 3:** Set machine to perform the specified work.

**Learning Outcomes:**

- Set up machine to accept work safely without damage to workpiece or machine.
- Select tools appropriate to material type and safety requirements.

**7.6.4 Subject Outcome 4:** Produce sample components.

**Learning Outcome:**

- Adhere to CNC machine operating instructions and worksite procedures.

**7.6.5 Subject Outcome 5:** Operate CNC machine.

**Learning Outcome:**

- Change and edit programme.

**7.6.6 Subject Outcome 6:** Recognise and report problems, changes and/or malfunctions while operating.

**Learning Outcomes:**

- Adhere to CNC machine operating instructions.
- Adhere to worksite procedures while operating.
- Make quick adjustments during CNC machine process.
- Make appropriate adjustments.

**7.6.7 Subject Outcome 7:** Record information on work done.

**Learning Outcomes:**

- Report accurate and clear information.
- Name the file.
- Record information.
- Store information in the appropriate place.
- Process CNC machine records.
- Complete CNC machine records.
- Measure components to conform to specification documentations.

**7.6.8 Subject Outcome 8:** Work safely with due care for self, fellow workers, machines, equipment, materials and environment.

**Learning Outcomes:**

- Clean work environment.
- Dispose waste materials.
- Apply health, safety and environmental procedures.
- Work safely in accordance with schedules and manufacturer specifications.

## **8 RESOURCE NEEDS FOR THE TEACHING OF FITTING AND TURNING - LEVEL 4.**

### **8.1 Physical resources**

- Store room for consumables
- Tool room.
- Lecture room(s)
- Training area -ork area
- Ablution facilities

### **8.2 Human resources**

The educator for Fitting and Turning Level 4 must be:

- A subject matter expert
- Instructor qualified in the field of study
- Qualified Fitter and Turner Artisan.
- A life-long learner
- Computer literate.
- Conversant with OBE methodologies
- Have skills in facilitating learning programmes development

It is of paramount importance that educators working in this environment attend seminars and upgrading workshops in order to be updated/re-skilled with the latest developments in technology.

### **8.3 Financial resources**

Funds, from learning provider or funding bodies for the procurement of consumables tools and equipment are readily available for the effective operation of a workplace involved in a training programme and to ensure that students are individually equipped with the necessary tools.

### **8.4 Learning materials**

Learning materials must conform to approved training and industrial standard requirements and articulate to Higher Education. The following is required:

- Learning material literature necessary to fully address the task.
- Learning materials using projection equipment.
- Promotion of opportunities to research information.
- Educational tours to relevant learning venues.
- Educational and motivational talks from industry.
- Visual and audio-visual material.
- Workshop manuals and documentation for the theoretical knowledge.
- Models and demonstrations.