education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

ENGINEERING PROCESS

NQF Level 4

September 2007

ENGINEERING PROCESSES – LEVEL 4

CONTENTS

INTRODUCTION

A. What is Engineering Processes?

The achievement of design gain through the evaluation and monitoring of component manufacture by modern technological equipment in the workplace and so allowing new methodology to be developed.Considerations that are included are the following:

- Flow and handling of materials;
- Automatic machines;
- Management techniques to reduce work content and ineffective time;
- Movements of workers in the shop;
- Factory organisation;
- Design and location of a factory;
- The elements of costs;
- Factory organisation in conjunction with the costing system;
- Purchasing procedure;
- Stores routine (buying and store keeping);
- Labour (employment, time-keeping and time-booking, methods of remuneration, wagws);
- Overheads (depreciation and interest on capital);
- Contract costs;
- Factory job cost accounting;
- Estimating and planning;
- Personnel administration;
- Incentive schemes.

B. Why is Engineering Processes important in the Engineering and Related Design Programme?

The subject addresses considerations that are essential to engineering and related design, including

- Identification and investigation of materials for manufacture of products;
- materials selection,
- determination manufacturing processes; and
- uses the materials in making the products.

C. The link between the Learning Outcomes for Engineering Processes and the Critical and Developmental Outcomes?

The Learning Outcomes for Engineering Processes focus on organisation and management activities such as:

- Identify and solve problems
- Analyse and critically evaluate
- Communicate effectively
- Use science and technology effectively
- Demonstrate understanding of the engineering processes in the manufacturing process.

D. Factors that contribute to achieving Engineering Processes Learning Outcomes

- The desire to make a contribution to the development of engineering in both the manufacturing and designing environment, gaining and applying knowledge to working situations.

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 preparations should consider students with special education needs.

2 SUBJECT LEVEL FOCUS

- Use mechanical engineering tools, equipment, methods and processes to produce and assemble components

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical component

The theoretical component will form 40 percent of internal assessment.

Internal assessment of the theoretical component of Engineering Processes Level 4 will take the form of observation, class question, group work. Individual discussion with students, topic and semester tests and internal examinations. Observation can be done on completion of work piece.

Assignments case studies and test can be done at the end of a topic, Test and internal examination must form part of internal assessment.

3.1.2 Practical component

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

All practical components must be indicated in a Portfolio of evidence (PoE)

The practical component includes applications and exercises

Internal assessment of the practical component of Engineering Processes Level 4 will take the form of assignments practical exercises, practical examination in a workshop environment. Students may complete practical exercises on a daily basis. Assignments 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, observations, role play, independent activity, synthesis and evaluation.
  - Exhibition by students
  - Visits undertaken by students based on a structured assignment task
  - Task performance simulated in a structured environment

- **Definition of the term "Structured Environment"**

For the purposes of assessment "structured environment" refers to an actual or simulated workplace, or a computer or a workshop environment

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the student's PoE. The assessment instruments used for the purpose of conducting such assessments must be part of the evidence contained in 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 subject to both internal and external moderation procedures as set out 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(s) set externally and marked and moderated externally.

Details in respect of external assessment are contained in the *Assessment Guidelines: Engineering Processes* (Level 4).

4 WEIGHTED VALUES OF THE TOPICS

TOPICS	WEIGHTED VALUES
1. Mechanical component service	6%
2. Component dismantling and assembling	26%
3. Operating and monitoring an engineering machine and component production	11%
4. Powered machinery used in the cutting of materials.	26%
5. Component production using Computer Aided Machining (CAM)	17%
6. Joining processes are selected and applied in materials technology.	14%
TOTAL	**100**

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, purposes of moderation and verification.

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 Engineering Processes Level 4 the student should have covered the following topics:

Topic 1: Mechanical component service
Topic 2: Component dismantling and assembling
Topic 3: Operating and monitoring an engineering machine and component production
Topic 4: Powered machinery used in the cutting of materials
Topic 5 Component production using computer aided machining (CAM).
Topic 6 Joining processes are selected and applied in materials technology

7.1 Topic 1: Mechanical component service

7.1.1 Subject Outcome: Prepare for service.

Learning Outcomes:

- Check that workplace environmental conditions are work-friendly.
- Inspect replacement parts for quality and correctness.
- Select correct equipment and tools for the task at hand.
- Place the disassembled component parts in order and visible for assembly clarity.
- Examine component parts for cleanliness.
- Check component functional operating position where applicable.

7.1.2 Subject Outcome 2: Carry out service and record the results.

Learning Outcomes:

- Record service information.

  Range: Date of service, parts replaced, replacement part information, and probable cause of breakdown.
- Use component manual for assembly.
- Apply internal inspection and examinations to the assembly to avoid infringements.

  Range: Motion inhibition of component, parts.
- Tighten to specified torque.
- Manually check component for operation where applicable.

7.1.3 Subject Outcome 3: Check quality of serviced components for compliance with servicing specification and store or move as instructed.

Learning Outcomes:

- Attach (fit) where applicable information plate/tag to component for future service reference.
- Ensure that replacement parts are suitable to performance and environmental conditions.
- Ensure that lubricants meet operational conditions.
- Ensure that storage is appropriate for the following expectations:

  Range: Dry and free of humidity, dust free, component is correctly zoned, customer delivery note is attached, protective coating applied (grease paper wrapping, plastic wrapping) boxed or crated to customer needs.

7.2 Topic 2: Component dismantling and assembling

7.2.1 Subject Outcome 1: Dismantle and clean components.

Learning Outcomes:

- Ensure the work area and conditions are free of obstacles.

  Range: Lighting, ventilation, dust, dampness, hazards (flammable material, electrical, excessive movement, accessibility).
- Scrutinize and memorise the total make up of a component before sub disassembly.
- Pre-clean using cleaning solvents that are non-reactive to components.
- Inspect and diagnose carefully in disassembly.

  Range: Positioning of parts, centre punch for clarity, tag for deeper clarity.
- Apply final cleaning operation ensuring that all passages, crevices and surfaces are clean and free of any residue.

7.2.2. Subject Outcome 2: Inspect and replace components.

Learning Outcomes:

- Examine components for defects.

  Range: Structural default, casting soundness, design error, wear, determine reasons for component faults.
- Inspect replacement parts for quality and correctness.
- Record reasoning for component replacement.

7.2.3 Subject Outcome 3: Assemble and test components.

Learning Outcome:

- Select the correct equipment and tools required for assembly.
- Correctly select and fit the component parts of the assembly within the specified time.
- Check and run assembly and record the result.

  Range: Overheating, vibration, noise decibels, component expectancy, KW rating, performance.
- Ensure assembly is cosmetically presentable.

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

7.3.1 Subject Outcome 1: Prepare to operate engineering machines.

Learning Outcomes:

- Ensure safety in the workplace.
- Communicate understanding of verbal instructions.
- Read and understand drawing information.
- Apply drawing information to task.
- Adjust machine settings for the required functions.
- Select correct equipment and tools for appropriate machining process.
- Select correct cutting tool for machining operation.
- Prepare cutting tool edge to suit material to be machined.
- Lubricate all significant points in accordance with workplace procedures.
- Understand and follow verbal or written instructions in accordance with workplace procedures.
- Make sure that machinery is made safe for emergency shut down and verify other procedures before starting with intended task.

  Range: Guards, personal protective equipment.

7.3.2 Subject Outcome 2: Carry out machining processes.

Learning Outcomes:

- Start and run machine.
- Ensure machine is functioning optimally.

  Range: Soluble oil flow capacity, backlash of feed screw, vibration of unit, machine noise.
- Carry out machining process.
- Check measurement of machined component against drawing information.
- Check computer program of machine component against drawing measurements.
- Make corrections to computer program if necessary.
- Examine material level consumption and replace timeously.
- Inspect machine components in CAM.
- Eliminate machining faults by correction through specific adjustments.

7.3.3 Subject Outcome 3: Perform post machining functions.

Learning Outcomes:

- Check components

  Range: Accuracy pertaining to drawing, all facets are machined as indicated on drawings, surface protection of components is addressed.
- Store completed components according to workplace procedures.

  Range: Name of customer, address of customer, job number, delivery date.
- Clean applicable equipment according to manufacturer's specifications.
- Return tools to store room.
- Clear work area of unnecessary clutter.

7.4 Topic 4: Powered machinery used in cutting of materials

7.4.1 Subject Outcome 1: Prepare for mechanical cutting of materials.

Learning Outcomes:

- Identify the type of material and composition.
- Select the cutting process.

  Range: Mechanical cutting, gas cutting – oxygen and acetylene, plasma cutting, laser cutting.
- Choose correct cutting equipment for the material being cut.
- Prepare cutting equipment.

  Range: Cutting speed – meters/min, feed speed or pressure adjustment, number of teeth per inch of blade.
- Choose correct cutting fluid for the material being cut.

- Inspect and check machines in readiness to achieve job specifications.
- Identify material characteristics.
- Identify and select cutting machines and lubricants in accordance with manufacturer's specifications.

7.4.2 Subject Outcome 2: Perform mechanical cutting of material.

Learning Outcomes:

- Set up and adjust equipment for cutting operation.
- Adjust cutting coolant/lubrication.
- Perform cutting operation.
- Check cutting operation.

  Range: Check completed cut (cut is straight, cut is clean), shape cut conforms to profile shape and dimensions, cutting blade is cutting and not rubbing.
- Cut materials in accordance to job specifications.
- Confirm blade clearances to achieve shearing consistent with job specifications.
- Cut edges to conform to job specification or workplace procedure.

7.4.3 Subject Outcome 3: Verify mechanical cutting of material using powered machinery.

Learning Outcome:

- Inspect completed component

  Range: Verify finish with specification needs, verify accuracy with specification requirements (cutting edge is not compositionally influenced through cutting application).
- Identify and report non conformance to job specifications.

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

7.5.1 Subject Outcome 1: Prepare the computer aided machine (CAM) and equipment.

Learning Outcomes:

- Select the necessary post processor.

  Range: Fanuc, Siemans, Heinaman.
- Select tools for the CAM system from existing library.
- Prepare the machining process by selecting the order of operation.

  Range: Contour milling, drilling, pockets and islands.
- Assess primary machining operation considering cutting allowance to suit material type and composition.
- Assess secondary machining operation to suit material type and composition (this is finishing cut).
- Set speeds and feeds reflective of tool type, material type and composition.
- Assess and configure program to the design of the project, and to site requirements.
- Fit machine tools to meet machine specifications to enable machining of the product.

7.5.2 Subject Outcome 2: Test CAM specification.

Learning Outcomes:

- Simulate the programme to test for correct drawing dimensions, tooling effect and elimination of tool breakage.
- Re-edit the programme if adjustment is required.
- Save programme on a disk or hard drive of computer.
- Examine cutting time, and speed up the process if necessary.
- Convert the planned machining operation into a set of instructions and draw up the operation planning sheet.
- Draw the outline for the manufacturing of the final product enabling the machining of the product.
- Define and verify the component surfaces on the drawn outline, if necessary, in accordance with the final design and site requirements.
- Define and verify tool processes on the drawn outline, if necessary, in accordance with the final design and site requirements.

7.5.3 Subject Outcome 3: Manufacture components using CAM process.

Learning Outcomes:

- Apply to the machine a programme that is compatible with the process and drip feeding.
- Prepare the machine by setting the tool lengths and zeroing axes X, Y and Z.
- Simulate the programme on the machine simulator, identifying infringements.
- Machine components to drawing specifications.
- Examine components for inacuracies, making editing adjustments to programme until components meet requirements.
- Measure, examine and record the quality of completed components according to specified requirements.
- Test machining program against the design specification prior to the manufacture of the final component, to determine conformity to the product design.
- Set up cutting lubrication to suit the material and check to determine conformity to CAM manufacturer's recommendations.
- Check that the manufacturing of components complies with the design specifications, health and safety requirements, and site requirements.
- Verify components in relation to the design specifications, and adjust CAM, where necessary, to achieve the specification.

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

7.6.1 Subject Outcome 1: Identify different joining systems and select appropriate methods.

Range: Bolt and nut, welding, riveting, brazing, soldering, adhesives.

Learning Outcomes:

- Identify different joining methods or systems.
- Choose correct joining methods.
  Range: Component operational values, effects of environmental conditions, type of material, thickness of material, compositional mechanical impartation, design specification.
- Explain economical reasoning in exercising joining method.
- Exercise component cosmetic thinking.

7.6.2 Subject Outcome 2: Prepare for joining of materials and components.

Learning Outcomes:

- Select the correct equipment and tools for the task at hand.
- Select the correct joining material.l
  Range: Composition, thickness, surface finish.
- Ensure working area is safe and condusive.
  Range: Ventilation, lighting, dust free, working space, working table, lifting support mechanism, respiratory apparatus.
- Clean material to be joined.
- Prepare tools and work area to suit selected methods and to meet Occupational Health and Safety Act, and workplace safety requirements.

7.6.3 Subject Outcome 3: Carry out the joining process and test and evaluate the process.

Learning Outcomes:

- Apply joining systems and process in accordance with manufacturer's and site requirements.
- Use joining techniques in accordance with design and product specifications.
- Join the material.
- Examine if the joined material conforms to the required standards.
  Range: Fatigue point, bending behaviour, tension, compressions, pressure.
- Inspect to see if joining of material is cosmetically appealing.
- Explain the tempering process for stress release.
- Explain the process to infuse metal properties.
- Assess joining method for redress in design.

8 RESOURCE NEEDS FOR THE TEACHING OF ENGINEERING PROCESSES - LEVEL 4

8.1 Human Resources

The educator for Engineering Processes Level 4 must be:

- A subject matter expert
- Competent lecturer
- A life-long student
- In possession of an NQF level 5 teaching qualification
- Conversant with OBE methodologies
- Instructor qualified in the field of study
- Have skills in facilitating learning programmes development
- A trade test would be an added advantage

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

Physical resources

- Store room for consumable stocks
- Tool room.
- Lecture room(s)
- Training area-work area
- Ablution facilities

Store room needs to be equipped with mechanical lifting devices suitable for dealing with the storage of heavy consumables.

Learning materials and other resources

- Funds obtained from the learning provider or from funding bodies for the procurement of consumable resources, tools and equipment must be readily made available for the effective operation of a workplace involved in a training programme. Students must be individually equipped with the necessary tools.

Learning materials must conform to approved training and industrial standard requirements and must articulate to Higher Education. Learning materials must cater for both academic and practical aspects of learning. Available materials need to address the following:

- Texts that fully address the task
- Workshop manuals and texts for the theoretical knowledge.
- Computer literacy.
- Learning materials using projection equipment.
- Visual and audio-visual material
- Promotion of research.
- Educational tours to relevant learning venues.
- Educational and motivational talks from industry.
- Models and demonstrations.