education

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

APPLIED ENGINEERING TECHNOLOGY

NQF Level 4

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APPLIED ENGINEERING TECHNOLOGY – LEVEL 4

CONTENTS

INTRODUCTION

A. What is Applied Engineering Technology?

Applied Engineering Technology is 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.

The subject includes considerations of 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); wages; overheads (depreciation and interest on capital); contract costs; factory job cost accounting; estimating and planning; personnel administration; incentive schemes.

B. Why is the subject important in the Engineering and Related Design programme?

Engineering students will benefit from the subject's focus on 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 Applied Engineering Technology and the Critical and Development Outcomes

Applied Engineering Technology teaches the organisation and management of activities such as;

- Identification and solution of problems
- Analysis and critical evaluation
- Effective communication
- Effective use of science and technology
- Demonstrated understanding of the engineering processes in manufacturing.

D. Factors that contribute to achieving Engineering Practice learning outcomes are as follows;

The desire of a student 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 all of the assessment requirements are adhered to.

Course preparation should consider students with special educational needs.

2 SUBJECT LEVEL FOCUS

Analyse mechanical engineering processes in order to diagnose and solve problems systematically.

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical Component

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

Internal assessment of the theoretical component of Applied Engineering Technology Level 4 will take the form of observations, class questions, group work, individual discussions with students, class 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 given at the end of a topic, and must form part of the internal assessment.

3.1.2 Practical Component

The practical component will form 60 percent of internal assessment.

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

Internal assessment of the practical component of Applied Engineering Technology 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 and case studies can be done at the end of a topic. Practical examinations 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, independent activity, sythesis and evaluation).
- 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 purpose 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 in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the student’s PoE. The tools and instruments constructed and used for the purpose of conducting such assessments must be clear from 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 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, marked and moderated externally.

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

4 WEIGHTED VALUES OF THE TOPICS

TOPICS	WEIGHTED VALUE
1. Mechanical fundamentals of the engineering industry	35%
2. Engineering practices are used to construct a structure prototype capable of bearing a point and / or distributed load	20%
3. Functionally dependant mechanisms are incorporated into a prototype of a technological solution.	25%
4. Control system is incorporated into a prototype of a technological solution	20%
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 Applied Engineering Technology Level 4 the student should have covered the following topics:

Topic 1: Mechanical fundamentals of the engineering industry
Topic 2: Engineering practices are used to construct a structure prototype capable of bearing a point and/or distributed load
Topic 3: Functionally dependant mechanisms are incorporated into a prototype of a technological solution.
Topic 4: Control system is incorporated into a prototype of a technological solution

7.1 Topic 1: Mechanical fundamentals of the engineering industry

7.1.1 Subject Outcome: Explain the principles of mechanical engineering.

Learning Outcomes:

- Explain motion in engineering design.

  Range: Resistance to motion, friction as a result of motion, inertia property of an object, Newton's third law of motion.
- Evaluate surface finishes involving sliding motion and consider alternatives to reduce friction.
- Consider the mass of matter with reference to its direct relationship to friction and the force required for motion.
- Explain the inertia effect as a result of mass and its resistance to motion resulting in the force required.

  Range: Mechanical processes may include but are not limited to centrifugal separation, polarisation, motorised conveying.

7.1.2 Subject Outcome 2: Demonstrate knowledge and understanding of the operating principles of mechanical components used in the engineering related design industry.

Learning Outcomes:

- Identify and describe the use of plain bearings.

  Range: Thick film lubricant, thin film lubricant, zero lubricant.
- Identify and describe the use of roller bearings.

  Range: Ball bearing, roller bearing, tapered roller bearing, cylindrical roller bearing, radial thrust bearing, angular thrust bearing, self aligning bearing, needle roller bearing.
- Identify and explain the working and the use the five general classifications in pump technology.

  Range: Reciprocating pump, steam pump, rotary pump, piston less pumps, and centrifugal pump.
- Explaining the following terminology related to pump technology.

  Range: Pressure, negative pressure, positive pressure

  Heads: suction, static, delivery, pressur).
- Describe and explain the use of hydraulic and pneumatic valves.

  Range: Hydraulic, pneumatic, relief valve, throttle/regulation valve, spool/4 way valve, rotary valve, diversion valve, non return valves.
- Describe the reasons for the use of different driving transmissions.

  Range: V belts, flat belts, chain drives, gear drives, frictional drive.
- Describe and explain the use of couplings.

  Range: Flexible couplings, marine type coupling, fenner-flex couplings, hydraulic couplings, self-aligning couplings, flange coupling, bibby coupling, single-plate clutch coupling, multi- plate-clutch coupling.
- Describe and explain the use of seals.

  Range: Packing, labyrinth, carbon ring, contact seals, oil seals, o-ring.
- Explain the refrigeration cycle.

  *Range: Liquification, vapour, heat exchange, high and low pressure of liquid, high and low pressure of pour***.**
- Explain the operation of a domestic refrigerator.

  Range: Convection flow of air, type of gas, temperature control, expansion valve, relay, overload.

7.1.3 Subject Outcome 3: Explain and perform safety checks on mechanical equipment.

Learning Outcomes:

- Describe safety procedures involved during the usage of mechanical equipment.
- Carry out a diagnostic analysis on mechanical equipment and report the findings.

  Range: Amperage, vibration, noise, excess play, oil leakage, rust deposits.

7.1.4 Subject Outcome 4: Ensure safety in work practices when working in the vicinity of mechanical equipment.

Learning Outcomes:

- Demarcate the location of machines and walk ways.
- Provide pallets for component handling.
- Ensure the height of working tables conforms to industry safety standards.
- Ensure that warning and informative signs are appropriately positioned.
- Safety attire conforms to workplace requirements.
- Provide adequate working space, illumination and ventilation in the work area.
- Ensure that safety instructions are always obeyed and adhered to.
- Ensure pre-operational inspection of applicable equipment is performed.
- Ensure spillage on working surfaces is immediately attended to.

7.2 Topic 2: Engineering practices are used to construct a structure prototype capable of bearing a point and/or distributed load

7.2.1 Subject Outcome 1: Interpret, draw and make calculations of a minimally engineered, supported structure capable of bearing a point and/or distributed load.

Learning Outcomes:

- Explain with sketches the difference between point loading and distributed loading.
- Explain with examples beam loading, identifying the different fields/methods of application.
- Perform calculations of bending moments and shear forces applicable to the design.

7.2.2. Subject Outcome 2: Design and construct a prototype of a structure for a given design problem.

Learning Outcomes:

- Apply calculations and their representation in the prototype design.
- Design prototype with new and different technological impact, considering a range of factors:

  Range: Design purpose, abnormal environmental issues, minimal material in construction, architectural appeal.
- Interpret the prototype, its constructional design and relevancy to the point of application.

7.2.3 Subject Outcome 3: Test and evaluate the prototype and make any necessary modifications.

Learning Outcomes:

- Accommodate environmental conditions relevant to design.
- Identify and analyse design faults where they exist.
- Apply corrective measures where appropriate.

  Range: Financial constraints, consumer pressure, political implications, professionalism.

7.3 Topic 3: Functionally dependant mechanisms are incorporated into a prototype of a technological solution

7.3.1 Subject Outcome 1: Describe functionally dependant mechanisms.

Learning Outcomes:

- Explain the dependency of components that are linked in order to produce motion.

  Range: Mechanical, hydraulic, pneumatic, electrical.
- Describe examples of dependency to produce a proto type

  Range: Motor vehicle (body, engine, gearbox, differential, wheels, electrical links), electrical motor (case, status, stator, armature, commutator, brushes).

7.3.2 Subject Outcome 2: Design and construct a prototype to solve a given design problem.

Learning Outcomes:

- Apply new design concepts onto an illustrative plan.
- Interpret illustrations and create a new prototype design.
- Examine the prototype for comparisons of previous design faults.
- Check all specifications, their corrections and identify them in the prototype upgrade.

7.3.3 Subject Outcome 3: Test and evaluate the prototype and make any necessary modifications.

Learning Outcomes:

- Assimilate operating conditions for prototype, recording test results.
- Field test prototype for operational expectations.
- Check prototype against design specifications and analyse results.

7.4 Topic 4: Control system is incorporated into a prototype of a technological solution

7.4.1 Subject Outcome 1: Explain and sketch different control systems.

Learning Outcomes:

- Illustrate diagrammatically the different control systems

  Range: Mechanical, hydraulic, and pneumatic, at least two control systems that have at least two inputs, two output states, and a feedback path.
- Explain control systems in terms of their component interactions, form/s of control employed, and construction details.
- Describe components in terms of requirements for the operation of the control systems.
- Identify and describe the control system diagrammatically.

7.4.2 Subject Outcome 2: Construct a control system to solve a given design problem.

Learning Outcomes:

- Identify the causes of the problem.

  Range: Operator, electrical, mechanical or environmental conditions or effects.
- Use the diagram to construct a control system.
- Select the form of a control system and justify components used against the requirements of the design problem.
- Include the control system components and structure, material/s, and construction process in the design of the prototype.

7.4.3 Subject Outcome 3: Test and evaluate the prototype and make any necessary modifications.

Learning Outcomes:

- Consider the impact to maintenance and down time of system.
- Consider the skill of operation required.
- Analyse efficiency of system and whether it meets its operational expectancy.
- Evaluate modification and record the results.
- Make further modifications where necessary, taking into account circumstantial considerations.

  Range: Specific time, skills availability, replacement of parts onsite, time for modification, testing and reversal of the situation.

7.4.4 Subject Outcome 4: Apply the prototype according to organisational requirements

Learning Outcomes:

- Identify the responsibilities of a process operator working with mechanical equipment in accordance with organisational requirements.
- Demonstrate safe working practices for working with mechanical equipment in accordance with organisational requirements.

8 RESOURCE NEEDS FOR THE TEACHING OF APPLIED ENGINEERING TECHNOLOGY - LEVEL 4

8.1 Human resources

The educator for Applied Engineering Technology Level 4 must be:

- A subject matter expert
- 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 will be an added advantage

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

Physical resources

- Store room-consumable
- Tool room.
- Lecture room(s)
- Training area-work area
- Ablution facilities
- NB: Store room to be equipped with mechanical lifting devices in the case of heavy consumables suitable for storage.
- Computer resources for student and lecturer use.
- Projection equipment

Other resources

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

8.4 Learning and teaching materials

Learning materials must conform to approved training and industrial standard requirements, and articulate to Higher Education.

Learning support materials and resources are needed for both academic and practical aspects of learning, and include the following:

- Comprehensive texts for student use as well as for supplementary reading.
- Learning materials for projection during lectures.
- Facilities to support the promotion of opportunities for research by both students and lecturers.
- Educational tours to relevant learning venues.
- Educational and motivational talks from industry.
- Visual and audio-visual material
- Relevant workshop manuals and documentation.
- Models and demonstrations.