

# **DEPARTMENT OF HEALTH.**

## OCCUPATIONAL HEALTH AND SAFETY, 1993

### EXAMINATIONS FOR THE MECHANICAL AND ELECTRICAL ENGINEERS

#### CERTIFICATES OF COMPETENCY

#### 1. INTRODUCTION

- 1.1 The following instructions, rules and syllabi of the examinations drawn up by the chief inspector are framed in terms of the Machinery and Occupational Safety Act,
- 1.2 The following Certificates of Competency are issued by the Department of Labour:
  - (a) Certificate of Competency as Mechanical Engineer
  - (b) Certificate of Competency as Electrical Engineer
- 1.3 Written examinations for each of these certificates are, conducted in June and November by the Department of Education and Culture in collaboration with the Commission of Examiners appointed by the Chief Inspector.
- 1.4 The procedure to be followed in order to acquire a certificate of competency is summarised in paragraph 3.

#### 2. QUALIFYING EXAMINATIONS

- 2.1 To qualify for a Certificate of Competency as Mechanical or Electrical Engineer, persons accepted as candidates must pass the following subjects:
  - (a) Plant Engineering
  - (b) Occupational Health and Safety Act, 1993, and the regulations promulgated thereunder.
- 2.2 To qualify for a Certificate of Competency, candidates must obtain at least 50% of the full marks in each subject stipulated in 2.1. Candidates need not pass both subjects at the same examination sitting, but the second subject must be passed within 2 years of passing the first, otherwise both subjects must be re-written. However, a candidate obtains 75% or more of the full marks in a subject, he will be permanently exempted from rewriting that subject. An appropriate certificate of competency will be issued to candidates who have passed both subjects.

#### 3. ACCEPTANCE OF CANDIDATES

- 3.1 No person will be allowed to enter for the qualifying examination unless the Commission of Examiners has accepted him as a candidate. No credit will be given for a pass in the subjects mentioned in 2.1 prior to such acceptance.

3. 2 An applicant shall not be accepted as a candidate by the Commission of Examiners unless he has submitted proof that he has reached the age of 23 years, of his sobriety and general good conduct and that he is in possession of one of the following qualifications with appropriate experience in engineering:

3. 2.1 A B. Sc. degree in mechanical or electrical engineering recognised by the Commission of Examiners and at least, 2 years post graduate experience in the maintenance and operation of mechanical or electrical machinery, as the case may be, which is to the satisfaction of the Commission of Examiners.

3.2. 2 A higher diploma in mechanical or electrical engineering, (Technikon course) plus at least 2 years subsequent experience in the maintenance and operation of mechanical or electrical machinery, as the case may be, which is to the satisfaction of the Commission of Examiners, and of which at least one year has been at a factory. The completion of such course shall include passing all the subjects with a mark of at least 50%,

Individual Technikons will structure a curriculum to cover the electrical and mechanical courses according to the requirements of the Plant Engineering Syllabus (Annexure IV (a). The Technikon will subsequently certify that a candidate for the Government Certificate of Competency, having followed the Technkon route, has –

- (i) completed a curriculum which covers the syllabus for Plant Engineering;
- (ii) acquired a National Higher Diploma with a mark per subject of at least 50% ; and
- (iii) received the required experiential training ;

A candidate who is in possession of the necessary qualifications as prescribed in Annexure II will be evaluated and accepted accordingly.

3.2.3 A National N6 diploma in mechanical or electrical engineering (Technical College Course). The completion of such a course shall include passing all the subjects with a mark of at least 50%. Such person shall also have served an apprenticeship in an appropriate trade and gained experience in the maintenance and operation of mechanical or electrical machinery, as the case may be, as listed in Annexure I. Such experience, of which at least one year has been at a factory, shall be to the satisfaction of the Commission of Examiners.

The Department of Education and Culture will structure a curriculum to cover the electrical and mechanical course according to the requirements of the Plant Engineering Syllabus Annexure IV (a) After completion of the prescribed course, the said Department will be required to certify that a candidate, having followed the Technical College route for the Government Certificate of Competency, has

- (i) completed a curriculum which covers the syllabus for Plant Engineering; and
- (ii) acquired a National Certificate with a mark of at least 50% in all the subjects.

A candidate who is in possession of the necessary qualifications as prescribed in Annexure III will be evaluated and accepted accordingly.

3.2.4 other qualifications and experience will be considered on merit by the Commission of Examiners.

3. 3 Persons who wish to be accepted as candidates and who are in possession of a foreign degree, diploma or certificate in engineering, or who are in possession of engineering qualifications other than those mentioned in 3.2, must have such a degree, diploma, certificate or engineering qualification evaluated by the Department of Education and Culture, Examination Section, Private Bag X110, Pretoria, 0001, who will indicate what additional subjects, -if any, must be passed in order to comply with the requirements for acceptance. A request for evaluation must indicate that it is for the Certificate of Competency (M) or (E), and must include a list of the subjects, including marks obtained, which led to the obtaining of the degree, diploma or certificate. A copy of the evaluation and a certified copy of the degree, diploma or certificate must accompany the application for acceptance as a candidate.

Note: An evaluation by the Human Science Research Council on its own is not sufficient.

#### 4. SYLLABI AND EXAMINATION RULES

- 4.1 The syllabi for the subjects mentioned in 2.1 are given in Annexure IV and V.
- 4.2 Plant Engineering is a "closed book" examination. It will consist of both mechanical and electrical questions, with a limited choice of questions. The time allowed for the examination will be 3 hours. Candidates may not use programmable calculators in the examination room.
4. 3 The question paper on the Occupational Health and Safety Act and Regulations is a "closed book" examination. There is no choice of questions and all questions must be answered. The time allocated for the examination is 3 hours.

It should be noted that the syllabus includes the practical application of the regulations. This implies an understanding of the regulations rather than committing the wording to memory only.

#### 5. ALTERNATIVE CERTIFICATES AND EXEMPTIONS

- 5.1 A candidate with a B.Sc. degree in electrical or mechanical engineering or an equivalent qualification, which is recognised by the Commission of Examiners, who has had at least 3 years post-graduate experience satisfactory to the Commission of Examiners and has been registered as a Professional Engineer by the Engineering council of SA (ECSA), may be exempted from the subject "Plant Engineering".
5. 2 The holder of a Certificate of Competency issues in terms of the Minerals Act of 1991, who wishes to qualify the equivalent certificate for Factories, shall re-apply for acceptance as a candidate together with proof of at least one year's appropriate experience in the maintenance and operation of machinery at a factory, satisfactory to the Commission of Examiners. After acceptance the subject Legal Knowledge (Factories) must be passed.
5. 3 The holder of a Certificate of Competency as Mechanical Engineer who wishes to qualify for a certificate as Electrical Engineer shall re-apply. He shall produce proof of appropriate experience, which shall be satisfactory to the Commission of Examiners. Such experience shall consist of at least 2 years experience in the maintenance and operation of electrical machinery or at least 4 years "mixed" experience in the maintenance and operation of both electrical and mechanical machinery, which was gained after the acquisition of the mechanical certificate. The applicant will also be required to produce proof of passing the conversion subjects required to cover the syllabus for the Certificate of Competency as Electrical Engineer, with a mark of at least 50%.

- 5.4 The holder of a Certificate of Competency as Electrical Engineer who wishes to qualify for a certificate as Mechanical Engineer shall re-apply. He shall produce proof of appropriate experience, which shall be satisfactory to the commission of Examiners. Such experience shall consist of at least 2 years experience in the maintenance and operation of mechanical machinery or at least 4 years "mixed" experience in the maintenance and operation of both mechanical and electrical machinery which was gained after the acquisition of the electrical certificate. The applicant will also be required to produce proof of passing the conversion subjects required to cover the syllabus for the Certificate of Competency as Mechanical Engineer with a mark of at least 50%.

6. SUMMARISED PROCEDURE

- 6.1 Application forms for acceptance is obtainable from:

The Secretary  
Commission of Examiners  
Department of Labour  
Private Bag X117  
PRETORIA  
0001 Tel:(012) 3091500

- 6.2 Completed forms to be returned to the above mentioned address together with:

- (a) RI30 revenue stamps affixed to the application form.
- (b) Certified copies of degrees, diplomas or certificates and if applicable, a copy of the evaluation thereof by the Department of Education and Culture (see 3.3).
- (c) Proof of appropriate practical experience.
- (d) A testimonial re: sobriety and conduct.
- (e) Proof of age i.e. a copy of ID document or a copy of birth certificate.
- (f) A letter from the Resident engineer, where possible, indicating that the applicant is considered to be a suitable candidate.

- 6.3 The Commission of Examiners will inform the candidate by letter of his acceptance for the examination.

6.4 The letter of acceptance must be submitted when entering for the qualifying subject's (2.1) at any Technical College or any Local Secretary for the Department of Education and Culture, to whom the examination fees must be paid. The examinations are held in June and November and the closing dates for entry are 20 March and 20 September respectively

- 6.5 The Commission will forward the appropriate certificate of competency to successful candidates. Candidates who have passed by means of a remark must notify the Commission of Examiners accordingly.
- 6.6 Candidates, who have passed the qualifying subjects and do not hear from the Commission of Examiners within 2 months, must notify the secretary at the above-mentioned address.

## 7. "MINES" CERTIFICATES

Persons who wish to qualify for a certificate of competency for Mines must apply to:

The Secretary  
Commission of Examiners  
Private Bag X59  
PRETORIA  
0001

Tel: (012) 3228561

### ANNEXURE I

#### ACCEPTABLE TRADES AND EXPERIENCE

Trade in which the apprenticeship has been served		Minimum appropriate post:- apprenticeship experience in the general maintenance and operation of machinery
TRADE	YEARS	
Aero engine fitter, ground engineer or equivalent	2	
Armature winder	3	On general electrical maintenance
Blacksmith	3	Not as a blacksmith
Boilermaker	3	Not as a boilermaker
Diesel mechanic	3	Not as a diesel mechanic
Electrician	2	
Engine room artificer	2	
Fitter	2	
Fitter and armoured	3	
Fitter and rigger (Air Force)	2	
Fitter and turner	2	
Instrument mechanic or instrument maker	2	Not as an instrument mechanic
Instrument technician (ISCOR, SASOR, AECI)	2	
Lift mechanic	2	
Millwright	2	
Motor mechanic	3	Not as a motor mechanic
Refrigeration mechanic	3	
Tool and die maker	2	
Turner	3	As a fitter
Welder	4	Not as a welder

## ANNEXURE II

### TECHNIKON COURSE NATIONAL DIPLOMA 1<sup>st</sup> N ENGINEERING MECHANICAL AND ELECTRICAL ENGINEERING

T1	Electrical Engineering	(M) (E)	T1
	Engineering Mathematics	(M) (E)	T1
	Engineering Mechanics	(M) (E)	T1
	Machine Drawing	(M) (E)	T1
T2	Electronics	(E)	T2
T3	Electrotechnology	(E)	T3
	Mechanical Technology	(M)	T3
T4	Applied Thermodynamics	(M)	T4
	Fluid Mechanics	(M)	T4
	Mechanics of Machines	(M)	T1
	Strength of Materials	(M)(E)	T4
	Electrical Engineering (h.c)	(E)	T4
	Electrical Machines	(E)	T4
	Industrial Electronics	(E)	T4

### CONVERSION COURSE

To enable holders of the Mechanical Certificate of Competency to qualify for the Electrical Certificate of Competency or vice versa:

Electrical Engineering (h.c)	(M)	T4
Electrical Machines	(M)	T4
Applied Thermodynamics	(E)	T4
Fluid Mechanics	(E)	T4

(M) - Mechanical Engineering  
(E) - Electrical Engineering  
(h.c.) - Heavy Current

The subjects shown are only the highest levels to be attained. All the grades leading to that level must also be attained with a 50% pass mark (e.g. Strength of Materials T4 includes a pass in this subject on T2 and T3 levels)

**NOTE:** Each candidate following this route to obtain a Certificate of Competency must provide documentation to prove that:

- (i) he has followed a "sandwich" course (i.e. one semester practical training - one semester classes, alternating at a Technikon), and
- (ii) that the syllabus in Annexure IV is included in the extended Technikon curriculum.

ANNEXURE III

TECHNICAL COLLEGE COURSE  
MECHANICAL AND ELECTRICAL ENGINEERING

N3	Engineering Drawing	(M)(E)	N3
N4	Engineering Science	(M)(E)	N4
	Industrial Electronics	(M)	N4
	Mathematics	(M)(E)	N4
N5	Electrotechnics	(M)	N5
	Strength of Materials	(E)	N5
N6	Control Systems	(M)(E)	N6
	Mechanotechnics	(M)(E)	N6
	Power Machines	(M)(E)	N6
	Strength of Materials	(M)	N6
	Fluid Mechanics	(M)	N6
	Industrial Electronics	(E)	N6
	Electrotechnics	(e)	N6
	Supervision	(M)(E)	N6

CONVERSION COURSE

To enable holders of the Mechanical Certificate of Competency to qualify for the Electrical Certificate of Competency and vice versa.

Electrotechnics	(M)	N6
Industrial Electronics	(M)	N6
Strength of Materials	(E)	N6
Fluid Mechanics	(E)	N6

(M) - Mechanical Engineering

(E) - Electrical Engineering (heavy current)

The subjects shown here are only the highest levels to be attained. All the grades leading to that level must also be attained with a 50% pass mark (e.g. Electrotechnics N6 includes a pass in this subject on the N3, N4 and N5 levels)

## ANNEXURE IV (a)

### SYLLABUS FOR PLANT ENGINEERING

. (From June 1993 Examination)

THE THEORETICAL SECTION OF THE SUBJECT PLANT ENGINEERING TO BE TAUGHT BY TECHNIKONS AND TECHNICAL COLLEGES

Questions will be framed on all aspects of the theory and the practical application of such theory in its widest sense as would be expected of a certificated engineer while performing his normal duties. Accent is placed on his competency in the execution, control and supervision of the safe installation, maintenance and operation of machinery

### SYLLABUS FOR PLANT ENGINEERING

MECHANICAL	ELECTRICAL
1. SAFETY AND MANAGEMENT	
Accident prevention	Accident prevention
Fire protection	Fire protection
Risk control	Risk control
Project management	Project management
Financial management	Financial management
Loss control	Loss control

2. ELECTRICAL TECHNOLOGY	
MECHANICAL	ELECTRICAL
Direct current machines	Direct current machines
Direct current generators	Direct current generators
Direct current motors	Direct current motors
Efficiency of D.C. machines	Efficiency of D.C. machines
Alternating voltage and current	Alternating voltage and current
Single and three phase circuits	Single and three phase circuits
Transformers	Transformers
	Alternating windings
Production of a rotating magnetic field	Production of a rotating magnetic field
Characteristics of synchronous generators and motors	Characteristics of synchronous generators and motors
Three phase induction motors	Three phase induction motors
Semi conductor devices	Semi conductor devices
Electric lamps and illumination	Electric lamps and illumination
Electric power transmission & distribution	Electric power transmission & distribution
Short circuit conditions	Short circuit conditions
Circuit breakers	Circuit breakers
Underground cables	Underground cables
Insulators	Insulators
Overhead lines	Overhead lines

Economics of power supply	Economics of power supply
Maximum demand	Maximum demand
Power factor correction	Power factor correction
MECHANICAL	ELECTRICAL
	High frequency transients
	Methods of earthing
	Protection.
	Storage of energy
	Rectification
Fault discrimination (basics)(Symmetrical faults only)	Fault discrimination
Illumination	Illumination
	Communication
Explosion proof equipment	Explosion proof equipment
Lightning protection	Lightning protection
	Basics of data transmission
3 APPLIED THERMODYNAMICS	
MECHANICAL	ELECTRICAL
Air and gas compressors and blowers	Air and gas compressors and blowers (rotary compressors only)
Air motor (applications)	
Compressed air columns	Compressed air columns
Compressed air receivers	
Refrigeration and properties of refrigerants	Refrigeration and properties of refrigerants
Air conditioning	Air conditioning
Psychometry	
Steam generators (boilers & ancillary equipment)	Steam generators (boilers & ancillary equipment)
Properties of steam	Properties of steam
Heat balancing	
Condensers	
Steam and gas turbines	
Fans	Fans (classification)
Internal combustion engines	Internal combustion engines
Heat transfer	
Fuels and combustion	

4. STRUCTURES AND STRENGTH OF MATERIALS	
MECHANICAL	ELECTRICAL
Simple stresses	Simple stresses
Simple Stress and Strain	Simple Stress and Strain
Thin-walled pressure vessels	Thin-walled pressure vessels
Torsion of circular shafts	Torsion of circular shafts
Close coiled helical springs	
Shear force and bending moments	Shear force and bending moments
Temperature stresses	Temperature stresses

MECHANICAL	ELECTRICAL
Strain energy due to direct stresses	
Second moment of area	Second moment of area
Bending stresses	Bending stresses
Shear stress in beams	
Struts & buckling	
Catenaries	Catenaries
Foundations	
Fatigue failure	
Mechanical and chemical properties of metals	Mechanical and chemical properties of metals
Testing of materials	Testing of materials
Twisting of shafts	
Ropes	Ropes
Properties of different types of ropes	
Reinforced concrete	
Retaining walls	
Fastenings	Fastenings

## 5. THEORY OF MACHINES

MECHANICAL	ELECTRICAL
Conveyors	Conveyors
Winding plant	Winding plant
Elevators	Elevators
Traction	Traction
Motion and inertia	Motion and inertia
Displacement velocity and acceleration	Displacement velocity and acceleration
Static and dynamic balancing	Static and dynamic balancing
Belt and chain drives	Belt and chain drives
Brakes and dynamometers	Brakes and dynamometers
Toothed gearing	
Gear trains	
Lubrication.	Lubrication.
Clutches	Clutches
Knowledge of machine tools	Knowledge of machine tools
Cranes	Cranes
Lifting equipment	Lifting equipment
Bearings	Bearings

## 6. FLUID MECHANICS

MECHANICAL	ELECTRICAL
Hydrostatic transmission	Hydrostatic transmission
Pumps	Pumps
Flow-through-pumps-lines	Flow-through-pumps-lines
Friction losses	Friction losses
Characteristic curves (pump and systems)	Characteristic curves (pump and systems)
Material transmission by Pipe Lines	
Measurement of flow rates	Measurement of flow rates
Orifices	Orifices

Pelton wheel	Pelton wheel
Flow in launders	
Hydraulic machines, circuits and components	

7. ENVIRONMENTAL	
MECHANICAL	ELECTRICAL
Measurements of airflow and dedusting	Measurements of airflow and dedusting
Properties and effects of dust (health)	Properties and effects of dust (health)
Water purification	Water purification
Waste disposal	Waste disposal
Pollution	Pollution
Noise	Noise
Illumination	Illumination

#### ANNEXURE IV (b)

##### PRACTICAL KNOWLEDGE (FACTORIES)

(From June 1998 Examination)

Candidates must be conversant with the following Plant, equipment, practices and processes at factories with emphasis on the general design, lay out, production capacity, reticulation, energy requirements, motion characteristics, economic operation, efficiency testing, commissioning, maintenance, safety precautions and safety devices. This section is complimentary and additional to the theoretical curriculum taught at Universities, Technikons or Technical Colleges.

1. Planning and commissioning of projects; Operating a planned maintenance scheme; Fire Prevention and fire control; Loss control management; Fire detection systems; Accident investigations.
2. Testing and repairing of electric motors; Phasing and synchronising a.c. motors operating in tandem; Fault discrimination in electric systems; Emergency electric plant; Explosion-proof equipment.
3. Hydrostatic drives-classification and characteristics; Hydraulic circuits for sequence operation; General properties of lubricants and additives to lubricants.
4. Dust suppression; Emission control of diesel engines; Flameproof diesel engines.
5. Boiler inspections and repairs; Inspection and repair of vessels under pressure; Maintenance and fault diagnosis of compressors, refrigeration and air-conditioning; Ventilation systems; Steam pipes and water traps.
6. Steel rope inspections: Application of various types of steel alloys.

## ANNEXURE V

### SYLLABUS FOR OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS

1. The Occupational Health and Safety Act, 1993 (No.85 of 1994) and any subsequent amendments including the definitions.
2. Regulations promulgated in terms of section 44 of the Act including all amendments to the Regulations:
  - (a) The "General Administrative Regulations" (Notice No. R.1449 of 6 September 1996), but excluding the definition of "Provincial Director".
  - (b) The "Electrical Installation Regulations" (Notice No. R.2920 of 20 May 1993).
  - (c) The "General Safety Regulations" (Notice No. R.1031 of 30 May 1986).
  - (d) The "Asbestos Regulations" (Notice No. R.773 of 10 April 1987)
  - (e) The "Environmental Regulations for workplaces" (Notice No. R2281 of 16 October 1987).
  - (f) The "Driven Machinery Regulations" (Notice No R.295 of 26 February 1988).
  - (g) The "General Machinery Regulations" (Notice No R.1521 of 5 August 1988).
  - (h) The "Electrical Machinery Regulations" (Notice No R.1593 of 12 August 1988)
  - (i) The "Facility Regulations" (Notice No R.2362 of 5 October 1990).
  - (j) The "Lead Regulations" (Notice No R.586 of 22 March 1991)
  - (k) The "Vessels Under Pressure Regulations" (Notice No R.1591 of 4 October 1996).
  - (l) The "Lift, Escalator and Passenger Conveyor Regulations" (Notice No R.797 of 20 April 1994)
  - (m) The "Regulation for Hazardous Chemical Substances" (Notice No R.1179 of 25 August 1995)
  - (n) The "Major Hazard Installation Regulations" (Notice No R.60 of 16 January 1998)

NOTE: The regulations promulgated under the old "Machinery and Occupational Health and Safety Act, 1983" are at present being systematically revised to fit in with the new "Occupational Health and Safety Act 1993". Once a revised chapter or portion of the regulations has been promulgated it becomes part of the syllabus. The onus rests with a candidate to ascertain

which regulations have been promulgated and thus become part of the syllabus in order to prepare him for the examination.