higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1210**(E)**(N16)T

NOVEMBER EXAMINATION

NON-NATIONAL CERTIFICATE: ENGINEERING
CERTIFICATE OF COMPETENCY

PLANT ENGINEERING: MINES AND WORKS

(8190306)

16 November 2015 (X-Paper)
09:00–12:00

CLOSED-BOOK EXAMINATION

Candidates may NOT use any notes, textbooks, references during this examination.

This question paper consists of 6 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NON-NATIONAL CERTIFICATE: ENGINEERING
CERTIFICATE OF COMPETENCY
PLANT ENGINEERING: MINES AND WORKS
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked must be clearly crossed out.

INSTRUCTIONS AND INFORMATION

1. SECTION A is COMPULSORY and must be answered by ALL the candidates.
2. Answer any TWO questions in SECTION B.
3. Read ALL the questions carefully.
4. Number the answers according to the numbering system used in this question paper.
5. Rule off across the page on completion of each question.
6. Show ALL the calculations.
7. Examination results will be disqualified if the candidate had not been accepted by *the* Commission of Examiners prior to the examination.
8. Candidates arriving 30 minutes late will NOT be allowed to sit for the examination. No candidate writing the examination may leave the examination room before ONE hour after commencement has elapsed.
9. Programmable calculators must NOT be used by any candidate.
10. Write neatly and legibly.

SECTION A

QUESTION 1

You are the engineer at a new production shaft and are responsible for a man winder on this shaft. You are therefore required to give recommendations and draft procedure to ensure safe winding operations.

Please answer the following questions:

1.1 What are the requirements for the Winding Engine Driver's (WED) in terms of testing of brakes? (4)

1.2 What will your recommendations be in terms of testing of brakes with an empty conveyance, also show how you came to the conclusion of this recommendation? (8)

1.3 Due to loading operations and the process of loading material cars on the shaft, clutching is an inevitable event.

Please draft a procedure for clutching operations to ensure safety to the operations of the shaft. (8)
[20]

QUESTION 2

A 525 V, 160 kW, 4-pole induction motor is used to drive a centrifugal pump which feeds the cyclone of a mineral processing plant. It was decided that this motor will be controlled by a variable speed drive which is capable of varying the frequency from 0 Hz to 120 Hz. The variable speed drive uses the insulated gate bipolar transistors (IGBT) for fast switching and achieving the high frequency.

2.1 Draw the power conversion circuit of the variable speed drive, and also show the waveform for each stage from the supply and to the output end. (10)

2.2 What is meant by Field weakening and at what condition does this occur on motors that are variable speed drive controlled? (5)

2.3 What are the benefits of using variable speed drives in pumping operations (5)
[20]

QUESTION 3

3.1 What does a term fiery *mine* mean? (4)

3.2 What are the requirements for a refuge bay underground (2)

3.3 In case of a power failure on a fiery mine, what steps should be taken during the power failure and when restoring power.

Name five steps. (10)

3.4 Why do we need a switching procedure? Give TWO reasons. (4)
[20]

TOTAL SECTION A: 60

SECTION B

Choose only TWO questions from this section

QUESTION 4

You have just been appointed as a shaft engineer at an Underground Coal Mine. Your shaft is equipped with two ventilation fans and in the last few months, the two fans failed interchangeably for extended periods of time, putting employees' lives at risk every time they failed. The fans are unreliable and very costly to run and you have made a decision to get them replaced. The following are particulars of two fans available for you to select from.

	Fan 1	Fan 2
Capacity	400 m^3/s	400 m^3/s
Pressure	5 kPa	5 kPa
Fan Efficiency	89%	87%
Motor Efficiency	96%	96%
Gearbox Efficiency	97%	Direct drive
Fan Speed	11,5 rev/s	10 rev/s
Cost of Fan	R 1,3 million	R1,35 million
Cost of Motor Switchgear	R650,000	R500,000
Cost of Gearbox	R 250,000	

The selected fan is expected to operate for 20 years, and the present value per annum at 12% over 20 years is R9,64. The cost of electrical power is R250, 00 per annum per kW.

Which fan will you choose and why? **[20]**

QUESTION 5

5.1 The Directive from the Department of Mineral Resources on 'Flexible cables used in hazardous areas,' dated 1 August 1993, in respect to self-propelled mobile machines working in hazardous areas, was issued to enhance Regulation 21.14.3.

5.1.1 Under what circumstances will collectively screened polyphase power supply cables be allowed? (2)

5.1.2 What is the purpose of individually screened polyphase flexible cables? (2)

5.1.3 Elaborate on the cable designs – other than power cables – that could be installed on a self-propelled mobile machine. (4)

5.1.4 What type of cable should be installed between two machine components where there is relative movement between these components? (2)

5.2 Explain why the operation of a plant at a low power factor results in power being wasted. (5)

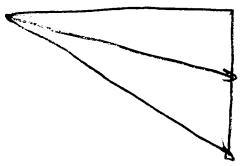
5.3 What economic criteria apply when considering the extent to which the power factor of electrical plant may be raised? (5)
[20]

QUESTION 6

A 4,27 m diameter autogenous mill has a circulating load of 300 t/h of solids of a relative density 2,7 in the form of pulp at a relative density of 1,8. The pulp is discharged into a sump where is diluted to a relative density of 1,25 and then pumped 20 m vertically and 15 m horizontally through a 350 mm diameter pipe to a cyclone.

Given the friction loss

$$h = \frac{0{,}001 \times L \times v^2}{d}$$



Calculate the:

6.1 Critical speed of the mill in r/min (7)

6.2 Water addition in the sump in litres per second (l/s) (6)

6.3 Power of the pump motor to elevate the pulp to the cyclone (7)
[20]

QUESTION 7

A 1 MVA, delta/star, 6 600/400 volt transformer has an iron loss of 3 200 W and a copper loss of 3 000 W at half-full load. The impedance is 4,75%.

Determine the following:

7.1 The overall efficiency at full-load 0,8 power factor lagging (10)

7.2 The line voltage to be applied to the primary windings with the secondary short-circuited to produce full-load current in both the primary and the secondary windings (5)

7.3 The MVA fault value for a short circuit on the secondary terminals of the transformer, assuming infinite capacity in the primary. (5)
[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100

$V = IR$