higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1340(E)(N12)T
NOVEMBER EXAMINATION

NON-NATIONAL CERTIFICATE: ENGINEERING CERTIFICATE OF COMPETENCY

PLANT ENGINEERING: MINES AND WORKS

(8190306)

12 November 2013 (X-Paper)
09:00–12:00

CLOSED-BOOK EXAMINATION

Nonprogrammable calculators may be used.

This question paper consists of 7 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.
2. Answer only TWO questions from 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. ALL calculations must be shown.
7. Use only BLACK or BLUE ink.
8. Questions are based on the requirements and practical application of the Mine Health and Safety Act, 1996 (Act 29 of 1996) and the regulations framed under Schedule 4. Answers must be confined to these requirements.
9. Candidates arriving 30 minutes late will NOT be allowed to sit for the examination. NO candidates writing the examination may leave the examination room before ONE hour after commencement of the examination.
10. This is a CLOSED-BOOK EXAMINATION. Candidates may NOT use any notes, text books or reference works during this examination.
11. NO cellular phones are allowed in the examination room.
12. Write neatly and legibly.

SECTION A

QUESTION 1

You are a newly appointed engineer on a shaft. It has come to your attention that the rope life on your rock winder is not as prescribed by the OEM. After investigation you gathered that the maintenance staff is only cutting a 1 meter back end.

Winder Data:

Drum diameter: 4 m
Rope diameter: 48 mm
Coils on the drum: 20 coils
Four layers of rope on the drum

1.1 Calculate the cross over points of the rope on the drum from the back end. (17)

1.2 What will your recommendation be to the maintenance staff to prevent similar problems? (3)
[20]

QUESTION 2

You have been appointed on a shaft. Your 6,6 kV reticulation system consists of the following equipment:

All the breakers are new magnetic-actuated controlled breakers
All Protection CT's installed are 10 p10 CT's
All panels busbars are 1 250 ampere rated
All relays are old type CDG relays
All the VT's installed are 3 Limb VT's. The only other VT is the VT installed at the emergency generator panel that is a 5 Limb VT
All the auxiliary transformers are 630 kVA oil type transformers with a star point resistor of 31,7 ohms installed, with a 50 : 1 ring CT around the star point
All pump motors are 4 MW direct on line started motors. The emergency generator is 12 MW FT4 gas turbine

All cables installed are 185 mm^2 PILCSWA Drained and Water block cable. You need to upgrade the protection system with newer type Electronic Relays (IED's) and redo the protection schema. After long consideration you have decided to implement a zone protection scheme as proposed by a consultant. You now need to select the correct relays to be installed on all the outgoing feeders, incomers, and pump motor feeders.

Answer the following questions based on the above-mentioned information.

2.1 Explain what the term *zone protection* means. (3)

2.2 The older CDG relays are limited to a protection curve.

Which curve was used? (2)

2.3 The newer electronic relays are capable of the selection of several types of curves.

Name FIVE most common curves you can select from. (5)

2.4 You also need to match the CT's ratios with the newly selected relays.

Indicate the CT ratios in each of the following cases to be installed:

2.4.1 Shaft feeders

2.4.2 Pump starters

2.4.3 Feeders from the emergency generators

2.4.4 Auxiliary transformers

2.4.5 Section feeders

(5 × 1) (5)

2.5 What type of protection relay would you install with an 5 Limb VT as indicated at the emergency generator station? (2)

2.6 What should you remember when you have 5 limb VT's installed in a system when you need to do fault finding? (3)

[20]

QUESTION 3

This question should be answered with full reference to the Guideline for Compilation of a Mandatory Code of Practice for the Design, development/Construction, Safe Operation and Maintenance of Draw Points, Tipping Points, Rock Passes and Box Fronts.

3.1 What are the THREE major causes of fatals associated with Ore pass systems? (3)

3.2 What are the FOUR different aspects that must be addressed by the COP which are similar to ALL the four different areas? Design, Operation, Maintenance, Erection of machinery (4)

3.3 Define each of the following terms used in the guideline:

3.3.1 Arching

3.3.2 Dog leg

3.3.3 Rock pass

3.3.4 Box front

3.3.5 Mud rush

(5 × 1) (5)

3.4 Name FOUR operational aspects to be considered for Box fronts covered under ADDENDUM A5 on Box fronts of the Guideline. (4)

3.5 State FOUR advantages of controlled passes covered under ADDENDUM A4 on Rock Passes of the Guideline. (4)
[20]

TOTAL SECTION A: 60

SECTION B

Answer only TWO questions from this section.

QUESTION 4

A fan which ventilates a small mine runs at 500 r/min. The air flow is measured at 150 m^3/s when the pressure developed across the fan is 0,85 kPa. The natural ventilation pressure of the mine is 0,40 kPa. The mine requires only 100 m^3/s air flow on Sundays and the fan is to be slowed down to meet the requirement. The efficiency remains at 75%.

4.1 Determine the new speed required for Sundays. (6)

4.2 Calculate the annual savings in electricity costs if the tariff is R0,63/kWh. (6)

4.3 Comment on any savings in the maximum demand. (4)

4.4 Name TWO methods that can be used for the reduction of speed on Sundays. (4)
[20]

QUESTION 5

A chairlift is required to transport 1 200 persons per hour through a 15° incline. The vertical distance to be travelled is 247 m and the rope friction is assumed to be 12% of the static force due to gravity. The mass of each chair is 22 kg.

Determine the following:

5.1 The maximum allowable breaking load of the rope (6)

5.2 The power of the drive motor if the drive efficiency of 80% is assumed (4)

5.3 Show, with the aid of sketches, a section through an incline giving the position of the chairs and required clearances (5)

5.4 Name FIVE safety requirements for a chairlift (5)
[20]

QUESTION 6

You are an engineer on a high production shaft. The maximum demand is 150 MW when operating at a power factor of 0,8 lagging. Your load factor currently is 40%. Most of the machines used on the shaft are large machines that is, pump motors, rated at 4 MW. Smallest rating is 2 MW. You need to improve on your electrical consumption. If you install power factor equipment, an improvement to 0,95 is realised. You also improve your load factor to 70%. The maximum demand charge is R20 per kVA and the energy charge is 63 cents per unit consumed.

6.1 Define *power factor.* (1)

6.2 Define *load factor.* (1)

6.3 What will the savings be if you improve the power factor to 0,95 with a load factor of 40% per year? (5)

6.4 What will the savings be if you improve the load factor to 70% at the low power factor and at the higher power factor? (4)

6.5 In doing power factor correction there are three methods or methodologies to implement.

Name the THREE methods and the significance each has to the electrical power system. (9)
[20]

QUESTION 7

7.1 State FIVE advantages and FIVE disadvantages of compressed air on a mine. (10)

7.2 Draw a schematic diagram of a pilot wire circuit for a trailing cable employed in a hazardous area. (5)

7.3 Discuss FIVE crucial points in the design of this pilot wire. (5)
[20]

QUESTION 8

8.1 What does the term DPM stand for with regard to fumes in an underground mine? (2)

8.2 What are the TWO major components of DPM? (2)

8.3 Name SIX control measures that can be put in place in an underground mine where diesel machinery is used to manage dangerous fumes. (6)

8.4 A refrigeration plant operates between -30 °C and 32 °C in the evaporator and condenser respectively. The actual coefficient of performance is 67% of the ideal.

Carnot COP = $\frac{T_1}{T_1 - T_2} = \frac{243}{62} = 3,92$

Calculate the refrigerating effect if the power input is 2 300 kW. (10)

$3,92 \times 0,67 = \frac{RE}{2300}$ RE = 6040 kW **[20]**

QUESTION 9

Briefly explain the following with regard to low pressure steam boilers:

9.1 How you would test the safety valves (2)

9.2 Where the sight glass blows down discharge to and why it is necessary (3)

9.3 How often a boiler is blown down (2)

9.4 How you would know that it is safe to open a boiler up for inspection (2)

9.5 Where the feed water line enters the boiler (2)

9.6 What the cause of furnace explosions is and what precautions you would take to prevent them (4)

9.7 How you would go about closing up a boiler and putting it back on line after an inspection (5) **[20]**

TOTAL SECTION B: 40
GRAND TOTAL: 100