higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N3

(11041263)

23 November 2016 (X-Paper)
09:00–12:00

This question paper consists of 7 pages and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ELECTRICAL TRADE THEORY N3
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Where applicable, answers must be in accordance with the SABS (SANS) Code of Practice SANS 10142-1:2003 for the Wiring of Premises.
5. Sketches must be neat, labelled and large enough to show the required detail.
6. Formulae used in Electrical Trade Theory N3 can be found at the end of the question paper.
7. Answers must be given to TWO decimal places.
8. Write neatly and legibly.

QUESTION 1: DOMESTIC APPLIANCES

1.1 Give THREE hints to save electricity in a normal household. (3)

1.2 A stove that has been wired for a three-phase supply must be coupled to a single-phase supply.

With the aid of a sketch, show how the connection to the supply must be made. (3)

1.3 Name THREE maintenance procedures/checks that can be done to maintain a washing machine. (3)

1.4 Name ONE precaution that should be taken before replacing a geyser element. (1)
[10]

QUESTION 2: PROTECTION

2.1 State THREE safety procedures that can be applied in a household which would eliminate dangerous situations when using electricity. (3)

2.2 State where the following conductors in house wiring are found:

2.2.1 Earth bar

2.2.2 Earthing lead

2.2.3 Earth electrode

(3 x 1) (3)

2.3 Describe the operation of a thermal-magnetic miniature circuit breaker under the following headings:

2.3.1 Overload protection

2.3.2 Short-circuit protection

(2 x 2) (4)
[10]

QUESTION 3: ILLUMINATION

3.1 A fluorescent lamp has a quick-start starter with preheating.

3.1.1 State what is being preheated.

3.1.2 State why a choke is included in this circuit.

3.1.3 State why a capacitor is included in this circuit.

(3 x 1) (3)

3.2 Draw a neat, labelled circuit diagram of a fluorescent lamp that uses a glow starter to start. (4)

3.3 In a workshop containing rotating machinery, two fluorescent lamps must be connected to a single-phase supply.

Explain how the two lamps should be connected to limit the stroboscopic effect. Do NOT draw a circuit diagram. (3)

[10]

QUESTION 4: ALTERNATING CURRENT THEORY

A voltage waveform is represented by e = 381sin(628,32t) volts

NOTE: The angle is in radians.

Calculate:

4.1 RMS value of the voltage (3)

4.2 Frequency of the wave (3)

4.3 Instantaneous voltage 5 m/s after t = 0 s
Round off the answer to the closest whole number. (3)

4.4 State the meaning of the term instantaneous value with reference to a voltage waveform. (1)

[10]

QUESTION 5: SERIES RLC CIRCUITS

A farmer wishes to use a 100 W, 220 V lamp on a 380 V, 50 Hz supply. He decides to insert an inductor in series with the lamp to obtain the desired voltage. Assume that the lamp is purely resistive and that the inductor is purely inductive.

5.1 Draw a circuit diagram and insert all the given information at the appropriate places in your diagram. (3)

5.2 Calculate the current flowing through the inductor. (3)

5.3 Calculate resistance of the lamp. (3)

5.4 State how it is possible to use a coil in an AC circuit to reduce the current through the lamp (1)

[10]

QUESTION 6: THREE-PHASE AC SYSTEMS

6.1 State the angle between the phasors of a three phase voltage waveform. (1)

6.2 A three-phase 380 V supply delivers 50 A to a balanced delta-connected load. The current lags the voltage by 30°.

Calculate:

6.2.1 Total power consumed (3)

6.2.2 Total apparent power (3)

6.2.3 Total reactive power (3)

[10]

QUESTION 7: TRANSFORMERS

7.1 A balanced three-phase star-coupled load draws a line current of 100 A from a transformer. This 200 kVA delta-star transformer is connected to a 6,6 kV supply.

Make a neat sketch that represents this circuit. Indicate on your sketch where the following can be measured:

7.1.1 The phase voltages of the transformer windings (2)

7.1.2 The line current on the primary (1)

7.1.3 The 6,6 kV line voltage (1)

7.2 Calculate the turns ratio of the transformer, mentioned in QUESTION 7.1, if the secondary phase voltage is 220 V. (3)

7.3 Calculate the apparent power used by the load that is connected to the transformer with a secondary line voltage of 380 Volts. (3)
[10]

QUESTION 8: DIRECT-CURRENT MACHINES

8.1 Name the functions of the following components of a DC motor:

8.1.1 The pole shoe

8.1.2 The pole core

8.1.3 The yoke

(3 x 2) (6)

8.2 Draw a freehand graph of the load characteristics of the following DC motors:

8.2.1 A shunt-connected motor

8.2.2 A series-connected motor

(2 x 2) (4)
[10]

QUESTION 9: ALTERNATING-CURRENT MACHINES

9.1 Name TWO types of single-phase AC motors. (2)

9.2 Name TWO types of rotors found in AC motors. (2)

9.3 State the purpose of the no-volt coil in a motor circuit. (2)

9.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (9.4.1–9.4.4) in the ANSWER BOOK.

9.4.1 Direct-on-line starting of motors places a reduced voltage on the stator coils to limit the starting current.

9.4.2 In star-delta starters there are six stator coils, three for star and three for delta.

9.4.3 In an automatic star-delta starter, the timer relay will activate the circuitry that opens the star contactors and closes the delta contactors.

9.4.4 By the time the motor is running at full speed, the rotor resistances of a slip-ring motor would have gradually decreased to form a short-circuit.

(4 x 1) (4)
[10]

QUESTION 10: MEASURING INSTRUMENTS AND ELECTRONICS

10.1 Give the function(s) of the following components of measuring instruments:

10.1.1 Hair springs

10.1.2 Fixed iron

10.1.3 Permanent magnets

(3 x 1) (3)

10.2 Draw the following:

10.2.1 A neat, fully labelled circuit diagram of a full-wave rectifier using two diodes and a centre-tap transformer (3)

10.2.2 The waveform across a load connected to the circuit, mentioned in QUESTION 10.2.1, if the supply is sinusoidal (2)

10.2.3 The waveform across a load connected to the circuit, mentioned in QUESTION 10.2.1, if the supply is sinusoidal and a smoothing capacitor is connected across the load (2)

[10]

TOTAL: 100

ELECTRICAL TRADE THEORY N3

FORMULA SHEET

$$I_T = \frac{V}{Z}$$

$$I_{ACTIVE} = I_T \ Cos \ \phi$$

$$I_{REACTIVE} = I_T \ Sin \ \phi$$

$$X_L = 2\pi f L$$

$$X_C = \frac{1}{2\pi f C}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\phi = Cos^{-1}\left(\frac{R}{Z}\right)$$

$$V_R = I_T R$$

$$V_{XL} = I_T X_L$$

$$V_{XC} = I_T X_C$$

$$V = \sqrt{V_R^{\ 2} + (V_{XL} - V_{XC})^2}$$

$$P = I^2 R$$

$$S = VI$$

3 – phase

$$P = \sqrt{3} \ V_L I_L \ Cos \ \phi$$

$$S = \sqrt{3} \ V_L \ I_L$$

DELTA

$$V_L = V_{PH/F}$$

$$I_L = \sqrt{3} I_{PH/F}$$

STAR

$$V_L = \sqrt{3} V_{PH/F}$$

$$I_L = I_{PH/F}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

$$\omega = 2\pi f$$

$$N = \frac{f.60}{p}$$

$$s = \frac{n - n_r}{n}$$

*The next five formulae are true for **v**oltage:*

$$i = I_m \ Sin \ (\omega t)$$

$$I_{rms} = 0{,}707 \ I_m$$

$$I_{ave} = 0{,}637 \ I_m$$

$$I_{rms} = \sqrt{\frac{i_1^{\ 2} + i_2^{\ 2} + \ldots i_n^{\ 2}}{n}}$$

$$I_{ave} = \frac{i_1 + i_2 + .. i_n}{n}$$

$$\text{Form factor} = \frac{\text{RMS- value}}{\text{AVE - value}}$$

$$\text{Crest factor} = \frac{\text{MAX - value}}{\text{RMS- value}}$$

SERIES

$$R_T = R_1 + R_2 + \ldots R_n$$

PARALLEL

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_n}$$