higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRICAL TRADE THEORY N2

24 November 2022 (X-paper)

This marking guideline consists of 9 pages.

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QUESTION 1: ALTERNATING CURRENT CIRCUIT THEORY

1.1 1.1.1 When changing or alternating magnetic flux links a coil, the alternating magnetic lines of flux cut across the conductors of the coil, ✓ inducing an emf in the coil. ✓

1.1.2 The ability of one coil or circuit to induce an emf in another coil✓ due to a changing magnetic flux in the first coil. ✓

(2 x 2) (4)

1.2 1.2.1 $F = \frac{1130,973}{2\pi}$ ✓

$= 180\ Hz$ ✓ (2)

1.2.2 $V_{rms} = 0,707 \times V_{max}$

$= 0,707 \times 360$ ✓

$= 254,52\ V$ ✓ (2)

1.2.3 $V_{ave} = 0,637 \times V_{max}$

$= 0,637 \times 360$ ✓

$= 229,32\ V$ ✓

$K_f = \frac{254,52}{229,32}$ ✓

= 1, 11 ✓ (4)

[12]

QUESTION 2: CONDUCTORS, INSULATORS AND CABLES

2.1 2.1.1 earth continuity
2.1.2 tee-piece

(2 x 1) (2)

2.2
- It is an extremely tough material that can withstand very high temperatures of up to 1 000 ˚C.
- Is a silicate mineral found in granite and other rocks.
- It is highly fire-proof, incombustible, non-flammable and infusible.
- High electrical resistance and low temperature coefficient.

(Any 2 x 1) (2)

2.3 $V_{drop} = 5\% \times V_s$

$= \frac{5}{100} \times 240 = 12\,V$ ✓

$V_{\min\, allowable\ voltage} = V_{supply} - V_{drop}$

$= 240 - 12$ ✓

$= 228\,V$ ✓

Alternative:

$V_{\min\ voltage} = 95\% \times V_s$

$= \frac{95}{100} \times 240 = 228\,V$

(3)

2.4
2.4.1 Conductor
2.4.2 XLPE insulation
2.4.3 PVC inner sheath
2.4.4 Steel wire armour
2.4.5 PVC outer sheath

(5 x 1) (5)
[12]

QUESTION 3: ELECTRICAL RETICULATION

3.1
- It is the simplest method of energy distribution.
- The initial installation costs are low.
- Minimum cabling is required.
- Less maintenance is required.
- It is the preferred method if the secondary substation is at the centre of all consumers.

(Any 3 x 1) (3)

3.2 It is easier to transmit electrical energy over long distances using transmission lines. (1)

3.3
3.3.1 11 kV
3.3.2 400 kV or 765 kV
3.3.3 132 kV
3.3.4 400 V or 240 V

(4 x 1) (4)
[8]

QUESTION 4: SWITHGEAR AND PROTECTIVE DEVICES

4.1

	Operation	Application/ Uses
Day-night switch	Photocell senses natural light and switches load off or, if it senses darkness, switches load on.✓	• Security lighting circuits✓ • Street lighting circuits.
Timer	Switched on or off by means of an electromagnetic switch but only at a present time or delayed interval.✓	• Motor starter circuits✓ • Pool pump circuits • Irrigation pump circuits.

(4)

4.2 4.2.1 Phase imbalance protection relays

4.2.2 Lightning arrestors (2 x 1) (2)

4.3
- Circuit breakers
- Fuses
- Overload relays
- Earth leakage relays
- Phase balance protection relays
- Lightning arrestors
- Earth compensators
- Autoreclosers

(Any 4 x 1) (4)

[10]

QUESTION 5: BATTERIES

5.1
- Very heavy.
- Acid is dangerous to handle.
- Not suitable for fast charging.
- Lead is not environmentally friendly.
- Can be stored only in the charged state.
- Sulphation occurs when stored in the discharged state.
- Need regular maintenance.
- Danger of overheating during charging.
- Must always be kept upright.
- Spillage of electrolyte is dangerous.

(Any 4 x 1) (4)

5.2 A lithium-ion battery consists of three functional parts which are a negative electrode, commonly made of graphite,✓ a positive electrode made of either lithium cobalt oxide, lithium ion, phosphate✓ or lithium manganese oxide and electrolyte made of lithium salt in an organic solvent,✓ that provides a conduction path for ions and electrons.✓ (4)

5.3
- Fast charging
- Float charging

(2)

[10]

QUESTION 6: DC MACHINES

6.1 6.1.1 Armature reaction – the distortion of the main flux entering and leaving the armature ✓caused by the flux set up by the armature conductors when they carry current. ✓

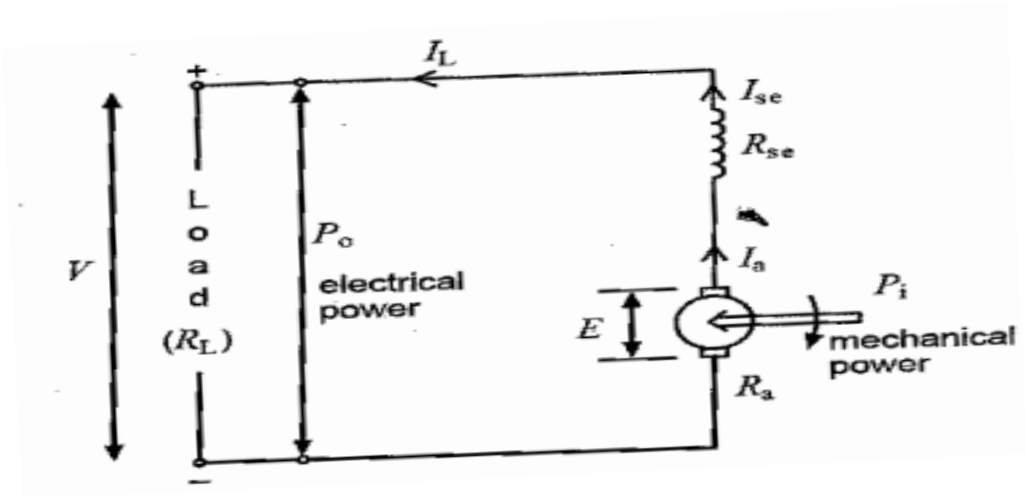
6.1.2 Commutation – is the reversal of the emf and current in the short-circuited coil✓ during its transfer from one commutator segment to the next. ✓

(2 x 2) (4)

6.2
- Increasing the brush contact resistance
- Using interpoles
- Using compensating windings
- Shifting the brushes

(Any 2 x 1) (2)

6.3



Correctness of the drawing	1 Mark
Input power and power output	1 Mark
Direction of currents	2 Marks

(4)
[10]

QUESTION 7: AC MACHINES

7.1
- Exhaust fans
- Cooling fans
- Toys
- Electric clocks
- Hair dryers

(Any 2 x 1) (2)

7.2 7.2.1 The main winding is made of thick wire with many turns✓, so it has a low resistance and a high inductance. ✓

7.2.2 The auxiliary winding is made of thin wire with few turns✓, so this winding has a high resistance and a low inductance. ✓

(2 x 2) (4)

7.3 The direction of rotation of a universal motor can be reversed by simply changing the polarity across the armature or field coils. ✓ This can be achieved by interchanging the connections to the brush holders. ✓ (2)

[8]

QUESTION 8: TRANSFORMERS

8.1 8.1.1 $\theta = \cos^{-1} 0{,}2 = 78{,}463°$ ✓

$I_m = I_0 \sin\theta$

$I_m = 2{,}5 \sin 78{,}463°$ ✓

$\therefore = 2{,}449A$ ✓

(3)

8.1.2 $I_c = I_0 \cos\theta$

$= 2{,}5\ X\ 0{,}2$ ✓

$= 0{,}5\ A$ ✓

(2)

8.2 When an alternating voltage is applied to the primary winding,✓ an alternating current flows through it,✓ which sets up an alternating flux in the iron core, ✓ which links with the secondary winding,✓ inducing in it an emf of the same frequency.✓ (5)

[10]

QUESTION 9: EARTHING

9.1
9.1.1 True
9.1.2 False
9.1.3 False
9.1.4 True
9.1.5 True
9.1.6 True

(6 x 1) (6)

9.2 9.2.1 Floating earth is non-current carrying parts✓ that are joined together forming a zero-volt potential. ✓ (2)

9.2.2
- Drilling machines
- Angle grinders
- Vacuum cleaners
- Electric lawnmowers

(Any 2 x 1) (2)

[10]

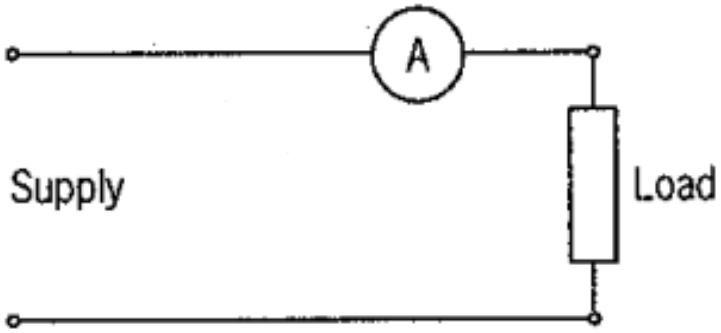
QUESTION 10: MEASURING INSTRUMENTS

10.1 $R_{sh} = \frac{I_m R_m}{I_T - I_m}$ ✓

$R_{sh} = \frac{\left(10 \times 10^{-3}\right) \times 10}{1 - (10 \times 10^{-3})}$ ✓

$\therefore R_{sh} = 0{,}101\Omega$ ✓ (3)

10.2



(1 mark each for ammeter, supply and the load) (3)

[6]

QUESTION 11: RENEWABLE ENERGY

11.1 Renewable energy is energy that is produced by renewable resources which can be used repeatedly as they do not deplete✓ and non-renewable energy is energy that is produced by non-renewable, finite energy sources. ✓ (2)

11.2
- Solar
- Wind
- Water
- Geothermal
- Biomass
- Ocean
- Hydrogen

(Any 2 x 1) (2)
[4]

TOTAL: 100

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