higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ELECTRO-TECHNOLOGY N3

12 August 2021

This marking guideline consists of 7 pages.

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QUESTION 1

1.1
- Brushes are spring loaded to maintain a constant pressure✓ on the commutator so that no gaps form.✓

OR
- Brushes are spring loaded to be kept in position✓ on the commutators✓ (2)

1.2
- Shaft
- Cooling fan
- Armature core
- Commutator
- Bearing
- Armature conductors or windings (Any 3 × 1) (3)

1.3 1.3.1 Commutation is the reversal of current through a coil✓ at the instant when the segments✓ to which the coil is connected are short-circuited by the brushes.✓ (3)

1.3.2
- Bedding of brushes is a process of changing a square face of a new brush to a concave face.

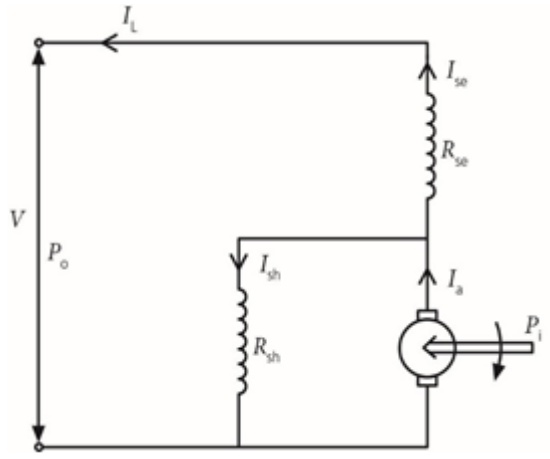
OR
- Bedding is when brushes are ground with emery paper so that they take on the arc of the commutator. (2)

[10]

QUESTION 2

2.1
- Series generator
- Shunt generator
- Compound generator or Series-parallel
- Short-shunt generator
- Long-shunt generator (Any 3 × 1) (3)

2.2



✓✓✓✓

Award ONE mark each for the following: power input, power output, series field current and shunt field current. (4)

2.3 • In a differential compound-wound generator, the two field coils are made to carry current in opposite directions.
OR
• In a differential compound-wound generator, the magnetic fields produced by the two field coils oppose each other. (2)

2.4 Armature current (1)
[10]

QUESTION 3

3.1 3.1.1 Place a variable resistor in series with the field coils.

3.1.2 Place a variable resistor in series with the armature.
(2 × 1) (2)

3.2 3.2.1 $P_i = \frac{P_o}{\eta} = \frac{22}{0,85} = 25,882\ kW$✓
$I_L = \frac{P_i}{V} = \frac{25,882 \times 10^3}{400} = 64,705\ A$✓
$I_{sh} = \frac{V}{sh} = \frac{400}{240} = 1,667\ A$✓
$I_a = I_L - I_{sh} = 64,705 - 1,667 = 63,038\ A$✓ (4)

3.2.2 $E = V - I_a R_a = 400 - (63,038)(0,25)$✓ $= 384,241\ V$✓ (2)

3.2.3 $Z = \frac{60Ec}{2\emptyset Np} = \frac{(60)(384,241)(2)}{(2)(25\times10^{-3})(1\,200)(3)}$✓ $= 256\ conductors$✓ (2)
[10]

QUESTION 4

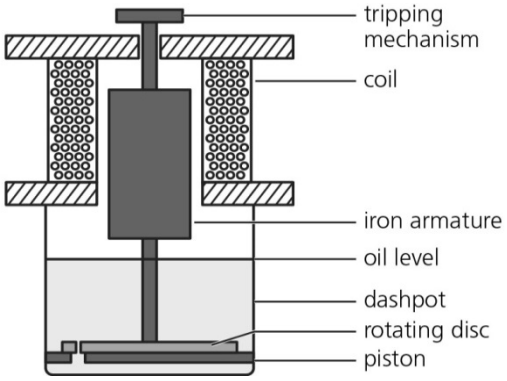
4.1 4.1.1 $P_o = \frac{2\pi Nr(W-S)}{60}$
$= \frac{(2\pi)(900)(0,29)(274,4-120)}{60}$✓
$= 4,22\ kW$✓ (2)

4.1.2 $P_i = VI = (220)(21,25)$✓ $= 4,675\ kW$✓ (2)

4.1.3 $\eta = \frac{P_o}{P_i} \times 100\% = \frac{4,22}{4,675} \times 100\% = 90,267\%$✓
OR
$\eta = \frac{2\pi N(W-S)r}{60VI}\ x\ 100$

$= \frac{2\pi(900)(274,4-120)(0,29)}{60(220\ x\ 21,25)} x\ 100\ = 90,267\%$ (1)

4.2



✓✓✓✓✓

Award TWO marks for correctness of sketch and THREE marks for any three labels. (5)

[10]

QUESTION 5

5.1 $K_f = \frac{E_{rms}}{E_{avg}}$ ✓

$= \frac{0{,}707E_m}{0{,}637E_m}$ ✓

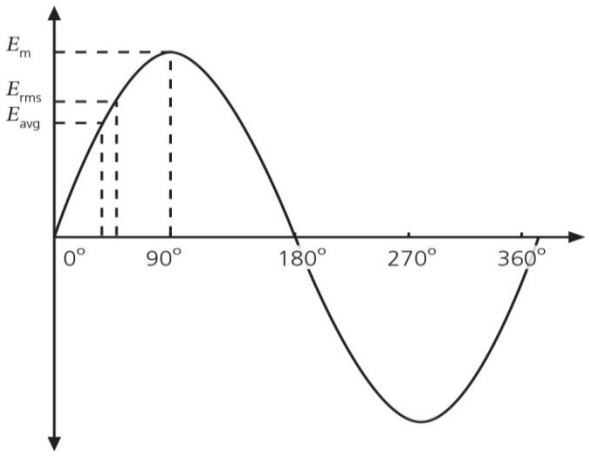
$= 1{,}11$ ✓ (3)

5.2 5.2.1 $E_{avg} = 0{,}637\ E_m = 0{,}637(500)$ ✓ $= 318{,}5\ V$ ✓

5.2.2 $E_{rms} = 0{,}707\ E_m = 0{,}707(500)$ ✓ $= 353{,}5\ V$ ✓

(2 × 2) (4)

5.3



✓✓✓

Award ONE mark each for correctly indicating the three values. No marks if graph is not sinusoidal. (3)

[10]

QUESTION 6

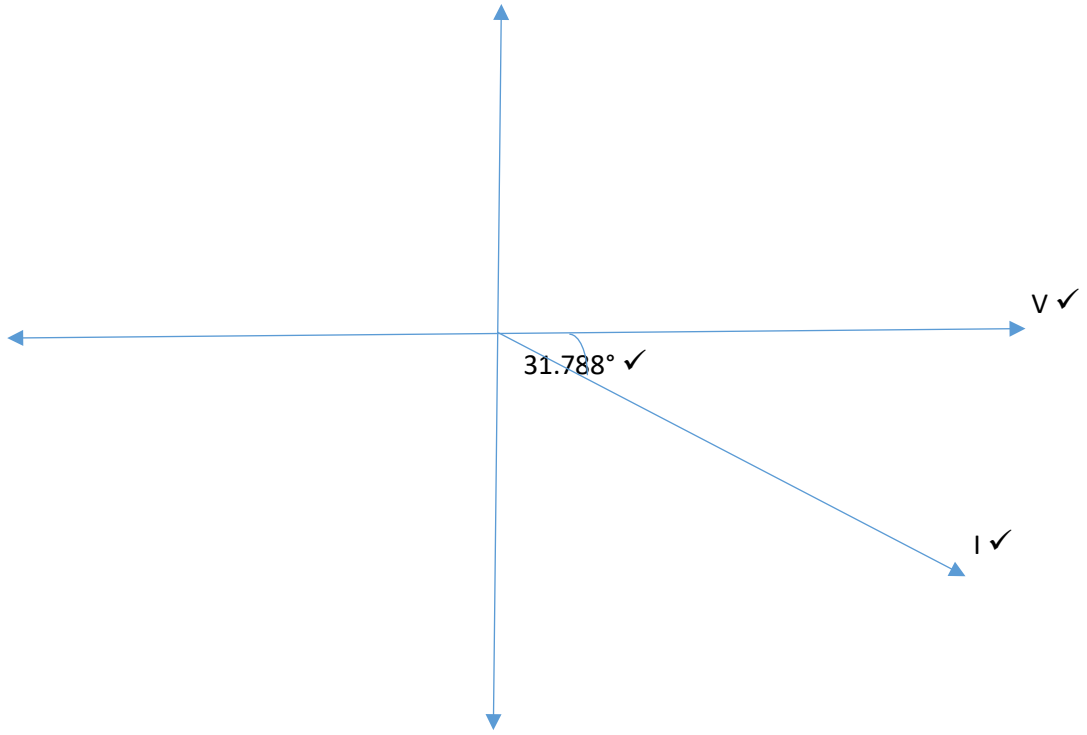
6.1 $I = \frac{P}{V\cos\emptyset} = \frac{6{,}75\times10^3}{(220)(0{,}85)}$ ✓ $= 36{,}096\ A$✓ (2)

6.2 $\cos\emptyset = 0{,}85\ \therefore\ \emptyset = 31{,}788°$ ✓ (1)

6.3 $Q = VI\sin\emptyset = (220)(36{,}096)(\sin 31{,}788°) = 4{,}183\ kVAr$✓✓ (2)

6.4 $Z = \frac{V}{I} = \frac{220}{36{,}096}$ ✓ $= 6{,}095\ \Omega$✓ (2)

6.5



(3)
[10]

QUESTION 7

7.1

Symbol	Quantity	SI Unit
P	True power	W or kW✓
S✓	Apparent power	VA or kVA✓
Q✓	Reactive power	VAr or kVAr✓

(5)

7.2 7.2.1

$$V_p = \frac{V_L}{\sqrt{3}} = \frac{525}{\sqrt{3}}\checkmark = 303{,}109\ V\checkmark$$

(2)

7.2.2

$$P_i = \frac{P_o}{\eta} = \frac{60}{0{,}95} = 63{,}158\ kW\checkmark$$

$$\cos\emptyset = \frac{P_i}{\sqrt{3}\,V_L I_L} = \frac{63{,}158\times10^3}{\sqrt{3}\,(525)(75)} = 0{,}926\checkmark$$

(2)

7.2.3

$$I_L = I_p = 75\ A$$

(1)

[10]

QUESTION 8

8.1
- Operate at a higher efficiency
- Smaller in size
- Have better voltage regulation than two-winding transformers
- Cost less, since they require less copper (Any 2 × 1) (2)

8.2 8.2.1 $I_1 = \frac{S}{V_1} = \frac{7{,}5\times10^3}{240}$ ✓ $= 31{,}25\ A$ ✓

8.2.2 $V_2 = V_1\frac{N_2}{N_1} = 240\left(\frac{1\,500}{500}\right)$ ✓ $= 720\ V$ ✓

8.2.3 $I_2 = \frac{S}{V_2} = \frac{7{,}5\times10^3}{720}$ ✓ $= 10{,}417\ A$ ✓

OR

$I_2 = I_1\frac{N_1}{N_2} = 31{,}25\left(\frac{500}{1\,500}\right) = 10{,}417\ A$

8.2.4 $P_2 = V_2I_2\cos\emptyset = (720)(10{,}417)(0{,}8)$ ✓ $= 6\ kW$ ✓

OR

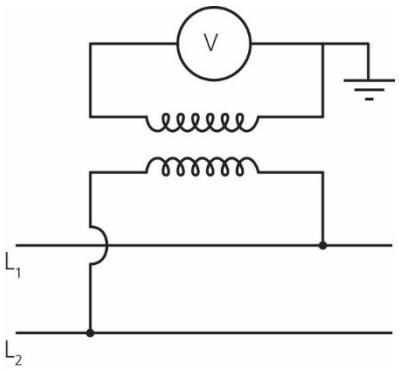
$P = S\cos\emptyset = (7{,}5)(0{,}8) = 6\ kW$

(2 × 4) (8)

[10]

QUESTION 9

9.1



✓✓✓

Award ONE mark each for correctly connecting the voltmeter, TWO marks for correct connection of terminals on the secondary winding. (3)

9.2 Advantages
- Very accurate readings obtained
- Used for both AC and DC measurement
- Not affected by stray magnetic fields (Any 2 × 1)

Disadvantages
- Scale is non-linear or uneven
- Relatively expensive
- Has a delicate construction (Any 2 × 1) (4)

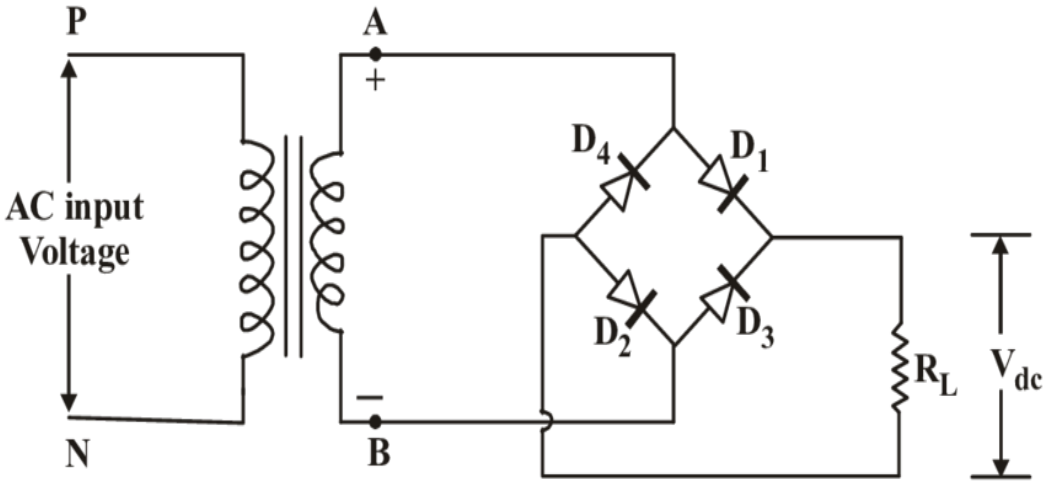
9.3

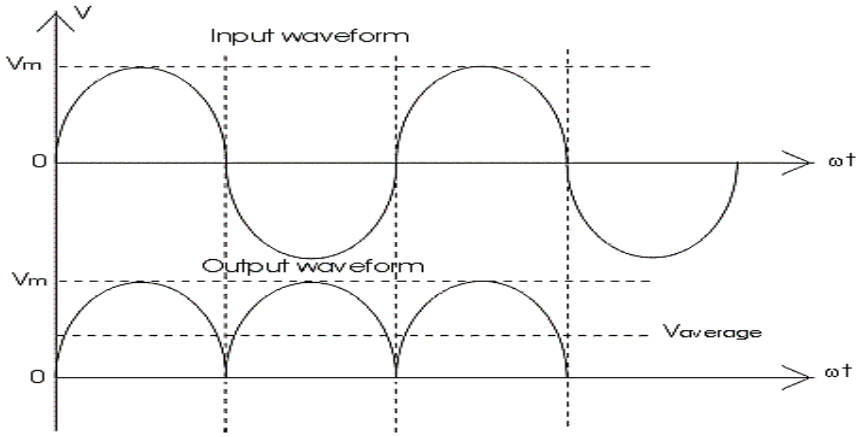
$$R_{se} = \frac{V}{I_m} - R_m$$
$$= \frac{100}{5\times10^{-3}} ✓ - 65 ✓$$
$$= 19\,935\ \Omega ✓$$

(3)
[10]

QUESTION 10

10.1





✓✓✓✓✓✓

Award ONE mark each for the following: input wave, output wave, diodes D1, D2, D3 and D4. (6)

10.2

$$\begin{array}{r} 101 \\ +\ \underline{111} \\ \underline{1100} \end{array}$$ (✓✓✓✓ $\frac{1}{2}$ mark for each place value)

$1100_2 = (1 \times 2^3) + (1 \times 2^2)✓ = 8 + 4 = 12✓$

(4)
[10]

TOTAL: 100

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