higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T60(**E**)(A6)T

NATIONAL CERTIFICATE

ARMATURE WINDING THEORY N2

(11020042)

6 April 2018 (X-Paper)
09:00–12:00

Calculators may be used.

This question paper consists of 4 pages and a formula sheet of 3 pages.

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ARMATURE WINDING THEORY N2

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. Diagrams must be neat and in proportion.
5. Use π =3,142.
6. Work neatly.

QUESTION 1

1.1 A six-pole wave-wound armature has 80 slots, 320 commutator segments and single-turn coils.

1.1.1 Make a neat, labelled sketch of the coil sides as they are arranged in each slot. (10)

1.1.2 Find a suitable coil span. (3)

1.1.3 Find a suitable commutator pitch. (3)

1.2 What is *armature reaction*? (3)

[19]

QUESTION 2

Draw neat, labelled diagrams to show each of the following:

2.1 Reversal of direction of rotation of a shunt motor (6)

2.2 Reversal of direction of rotation of a series motor (6)

2.3 Reversal of direction of a long-shunt motor (8)

[20]

QUESTION 3

A series circuit consists of a resistor of 5 ohms, an inductor of 0,01 henry and a capacitor of 75 microfarad connected to a 200 V/100 Hz supply.

Calculate the following:

3.1 Total current (8)

3.2 Phase angle (2)

3.3 Potential difference across each component (6)

[16]

QUESTION 4

4.1 What is the purpose of a centrifugal switch in a single-phase motor? (3)

4.2 Make a neat, labelled sketch of a single-phase transformer. (4)

4.3 How efficient is a transformer? (1)

4.4 A three-phase delta/star transformer supplies a line current of 900 amperes to a load.

Calculate the following if the primary line voltage is 6,6 kV and the secondary line voltage is 380 V:

4.4.1 Primary and secondary phase voltages (3)

4.4.2 Transformation ratio (3)

4.4.3 Primary line current (6)
[20]

QUESTION 5

5.1 Make neat, labelled sketches to show the reversal of rotation of a three-phase induction motor. (6)

5.2 Explain how the rotating magnetic field operates in a three-phase induction motor. (4)
[10]

QUESTION 6

Draw a neat data sheet giving all the information required before an armature is rewinded. **[11]**

QUESTION 7

Draw and label a section of armature slots with coils. **[4]**

TOTAL: 100

ARMATURE WINDING THEORY N2

FORMULA SHEET

1\. COIL SPAN $= \dfrac{Total\ number\ of\ slots + 1}{Total\ number\ of\ poles}$

SPOELSPAN $= \dfrac{Totale\ aantal\ gleuwe + 1}{Totale\ aantal\ pole}$ =

2\. COMMUTATOR PITCH $= \dfrac{Number\ of\ segments \pm 1}{Number\ of\ pairs\ of\ poles}$

KOMMUTATORSTEEK $= \dfrac{Hoeveelheid\ segmente \pm 1}{Hoeveelheid\ poolpare}$

3\. $E = \dfrac{Total\ flux\ of\ pole}{Time\ of\ one\ revolution}$

$= 2p\ \phi \div \dfrac{60}{N}$

$= \dfrac{2\ \phi NP}{60}\ volt$

$E = \dfrac{Totale\ vloed\ van\ pole}{Duur\ van\ een\ omwenteling}$

$E = \dfrac{2\ ZNP\ \varphi}{C \times 60}$

$Z = \dfrac{EXC \times 60}{2\ NP\ \varphi}$

MECHANICAL POWER $= \dfrac{Force \times distance}{Time\ in\ seconds}$

$= 2\ \pi\ metres$

$\therefore\ P = F \times 2\ \pi\ R \times \dfrac{N}{60}$

$= \dfrac{2\ \pi\ NT}{60}\ watts$

MEGANIESE DRYWING $= \dfrac{Krag \times afstand}{Tyd\ in\ sekondes}$

$E = V + Ia\ Ra$ or/of $E = V - Ia\ Ra$

$V = E + Ia\ Ra$

SUMMARY

$$E = \frac{2\,ZNP\phi}{C \times 60}$$

$$T = \frac{ZP\phi Ia}{C \times \pi}$$

$$A = \frac{I}{J}$$

$$E = V + Ia\,Ra \qquad A\,max/maks = \frac{Ia}{J\,\min}$$

$$Ia = I + If \qquad A\,min = \frac{Ia}{J\;max/maks}$$

$$P = EIa$$

$$Lt = Z \times \frac{Length\;\;per\;\;turn}{2}$$

$$Lt = Z \times \frac{Lengte\;\;per\;\;draai}{2}$$

$$Ra = Zx\,\underline{Length\ per\ turn \times Resistance\ per\ unit\ x}\ \frac{1}{C^2}$$

$$Ra = Zx\,\underline{Lengte\ per\ draai \times Weerstand\ per\ eenheid\ x}\ \frac{1}{C^2}$$

RECTANGULAR CONDUCTORS
REGHOEKIGE GELEIERS

$$R = \frac{\rho\ell}{A}$$

$$Ra = \frac{1t \times resistance\;\;per\;\;unit\;\;length}{C^2}$$

$$Ra = \frac{1t \times weerstand\;\;per\;\;eenheidlen\,gte}{C^2}$$

$$A\,max = \frac{Ia}{J\,\min} \qquad A\,maks = \frac{Ia}{J\,\min}$$

$$A\,min = \frac{Ia}{J\,\max} \qquad A\,min = \frac{Ia}{J\;maks}$$

$$n = f/p$$

$$QV^2 = QR^2 + QL^2 \qquad \frac{VP}{VS} = \frac{NP}{NS} = \frac{IS}{IP}$$

$$V^2 = (IR)^2 + (I \times L)^2$$

$$V = I\sqrt{R^2 \times XL^2}$$

$$\frac{V}{I} = \sqrt{R^2 \times XL^2}$$

$$Z = \sqrt{R^2 + xc^2}$$

$$XL = 2\,\pi FL$$

$$Z = \sqrt{R^2 + XL^2}$$

$$C = \frac{Q}{V}$$

$$X_C = \frac{1}{2\pi fc}$$

$$XC = \frac{V}{I} = \frac{1}{2\,\pi}FC$$

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

$$C = \frac{1}{2\,\pi}FXc$$

$$Z = \sqrt{R^2 + (XC - XL)^2}$$

$$Cos\ \phi = \frac{R}{Z}$$

$$Ip\ Np = Is\ Ns$$

$$\frac{Ip}{Is} = \frac{Ns}{Np}$$

$$\frac{IP}{IS} = \frac{Ns}{Np} = \frac{Vs}{Vp}$$

$$Current = \frac{Apparent\ power\ .\,Ps}{Potential\ difference\ .\,V}$$

$$Stroom = \frac{Skyndrywing\ .\,Ps}{Potensiaalverskil\ .\,V}$$