higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T60**(E)**(A8)T

NATIONAL CERTIFICATE

ARMATURE WINDING THEORY N1

(11020042)

8 April 2019 (X-Paper)
09:00–12:00

Calculators may be used.

This question paper consists of 5 pages and a formula sheet of 3 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
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. Sketches must be large, neat and fully labelled.
5. Write neatly and legibly.

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QUESTION 1

1.1 Explain *Fleming's Right-hand Rule* for generators. (4)

1.2 A six-pole wave-wound armature has 72 slots and 143 commutator segments.

Calculate the following:

1.2.1 Coil span

1.2.2 Commutator pitch

(2 × 2) (4)

1.3 Use current, resistance and voltage values to explain the characteristics of an overcompounded generator with the aid of a sketch. (8)

1.4 Draw the load characteristic curves of a shunt-wound generator. (4)

[20]

QUESTION 2

2.1 With the aid of diagrams, explain the difference between a cumulatively compound-wound motor and a differentially compound-wound motor. (8)

2.2 Why are equalising windings installed? (4)

[12]

QUESTION 3

3.1 Explain THREE methods of closing slots after windings have been inserted.

(3 × 2) (6)

3.2 Draw a labelled diagram to illustrate how a commutator is soldered. (8)

[14]

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QUESTION 4

4.1 A single-phase AC series circuit has a resistance of 60 ohms, an inductance of 0,25 Henry and a capacitance of 32 micro farad, which is connected to a 250 V/50 Hz supply.

Calculate the following:

4.1.1 Inductive reactance (3)

4.1.2 Capacitive reactance (3)

4.1.3 Impedance (3)

4.1.4 Total current (3)

4.1.5 Phase angle of the circuit (4)

4.2 How are coil turns accurately determined when recording data before winding? (2)

[18]

QUESTION 5

5.1 Why is the core of the transformer laminated? (3)

5.2 A 2,5 kVA single-phase transformer with a turns ratio of 1:5 is connected to a 200 volt supply.

Calculate the following:

5.2.1 Secondary current

5.2.2 Primary current

5.2.3 Secondary voltage

(3 × 4) (12)

[15]

QUESTION 6

6.1 Draw a neat, labelled sketch of a growler. (5)

6.2 Explain how a test is administered on a growler to find a short-circuited coil. (5)

6.3 What type of brushes are used for a high-speed slip-ring motor? (2)

[12]

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QUESTION 7

7.1	What is the function of a centrifugal switch in a single-phase motor?	(3)
7.2	State FIVE important parts of a single-phase capacitor start motor.	(5)
7.3	What voltage value would you associate with a single-phase AC?	(1)
		[9]

TOTAL: 100

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ARMATURE WINDING THEORY N2

FORMULA SHEET

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

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

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

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

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

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

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

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

$= 2\ \pi\ metres$

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

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

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

$V = E + Ia\ Ra$

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SUMMARY

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

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

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

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

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

$P = EIa$

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

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

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

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

RECTANGULAR CONDUCTORS
REGHOEKIGE GELEIERS $R = \frac{\rho\ell}{A}$

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

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

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

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

$n = f/p$

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

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

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

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

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

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

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

$$\frac{V}{I} = \sqrt{R^2 + XL^2} \qquad XC = \frac{V}{I} = \frac{1}{2\,\pi}\,FC$$

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

$$Z = \sqrt{R^2 + (XC - XL)^2} \qquad Cos\,\phi = \frac{R}{Z}$$

$$Ip\,Np = Is\,Ns$$

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

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

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

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