# PAST EXAM PAPERS & MEMOS FOR ENGINEERING STUDIES N1-N6

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE

# ARMATURE WINDING THEORY N2

(11020042)

**9 April 2020 (X-paper)**
**09:00–12:00**

**Calculators may be used.**

**This question paper consists of 4 pages and a formula sheet of 2 pages.**

181Q1A2009

# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ARMATURE WINDING THEORY N2
TIME: 3 HOURS
MARKS: 100

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**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 Use diagrams to differentiate between *lap windings* and *wave windings*.
(4 + 4) (8)

1.2 Explain the term *coil span.* (4)

1.3 An eight-pole wave-wound armature has 115 slots and 345 commutator segments.

Calculate:

1.3.1 The coil span

1.3.2 The commutator pitch
(2 × 2) (4)

1.4 Explain the type of energy conversion that takes place in a *DC motor* and the type of energy conversion that takes place in a *DC generator*. (2 + 2) (4)
**[20]**

## QUESTION 2

2.1 Explain the term *armature reaction*. (3)

2.2 What is *commutation*? (3)

2.3 Explain the function of interpoles in a DC motor. (3)

2.4 Why are equalising windings used? (4)
**[13]**

## QUESTION 3

Explain each of the following coil-winding methods:

3.1 Hand winding

3.2 Form winding

3.3 Skein winding
(3 × 4) **[12]**

 

## QUESTION 4

4.1 In a single-phase AC series circuit the resistance is 17 Ω, the inductance is 10 mH and the capacitance is 20 μF. The circuit is connected to a 250 V/50 Hz supply.

Calculate:

4.1.1 The inductive reactance (3)

4.1.2 The capacitive reactance (3)

4.1.3 The impedance (3)

4.1.4 The phase angle between the current and the voltage (4)

4.1.5 The total current (3)

4.2 What is the function of a centrifugal switch in a single-phase motor? (3)
**[19]**

## QUESTION 5

Draw a neat, labelled diagram of a shunt-motor face-plate starter. **[10]**

## QUESTION 6

6.1 Explain the function of a transformer. (3)

6.2 A 220/10 V single-phase transformer has 50 turns on the secondary coil.

If the transformer draws a current of 1,5 A from the supply, calculate:

6.2.1 The number of primary turns (4)

6.2.2 The current delivered to the load (4)

6.2.3 The rating of the transformer (3)
**[14]**

## QUESTION 7

7.1 Draw labelled diagrams to illustrate how reversals of rotation of three-phase AC motors are achieved. (6)

7.2 Draw a labelled diagram of a capacitor start motor. (6)
**[12]**

**TOTAL: 100**

## FORMULA SHEET

Coil span = $\frac{\text{Total number of slots} + 1}{\text{Total number of poles}}$

Commutator pitch = $\frac{\text{Number of segments} \pm 1}{\text{Number of pairs of poles}}$

E = $\frac{\text{Total flux of pole}}{\text{Time of one revolution}}$

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

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

$= \frac{2\ ZNP\ \varphi}{C \times 60}$

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

Mechanical power = $\frac{\text{Force} \times \text{distance}}{\text{Time in seconds}}$

= 2 π metre

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

$= \frac{2\ \pi\ NT}{60}$ watt

E = V + IaRa **OR** E = V – IaRa

V = E + IaRa

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

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

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

E = V + IaRa

Amax = $\frac{Ia}{J \min}$

Ia = I + If

Amin = $\frac{Ia}{J \max}$

P = EIa

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

Ra = Z × length per turn × resistance per unit × $\frac{1}{C^2}$

Rectangular conductors: $R = \frac{\rho \ell}{A}$

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

Amax = $\frac{Ia}{J \min}$

Amin = $\frac{Ia}{J \max}$

n = f/p

$QV^2 = QR^2 + QL^2$

$\frac{VP}{VS} = \frac{NP}{NS} = \frac{IS}{IP}$

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

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

$XL = 2\pi FL$

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

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

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

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

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

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

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

Ip Np = Is Ns

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

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

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