task_0j7accfimmemytq9_with_calculation

Student Group

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magnetostatic, flux density, magnetic field strength, coil, flux, exam ee2 SS2021

Exercise E1 Cylindrical Coil
(written test, approx. 6 % of a 120-minute written test, SS2021)

a) the magnetic flux (2 points)

Result

Path

The proportion of the magnetic voltage outside the coil can be neglected. Determine the following for the inside of the coil:

a) the magnetic field strength (2 points)

Path

Result

b) the magnetic flux density (2 points)

Path

Result

c) the magnetic flux (2 points)

Path

Result

d) the inductance of the coil (2 points)

Path

Result

e) the energy stored in the magnetic field (2 points)

Path

Result

A cylindrical coil with the following information is given:

- Length $ = 30 {~\rm cm}$,
- Winding diameter $ = 390 {~\rm mm}$,
- Number of windings $ = 240$,
- Current through the conductor $ = 500 {~\rm mA}$,
- Material inside: Air
- $\mu_0 = 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}}$

The magnetic field strength is given by $H = {{N \cdot I}\over{l}} = {{w \cdot I}\over{l}}$

Putting in the numbers: \begin{align*} H &= {{240 \cdot 0.5 {~\rm A}}\over{0.3 {~\rm m}}} \end{align*}

The magnetic field strength is $B = \mu_0 \mu_{\rm r} \cdot H$:

\begin{align*} B &= \mu_0 \cdot H \end{align*}

Putting in the numbers: \begin{align*} B &= 4\pi\cdot 10^{-7} {{\rm Vs}\over{\rm Am}} \cdot 400 ~\rm {{A}\over{m}} \\ &= 0.0005026... {{\rm Vs}\over{\rm m^2}} \end{align*}

\begin{align*} A = \pi r^2 = \pi \left({{d}\over{2}} \right)^2 \end{align*}

Therefore: \begin{align*} \Phi &= B \cdot \pi \left({{d}\over{2}} \right)^2 \end{align*}

Putting in the numbers: \begin{align*} \Phi &= 0.0005026... {{\rm Vs}\over{\rm m^2}} \cdot \pi \left({{0.39{\rm m}}\over{2}} \right)^2 \\ &= 0.00006004... {\rm Vs} \end{align*}