EEE 3351

ELECTROMECHANICS & ELECTRICAL MACHINES

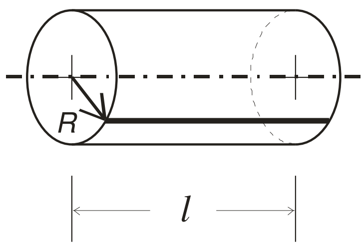
END OF TERM TESTS

DECEMBER 2013/JANUARY 2014

MODEL SOLUTIONS

4.

(a) For one conductor, Faraday's law for a length l in a magnetic field B gives induced voltage v_{in}

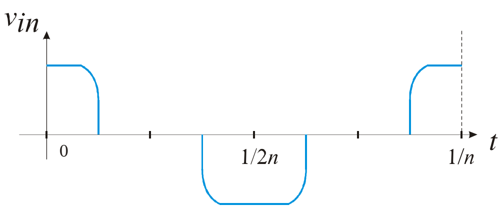


as

$v_{in} = Blu$

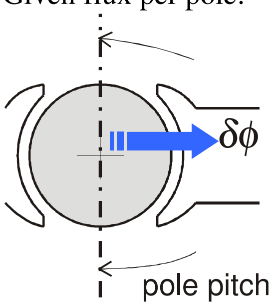
Speed of rotation is: $u = 2\pi Rn$

$v_{in} = (2\pi Rnl)B$



[4 marks]

Given flux per pole:



$\int \delta\phi = \phi$

Over one pole pitch:

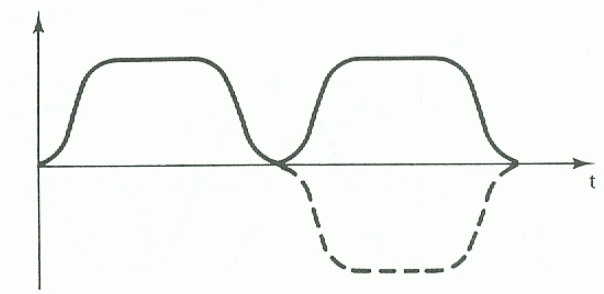
$$v_{in}\big|_{av} = \frac{\int_0^{\frac{T}{2}} Bludt}{\frac{T}{2}} = \frac{\int_0^{\frac{1}{2n}} Bludt}{\frac{1}{2n}} = \frac{\int d\phi}{\frac{1}{2n}} = 2n\phi$$

$$V_{in}\big|_{av} = \frac{\phi}{1/2np}$$

$$V_{in}\big|_{av} = 2np\phi$$

[4 marks]

For dc output through commutator:



$V_{av} = 2pn\phi Z_s$

In general, if there are Z conductors with c parallel paths, then

$$Z_s = \frac{Z}{c}$$

and

$$V = \frac{2pZ}{c} n\phi$$

For:

lap winding, c = 2p,
wave winding c = 2

[4 marks]

(b)

$p = 6$, $n = 3$ r/s, $N = 1200$, $A = 4$ cm^2, $B = 0.5$ T

(i)

$$V = \frac{2pZ}{c} n\phi = \frac{2pZ}{c} n[BA]$$

$$= \frac{2\times 6\times (2\times 1200)}{2\times 6}\times 3\times (0.5\times 4\times 10^{-4})$$

$$= \underline{\underline{1.44 \text{ V}}}$$

[2 + 4+ 2 marks]

(ii)

$$f = np$$

$$= 3\times 6 = \underline{\underline{18 \text{ Hz}}}$$

[2 + 3 marks]