Worked solutions – Tutorial sheet 3

(1)

12 Stator poles
8 rotor poles

15° mechanical step angle.

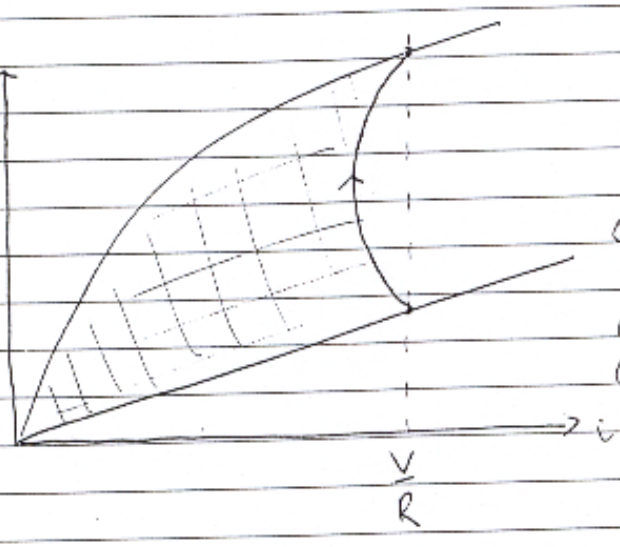
24 strokes per revolution.

Each phase has 8 strokes.

6000 rpm gives 48000 strokes/phase/M

Commutation frequency = 800 Hz.

(2)



Parameters which affect its shape.

(i) Variation of load torque with speed
(ii) Mechanical inertia
(iii) Inductance.

Explanation see notes

(3) Average torque at 8A $= \frac{0.798 - 0.112}{30 \times \frac{\pi}{180}} = 1.3\,\text{Nm}$.

↑ N-B reads

Average torque

(a) 3A.

$\int_0^{3A} \psi \, di$ graphically ≈ 0.020 WbA. in un-aligned

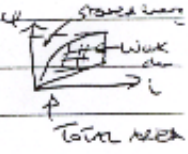
$\int_0^{3} \psi \, di$ graphically ≈ 0.212 WbA in aligned

$T_{AVE} = 0.367$ NM.

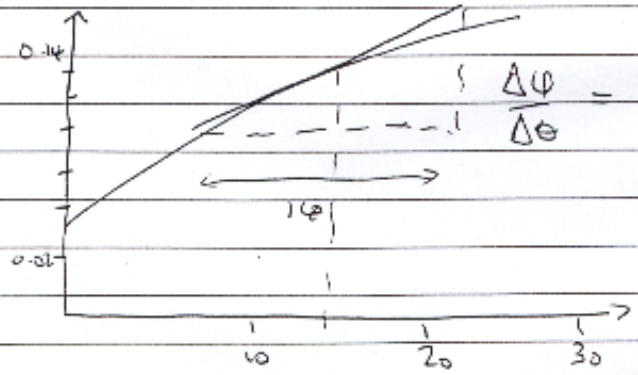
(c) T per amp^L higher because of sat.

(d) For 8A case: energy = 0.96J

For 3A case: energy = 0.34J



(e)



$\frac{\Delta\psi}{\Delta\theta} = \frac{0.056}{14 \times \frac{\pi}{180}} = 0.23$ Wb turns/rad

No. of rotor poles.

$e = 0.23 \cdot \frac{4500}{60} \times 2\pi \times \frac{4}{}$

$e = 433V$ at mid point at 4500 rpm

Assumptions

Eddy currents are negligible.

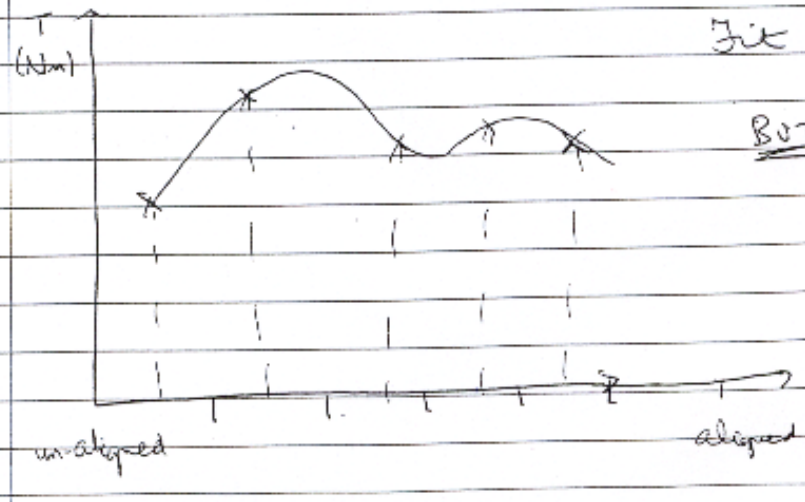
f). $V = IR + E$

$= 30 \times 10^{-3} \times 8 + 433$

$= 433.3\,A.$

g).

Interval	$\frac{\Delta W}{\Delta \theta}$
unaligned-5	1.19
5-4	1.61
4-3	1.64
3-2	1.41
2-1	1.48
1-aligned	1.13



Fit with smooth curve
BUT show points

h) Average o/p torque = 1.3 Nm

O/p power = $\frac{1.3 \times 5000 \times 2\pi}{60}$ = 680.7 W.

4) BOOKWORK