



SNS COLLEGE OF ENGINEERING

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AN AUTONOMOUS INSTITUTION



Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POWER SYSTEM ANALYSIS

UNIT - III

STEPPER MOTOR

The case of constant permeabilities.

L = Coil inductance
 ψ = flux linkages.

$$\psi = LI$$

The magnetic energy.

$$W_m = \frac{1}{2} LI^2 \quad (18)$$

emf induced in the coil

$$e = -\frac{\Delta\psi}{\Delta t}$$

$$= -\frac{\Delta(LI)}{\Delta t} \quad (19)$$

$$e = -I \frac{\Delta L}{\Delta t} \quad (20)$$

Work done ΔP_i

$$\Delta P_i = T |e| \Delta t$$

$$= T \left| -T \frac{\Delta L}{\Delta t} \right| \Delta t$$

$$= T^2 \Delta L \quad \text{--- (21)}$$

$$\Delta W_m = \frac{1}{2} \Delta P_i$$

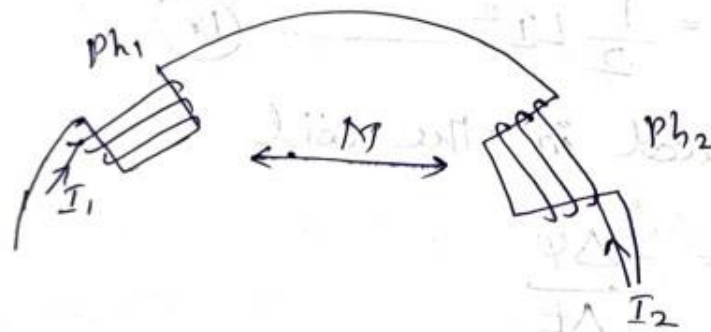
$$= \frac{1}{2} T^2 \Delta L \quad \text{--- (22)}$$

$$\Delta W_m = f \Delta x$$

$$f \Delta x = \frac{1}{2} T^2 \Delta L \quad \text{--- (23)}$$

$$\boxed{f = \frac{1}{2} T^2 \frac{\Delta L}{\Delta x}} \quad \text{--- (24)}$$

Effects of Mutual induction



The induced Voltages at each phase are

$$e_1 = -I_1 \frac{\Delta L_1}{\Delta t} - I_2 \frac{\Delta M}{\Delta t} \quad (25)$$

$$e_2 = -I_2 \frac{\Delta L_2}{\Delta t} - I_1 \frac{\Delta M}{\Delta t} \quad (26)$$

$e_1 =$ Induced Voltages of phase 1.

$e_2 =$ " " " " " " 2.

$L_1 =$ Inductance of phase 1.

$L_2 =$ " " " " " " 2.

M = Mutual inductance between the two phases.

$$\Delta P_i = (-e_1 I_1 + e_2 I_2) \Delta t$$

$$= I_1^2 \Delta L_1 + I_2^2 \Delta L_2 + 2 I_1 I_2 \Delta M \quad \text{--- (21)}$$

$$\Delta W_m = \frac{1}{2} (I_1^2 \Delta L_1 + I_2^2 \Delta L_2) + I_1 I_2 \Delta M$$

$$(\Delta W_m) \Delta \theta = T \Delta \theta$$

$$T \Delta \theta = \frac{1}{2} (I_1^2 \Delta L_1 + I_2^2 \Delta L_2) + I_1 I_2 \Delta M$$

$$T = \frac{1}{2} I_1^2 \frac{\partial L_1}{\partial \theta} + \frac{1}{2} I_2^2 \frac{\partial L_2}{\partial \theta} + I_1 I_2 \frac{\partial M}{\partial \theta} \quad \text{--- (22)}$$

