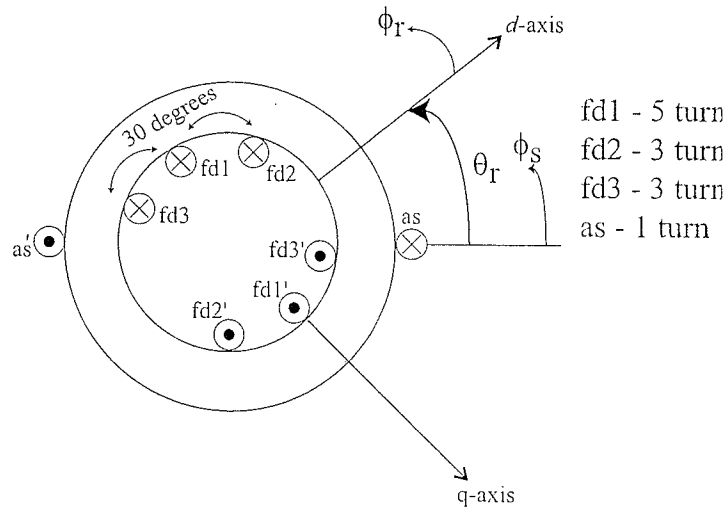
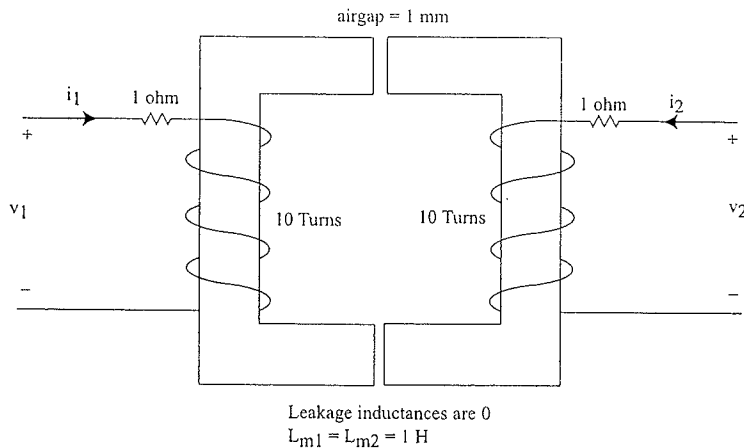


1) (30 pts) Given the stator and rotor coils of the machine shown below:



- Assuming 1A current in the winding, graph the MMF created in the airgap by the field winding (fd) of the machine versus ϕ_r .
 - Assuming 1A current in the winding, plot the MMF created in the airgap by the phase-a stator winding versus ϕ_s .
- 2) (40 pts) Given the transformer system shown below. At $t = 0$ s, an input voltage of $v_1 = 10$ v



is applied. The secondary is open-circuited. Under this condition $i_1 = 10(1 - e^{-t})$. At $t = 1$ s, the primary circuit is suddenly open circuited (i_1 goes from 6.32 A to 0 instantaneously). At the same instant the secondary is short-circuited. Determine piecewise expressions for W_E , W_f , W_{el} that are valid from $t \geq 0$. You may leave the expressions in integral form.

3) (30 pts) Given a system with the following dynamic equations

$$\dot{\mathbf{v}}_{12r} = \mathbf{r}'_r \mathbf{i}'_{12r} + p \dot{\lambda}'_{12r} \quad (1)$$

$$\dot{\lambda}'_{12r} = L_m \begin{bmatrix} \cos(\theta_r) & -\sin(\theta_r) \\ -\sin(\theta_r) & -\cos(\theta_r) \end{bmatrix} \mathbf{i}_{12s} \quad (2)$$

$$\mathbf{r}'_r = \begin{bmatrix} r'_r & 0 \\ 0 & r'_r \end{bmatrix}$$

Using the definitions

$$\begin{bmatrix} f_{qs}^s \\ f_{ds}^s \end{bmatrix} = \mathbf{K}_s^s \begin{bmatrix} f_{1s} \\ f_{2s} \end{bmatrix}, \quad \text{where } \mathbf{K}_s^s = (\mathbf{K}_s^s)^{-1} = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

$$\begin{bmatrix} f_{qr}^s \\ f_{dr}^s \end{bmatrix} = \mathbf{K}_r^s \begin{bmatrix} f'_{1r} \\ f'_{2r} \end{bmatrix}, \quad \text{where } \mathbf{K}_r^s = (\mathbf{K}_r^s)^{-1} = \begin{bmatrix} -\sin(\theta_r) & -\cos(\theta_r) \\ -\cos(\theta_r) & \sin(\theta_r) \end{bmatrix}, \quad \theta_r = \int_0^t \omega_r(\tau) d\tau + \theta_r(0)$$

Transform (1) and (2) into the stationary reference frame. Determine the frequency of the currents, voltages, flux linkages in this frame of reference (assuming balanced inputs and an input stator frequency of ω_e)