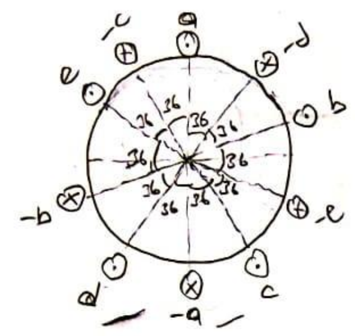
Ali AYDIN 2093326

EE462 HOMEWORK 2

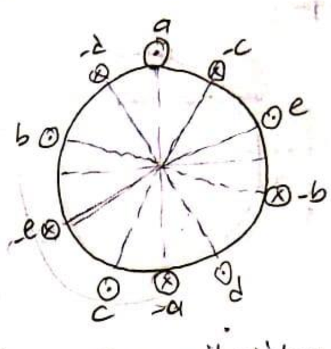
Q1-)

a)

Spatial phase shift $= \frac{2\pi}{5} = 72^{\circ}$



negative coil slides



positive coil slides

b)

$I_A = I_{max}\cos(w_e t)$

$I_B = I_{max}\cos(w_e t - \frac{2\pi}{5})$

$I_C = I_{max}\cos(w_e t - \frac{4\pi}{5})$

$I_D = I_{max}\cos(w_e t - \frac{6\pi}{5})$

$I_E = I_{max}\cos(w_e t - \frac{8\pi}{5})$

C)

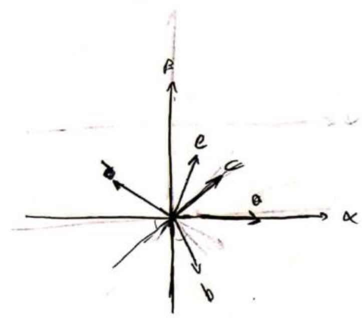
Phase A $\Rightarrow$	$A\cos(w_e t)\sin(\alpha)$	$A\cos(w_e t)\sin(\alpha)$
phase B $\Rightarrow$	$A\cos(w_e t - \frac{2\pi}{5})\sin(\alpha - \frac{2\pi}{5})$	$A\cos(w_e t + \frac{2\pi}{5})\sin(\alpha + \frac{2\pi}{5})$
phase C $\Rightarrow$	$A\cos(w_e t - \frac{4\pi}{5})\sin(\alpha - \frac{4\pi}{5})$	$A\cos(w_e t + \frac{4\pi}{5})\sin(\alpha + \frac{4\pi}{5})$
phase D $\Rightarrow$	$A\cos(w_e t - \frac{6\pi}{5})\sin(\alpha - \frac{6\pi}{5})$	$A\cos(w_e t + \frac{6\pi}{5})\sin(\alpha + \frac{6\pi}{5})$
phase E $\Rightarrow$	$A\cos(w_e t - \frac{8\pi}{5})\sin(\alpha - \frac{8\pi}{5})$	$A\cos(w_e t + \frac{8\pi}{5})\sin(\alpha + \frac{8\pi}{5})$
	positive MMF sequence	Negative MMF sequence

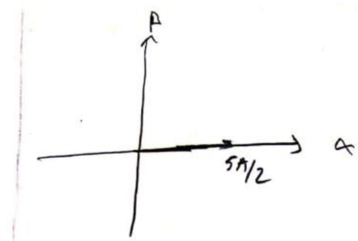
d) +

$= \frac{5A}{2}\sin(\alpha - w_e t)$ $\qquad$ $= \frac{5A}{2}\sin(\alpha + w_e t)$

When we change phase sequence, the direction of the rotating field changes.

e) Let's say $\alpha = 90°$





f)

f) The amplitude of the resultant vector is $\frac{5A}{2}$ and it is larger than three phase system.

Q2-)

$$V_\alpha = \frac{2}{3}\left(V_1 - \frac{V_2}{2} - \frac{V_3}{2}\right)$$

$$V_\beta = \frac{\sqrt{3}}{3}(V_2 - V_3)$$

$$i_\alpha = \frac{2}{3}(i_1 - \frac{i_2}{2} - \frac{i_3}{2})$$

$$i_\beta = \frac{\sqrt{3}}{3}(i_2 - i_3)$$

$$V_\alpha * i_\alpha = \frac{4}{9}(V_1 i_1 + \frac{V_2 i_2}{4} + \frac{V_3 i_3}{4} - \frac{V_2 i_1}{2} - \frac{V_3 i_1}{2} - \frac{V_1 i_2}{2} + \frac{V_3 i_2}{4} - \frac{V_1 i_3}{2} + \frac{V_2 i_3}{4})$$

$$V_\beta * i_\beta = \frac{4}{9}(\frac{3}{4}(V_2 i_2 + V_3 i_3 - V_3 i_2 - V_2 i_3))$$

$$\begin{aligned} P_{2-phase} &= V_\alpha i_\alpha + V_\beta i_\beta \\ &= \frac{4}{9}\Big(V_1 i_1 + \frac{V_2 i_2}{4} + \frac{V_3 i_3}{4} - \frac{V_2 i_1}{2} - \frac{V_3 i_1}{2} - \frac{V_1 i_2}{2} + \frac{V_3 i_2}{4} - \frac{V_1 i_3}{2} + \frac{V_2 i_3}{4} + \frac{3}{4}V_2 i_2 + \frac{3}{4}V_3 i_3 \\ &\quad - \frac{3}{4}V_3 i_2 - \frac{3}{4}V_2 i_3\Big) \\ &= V_1 i_1 + V_2 i_2 + V_3 i_3 - \frac{V_2 i_1}{2} - \frac{V_3 i_1}{2} - \frac{V_1 i_2}{2} - \frac{V_3 i_2}{2} - \frac{V_1 i_3}{2} - \frac{V_2 i_3}{2} \end{aligned}$$

We know that $V_1 + V_2 + V_3 = 0$ and $i_1 + i_2 + i_3 = 0$. When we multiply these equations

$$V_1 i_1 + V_2 i_2 + V_3 i_3 + V_2 i_1 + V_3 i_1 + V_1 i_2 + V_3 i_2 + V_1 i_3 + V_2 i_3 = 0$$

$$V_1 i_1 + V_2 i_2 + V_3 i_3 = -V_2 i_1 - V_3 i_1 - V_1 i_2 - V_3 i_2 - V_1 i_3 - V_2 i_3$$

Ali AYDIN 2093326

$$P_{2-phase} = \frac{4}{9}(V_1 i_1 + V_2 i_2 + V_3 i_3 + \frac{V_1 i_1 + V_2 i_2 + V_3 i_3}{2})$$

$$P_{2-phase} = \frac{4}{9} * \frac{3}{2} * P_{3-phase}$$

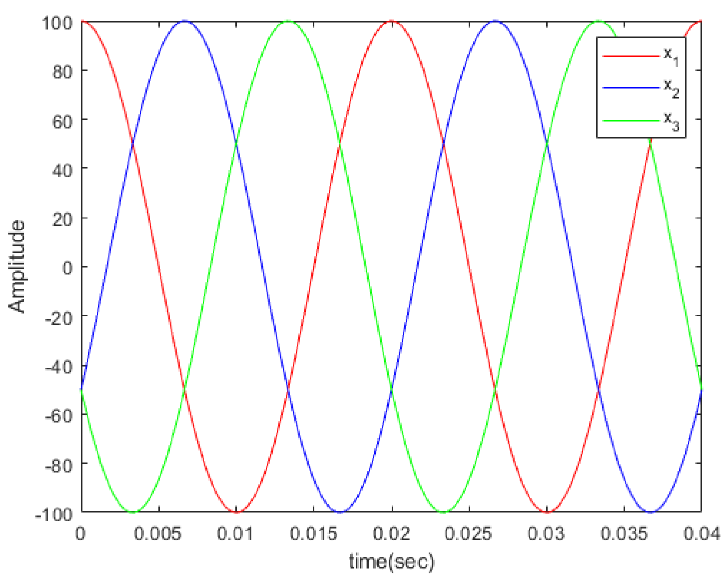
$$P_{2-phase} = \frac{2}{3} P_{3-phase}$$

Q3-)

```
t = 0:0.0001:0.04;
f = 50;
we = 2 * pi * 50;
x1 = 100 * cos(we * t);
x2 = 100 * cos(we * t - 2 * pi / 3);
x3 = 100 * cos(we * t + 2 * pi / 3);
```

part A

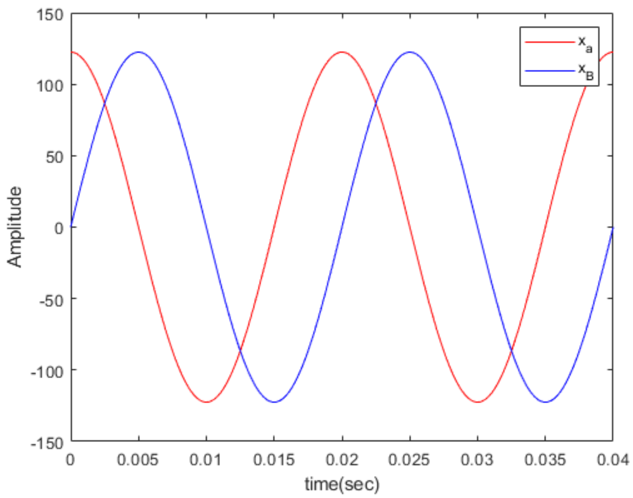
```
figure();
plot(t, x1, 'r');
hold on
plot(t, x2, 'b');
hold on
plot(t, x3, 'g');
legend x_1 x_2 x_3
hold on
xlabel("time(sec)");
ylabel("Amplitude");
```



Ali AYDIN 2093326

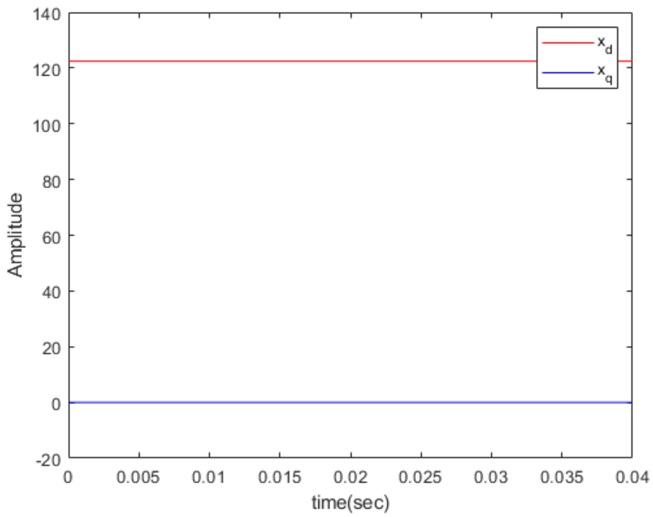
Part B

```
x_alfa = sqrt(2/3)*(x1 - x2 / 2 - x3 / 2);
x_beta = sqrt(2/3)*(sqrt(3)/2*(x2 - x3));
figure();
plot(t, x_alfa, 'r', t, x_beta, 'b');
legend x_a x_B
xlabel("time(sec)");
ylabel("Amplitude");
```



Part C

```
xd = x_alfa .* cos(we * t) + x_beta .* sin(we*t);
xq = -x_alfa .* sin(we * t) + x_beta .* cos(we*t);
figure();
plot(t, xd, 'r', t, xq, 'b');
legend x_d x_q
xlabel("time(sec)");
ylabel("Amplitude");
```



Part D

Instead of using three vector components, we can handle calculate with two vector components. This provides simplicity to control system.

Published with MATLAB® R2018a