# ELEMENTS OF ELECTRICAL ENGINEERING
# Course Code : UE25EE141A/B

PES UNIVERSITY

## FACULTY CONTRIBUTED:


Department of EEE, RR Campus

Prof . Jyothi T N
Prof. Vadhiraj K P P
Prof. Kruthika N
Prof. Suma S
Prof. Pushpa K R
Prof. Sangeeta Modi

Department of ECE, EC Campus

Prof. Lokesh L
Prof. Dhanashree G Bhate
Dr. Renuka R Kajur
Prof. Rajesh Chandrashekar
Prof. Sangam Kumar G H

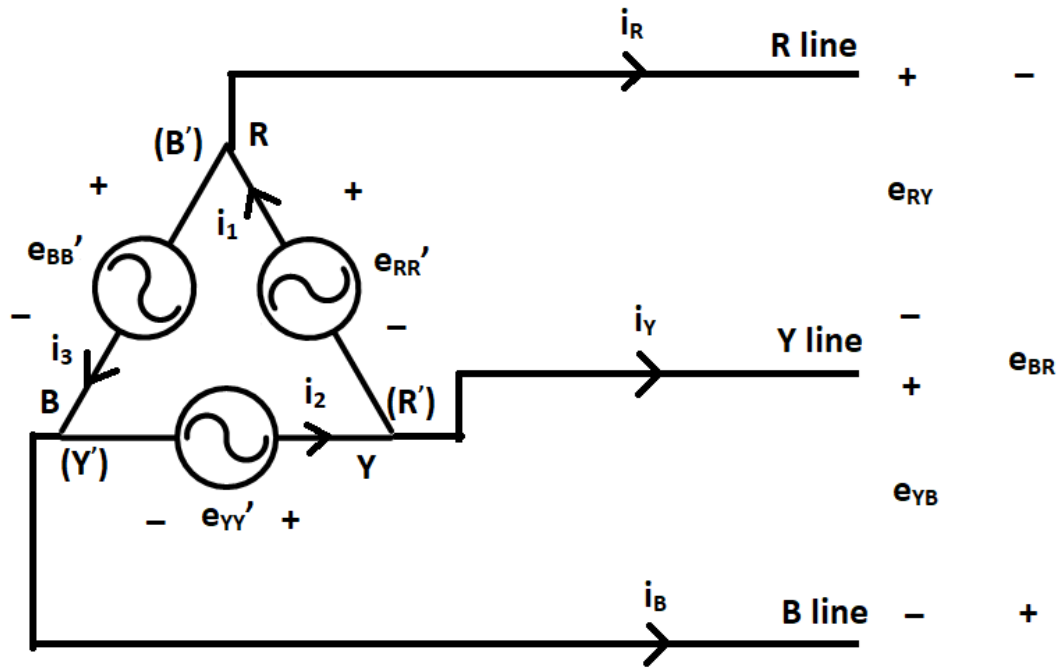
# ELEMENTS OF ELECTRICAL ENGINEERING

## Balanced Delta Connected Three Phase System; Voltage and Current Relations

**Jyothi T.N**
Department of Electrical & Electronics Engineering

# ELEMENTS OF ELECTRICAL ENGINEERING

## Balanced Delta (or) Mesh Connected Three Phase System

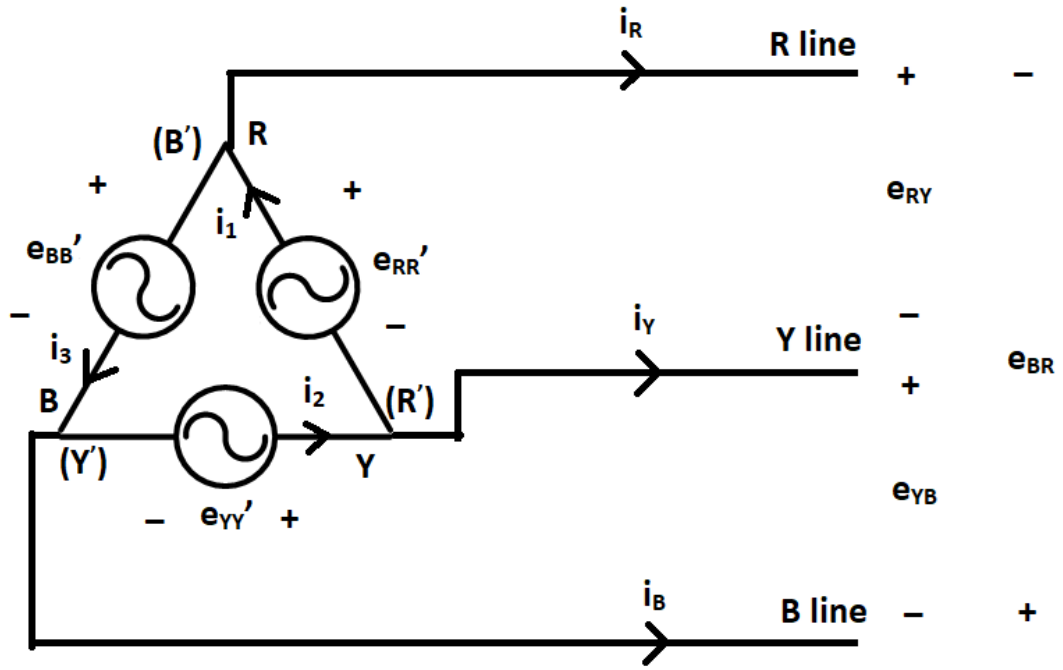



- Coil R, Coil Y and Coil B are connected end to end to form a delta connected three phase system.

- $e_{RR'}$ , $e_{YY'}$ & $e_{BB'}$ represent phase voltages.

# ELEMENTS OF ELECTRICAL ENGINEERING

## Balanced Delta (or) Mesh Connected Three Phase System




- $e_{RY}$ , $e_{YB}$ & $e_{BR}$ represent Line (or) Line to line voltages.
- $i_1$ , $i_2$ & $i_3$ represent phase currents.
- $i_R$ , $i_Y$ & $i_B$ represent line currents.

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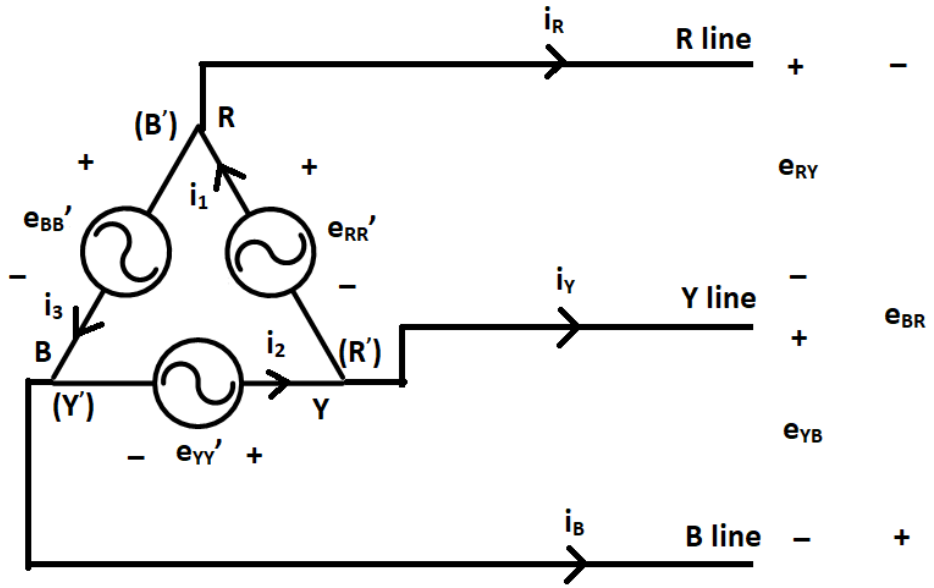
## Relation between Line & Phase voltages – Balanced Delta System

In a balanced delta connected three phase system,




Line voltage = Phase voltage

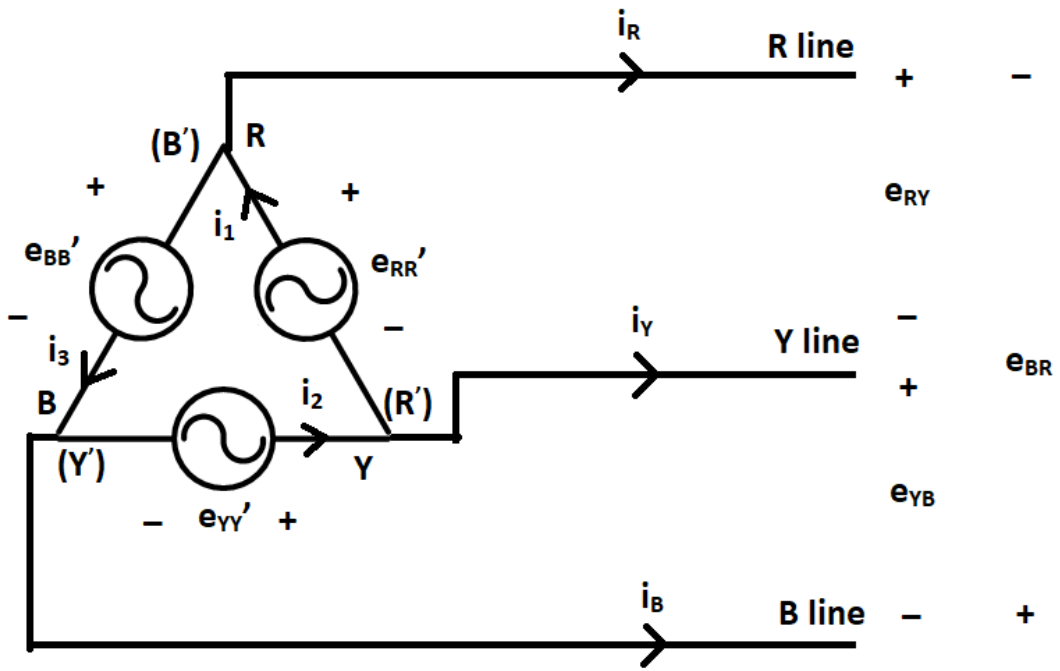
i.e., $e_{RY} = e_{RR'}$

$e_{YB} = e_{YY'}$

$e_{BR} = e_{BB'}$

# ELEMENTS OF ELECTRICAL ENGINEERING

## Relation between Line & Phase currents – Balanced Delta System




By KCL at R, $i_1 = i_R + i_3$

Hence, $i_R = i_1 - i_3$

## Relation between Line & Phase currents – Balanced Delta System

$$\overline{I_R} = \overline{I_1} - \overline{I_3}$$

$$\overline{I_1} = \frac{I_m}{\sqrt{2}} \angle 0^\circ = I_{ph} \angle 0^\circ$$

where, $I_{ph}$ is the RMS value of phase current.

$$\overline{I_2} = \frac{I_m}{\sqrt{2}} \angle -120^\circ = I_{ph} \angle -120^\circ$$

$$\overline{I_3} = \frac{I_m}{\sqrt{2}} \angle -240^\circ = I_{ph} \angle -240^\circ$$

$$\overline{I_R} = I_{ph} \angle 0^\circ - I_{ph} \angle -240^\circ$$

$$= I_{ph}(1 - (\cos 240^\circ - j \sin 240^\circ))$$

$$= I_{ph}(\frac{3}{2} - j\frac{\sqrt{3}}{2})$$

## Relation between Line & Phase currents – Balanced Delta System

$$= \sqrt{3} I_{ph} (\cos 30° - j \sin 30°)$$

$$= \sqrt{3} I_{ph} \angle -30°$$

$$\overline{I_Y} = \overline{I_2} - \overline{I_1} = \sqrt{3} I_{ph} \angle -150^\circ$$

$$\overline{I_B} = \overline{I_3} - \overline{I_2} = \sqrt{3} I_{ph} \angle -270^\circ$$

Thus, in a balanced delta connected three phase system,

(i) Magnitude (RMS value) of Line current = √3*(Magnitude of Phase current)

(ii) Each line current lags the corresponding phase current by 30°

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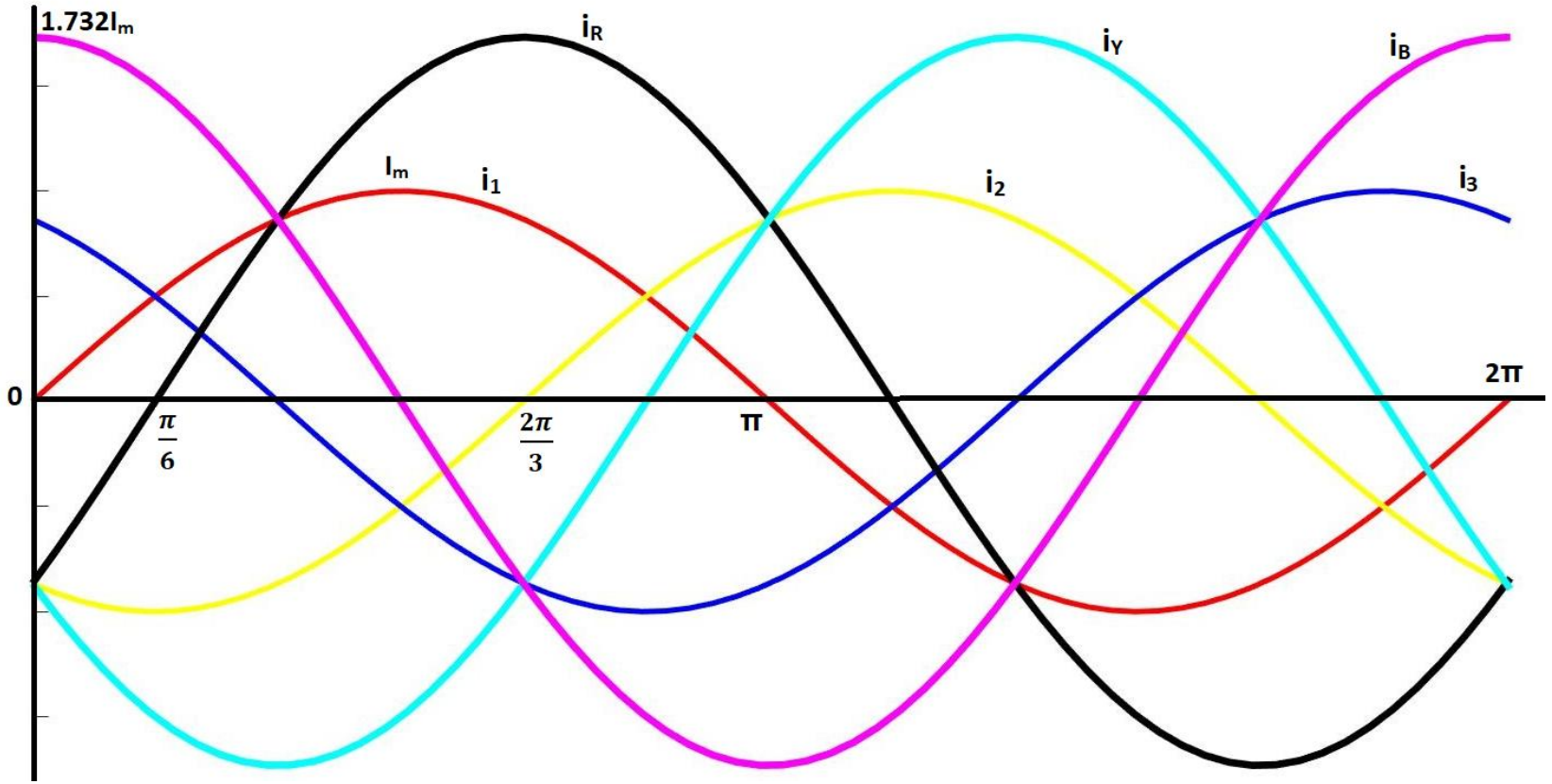
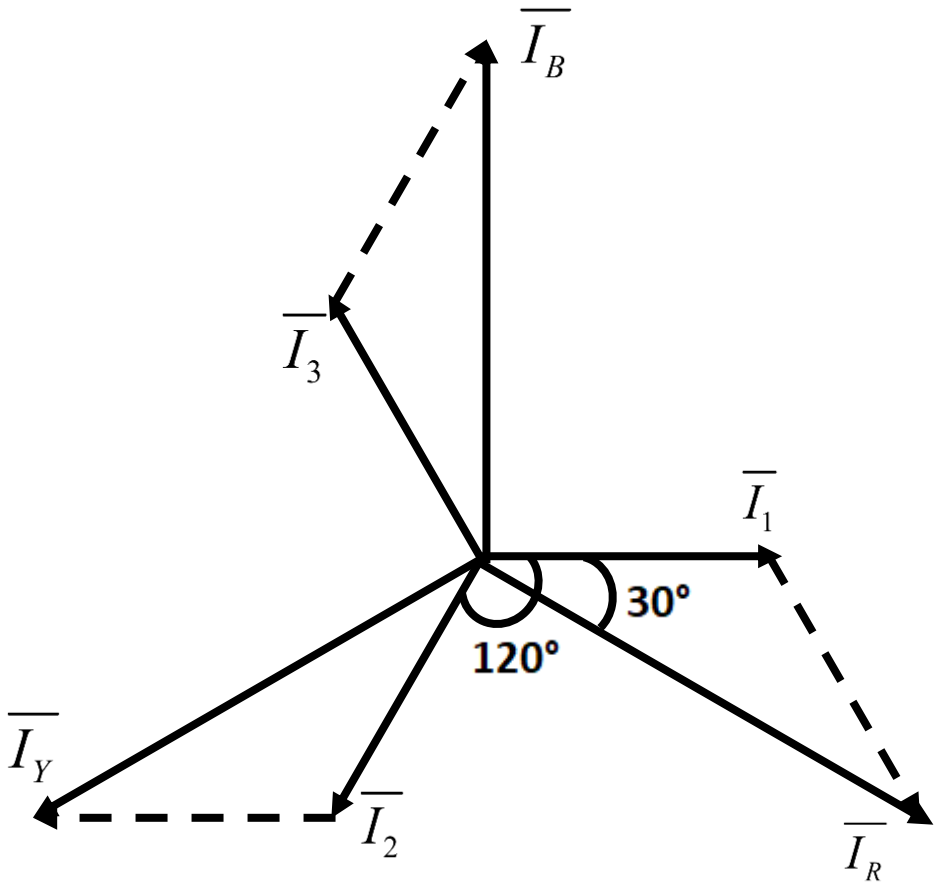
## Balanced Delta System – Line and Phase Current Waveforms



## Balanced Delta System – Phasor diagram




$$\overline{I_R} = \overline{I_1} - \overline{I_3}$$

## Balanced Delta System – Numerical

1) Three similar elements are connected in delta across 2000V, 50HZ three phase supply. Load has power factor of 0.5 . Current taken is 100A leading. Find the values of circuit parameters.

# ELEMENTS OF ELECTRICAL ENGINEERING

## Text Book & References

### Text Book:


1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014


### Reference Books:


1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023
2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.


# THANK YOU

**Jyothi T N**
Department of Electrical & Electronics Engineering

**jyothitn@pes.edu**