# SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

## COURSE NAME : 19EE401 SYNCHRONOUS AND INDUCTION MACHINES

II YEAR /IV SEMESTER

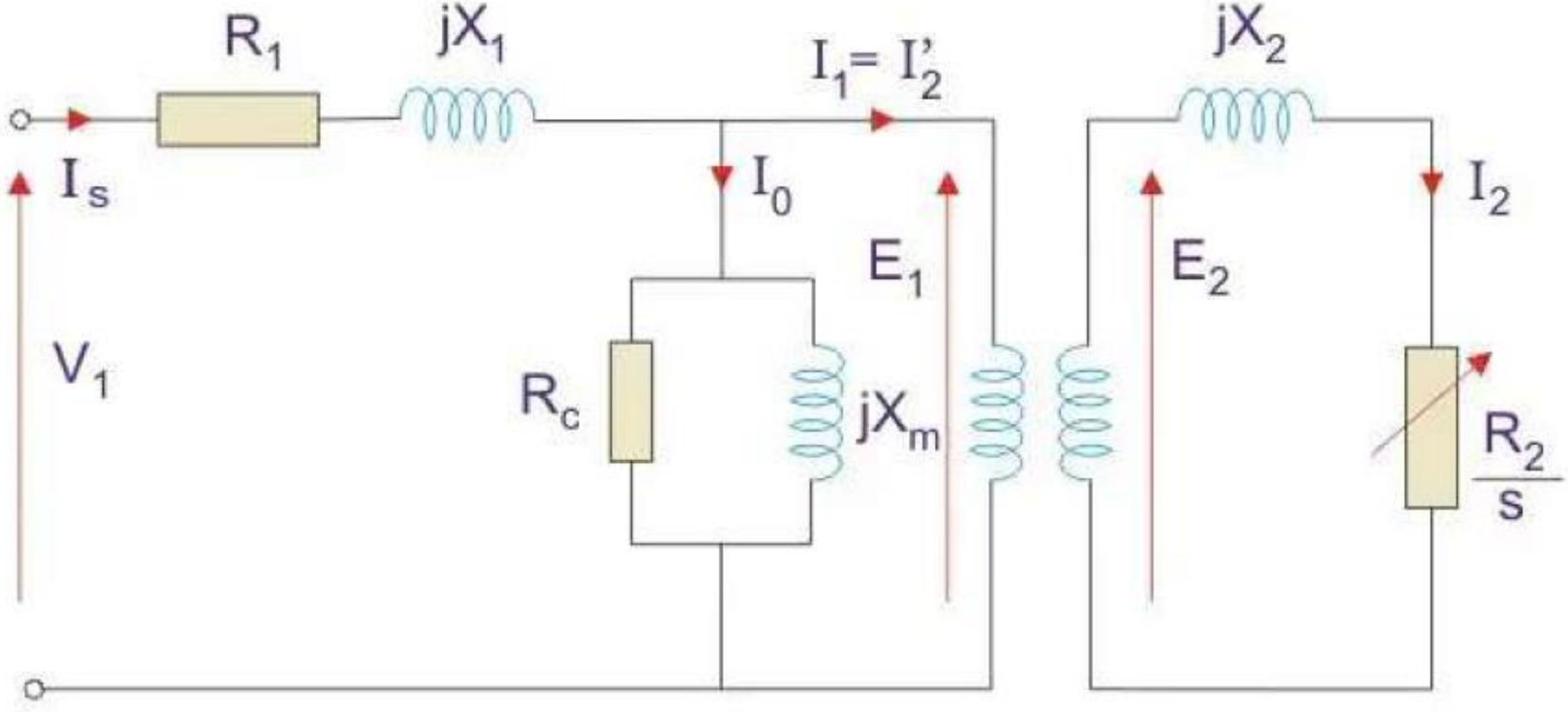
## Unit 3: INDUCTION MOTOR

Topic 5 : Equivalent Circuit of Three Phase Induction Motor

# Equivalent Circuit of Three Phase Induction Motor

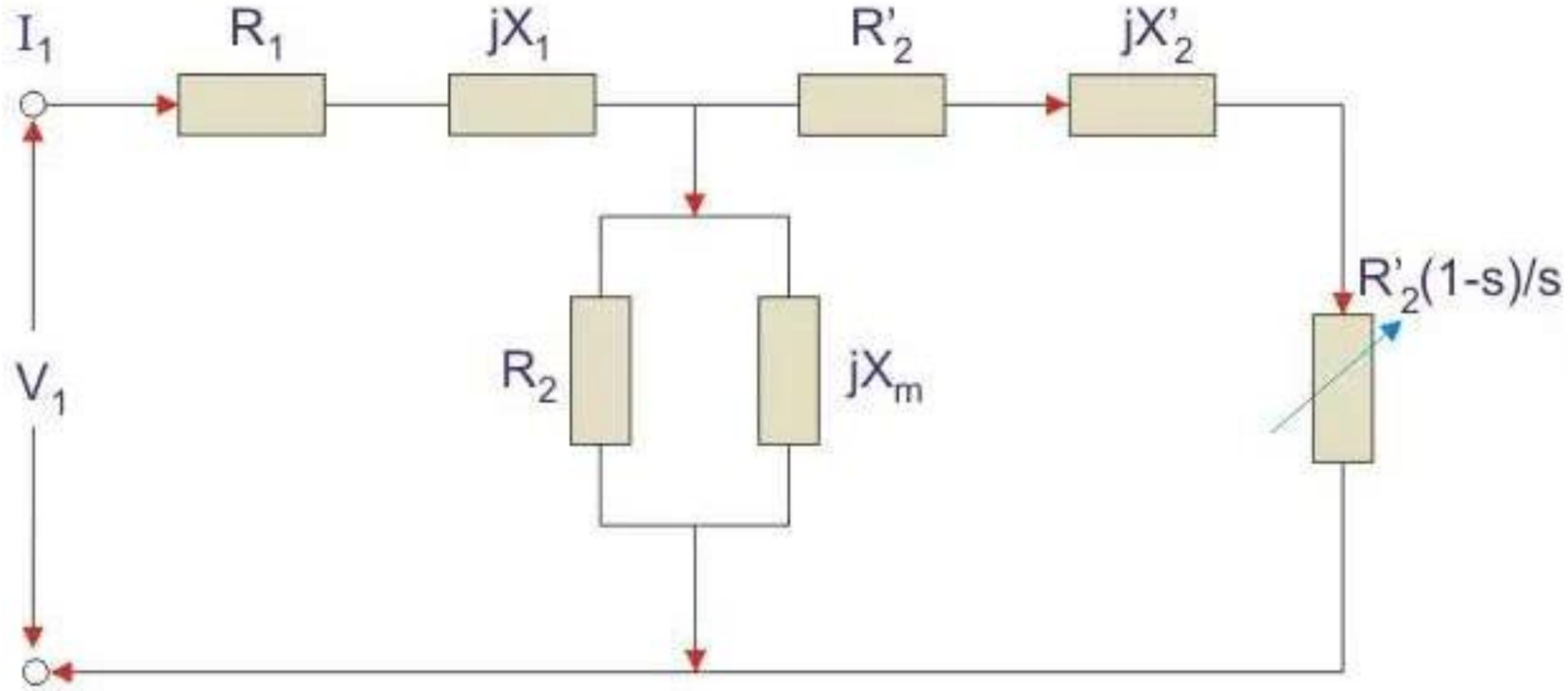
An induction motor is a well-known device which works on the principle of transformer. So it is also called the rotating transformer. That is, when an EMF is supplied to its stator, then as a result of electromagnetic induction, a voltage is induced in its rotor. So an induction motor is said to be a transformer with rotating secondary. Here, primary of transformer resembles stator winding of an induction motor and secondary resembles rotor.

# Equivalent Circuit of Three Phase Induction Motor



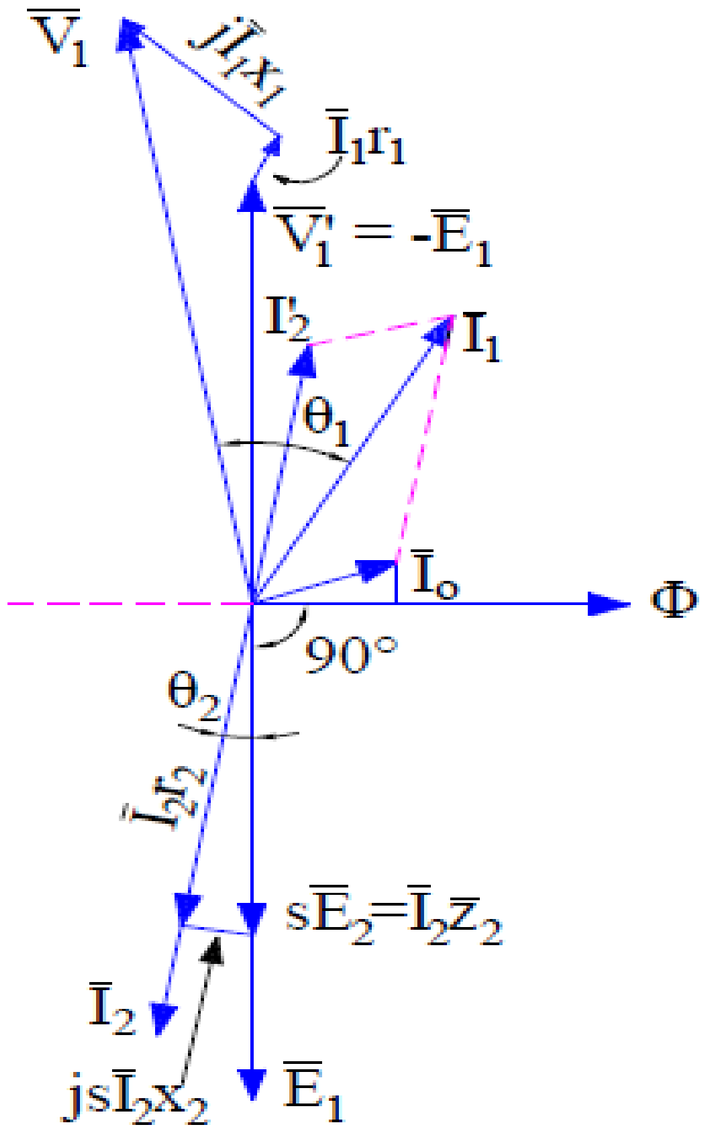

Here, $R_1$ is the winding resistance of the stator.
$X_1$ is the inductance of the stator winding.
$R_c$ is the core loss component.
$X_M$ is the magnetizing reactance of the winding.
$R_2/s$ is the power of the rotor, which includes output mechanical power and copper loss of rotor.

# Equivalent Circuit of Three Phase Induction Motor




$R_2'$ is the rotor winding resistance with referred to stator winding. $X_2'$ is the rotor winding inductance with referred to stator winding. $R_2(1 - s) / s$ is the resistance which shows the power which is converted to mechanical power output or useful power. The power dissipated in that resistor is the useful power output or shaft power.

# Three Phase Induction Motor on Load




$$V_1 = V_1' + I_1(r_1 + jx_1)$$

$$E_2 = I_2\,(r_2 + jx_2)$$

# Power Relation of Equivalent Circuit of Three Phase Induction Motor

- Input power to stator $P_1 = 3\ V_1 I_1 \cos(\theta)$

  Where, $V_1$ is the stator voltage applied, $I_1$ is the current drawn by the stator winding. $\cos(\theta)$ is the stator power stator.

- Rotor input =Power input - Stator copper and iron losses.
- Rotor Copper loss = Slip × power input to the rotor.
- Developed Power = (1 – s) × Rotor input power.

# References


1.Kothari, D.P., Nagrath, I.J., “Electric Machines”, McGraw Hill Publishing Company Ltd, 5th Edition, 2017.

2. Murugesh Kumar, K., “Induction and Synchronous machines”, Vikas Publishing House Private Ltd, 2016.


## Thank You