# SNS COLLEGE OF TECHNOLOGY

**(An Autonomous Institution)**

**COIMBATORE-35**

**Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade**
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## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

## COURSE NAME: 24EET204/ ELECTRICAL MACHINES II

II YEAR / IV SEMESTER

Unit 3 – THREE PHASE INDUCTION MOTOR

Topic 1: Torque Slip Characteristics

# Torque Slip Characteristics

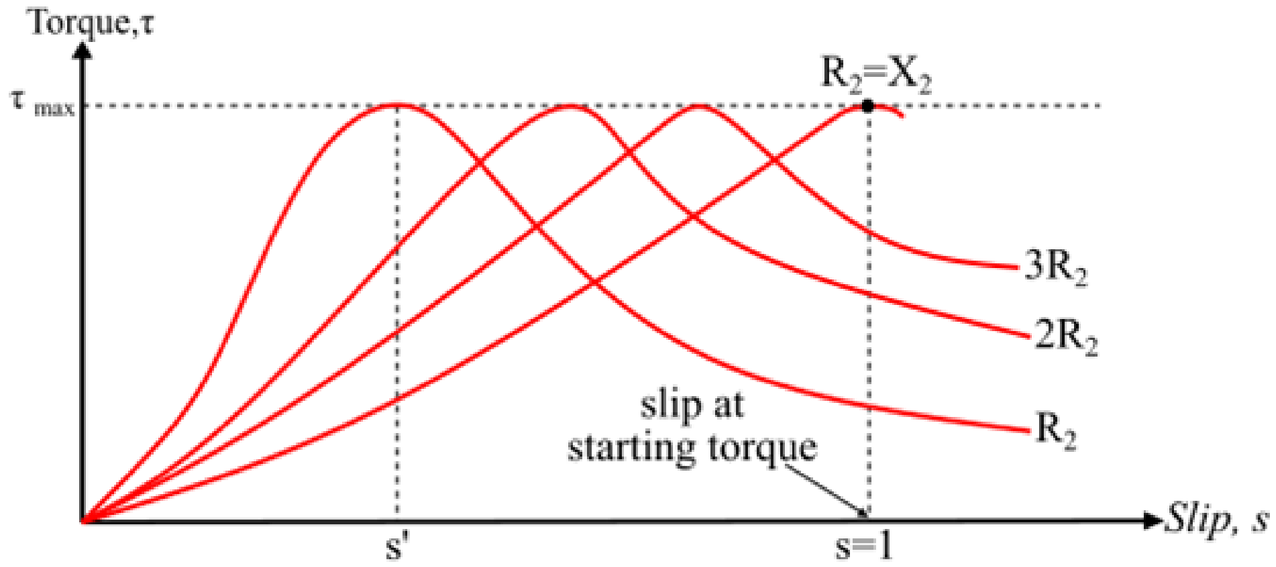
The graph plotted between the torque and slip for a particular value of rotor resistance and reactance is known as **torque-slip characteristics** of the **induction motor**.
The torque of a 3-phase induction motor under running conditions is given by,

$$Tr = KsE_2^2R_2/R2^2+(sX_2)^2 \ldots(1)$$

From the eqn. (1), it can be seen that if $R_2$ and $X_2$ are kept constant, the torque depends upon the slip 's'. The torque-slip characteristics curve can be divided into three regions, viz.

- Low-slip region
- Medium-slip region
- High-slip region

# INDUCTION MOTOR-TORQUE EQUATION




# TORQUE EQUATION

Low-Slip Region

At synchronous speed, the slip s = 0, thus, the torque is 0. When the speed is very near to the synchronous speed, the slip is very low and the term $(sX_2)^2$ is negligible in comparison with $R_2$. Therefore,

$Tr \propto sR_2$

If $R_2$ is constant, then $Tr \propto s$…(2)

Eqn. (2) shows that the torque is proportional to the slip. Hence, when the slip is small, **the torque-slip curve is straight line**.

**Medium-Slip Region**

When the slip increases, the term $(sX_2)^2$ becomes large so that $R_2^2$ may be neglected in comparison with $(sX_2)^2$. Therefore,

$Tr \propto s / (sX_2)^2 = 1/sX_2^2$

If $X_2$ is constant, then

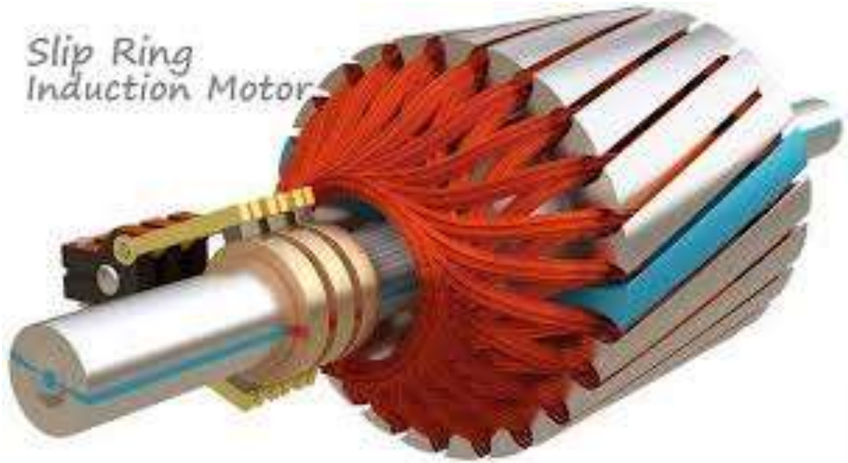
$Tr \propto 1s$…(3)

Thus, the torque is inversely proportional to slip towards standstill conditions. Hence, for intermediate values of the slip, the torque-slip characteristics is represented by a **rectangular hyperbola**. The curve passes through the point of **maximum torque** when $R_2 = sX_2$.

The maximum torque developed by an induction motor is known as **pull-out torque** or **breakdown torque**. This breakdown torque is a measure of the short time overloading capability of the motor.

High-Slip Region

The torque decreases beyond the point of maximum torque. As a result of this, the motor slows down and eventually stops. The induction motor operates for the values of slip between s = 0 and s = $s_m$, where sm is the value of slip corresponding to maximum torque. For a typical 3-phase induction motor, the breakdown torque is 2 to 3 times of the full-load torque. Therefore, the motor can handle overloading for a short period of time without stalling.



KEEP
LEARNING..

# Thank u

SEE YOU IN NEXT CLASS