Electrical Machine- II

UNIT – II
Induction Generator

Lokesh Varshney,
GalgotiasUniversity, Greater
Noida

Source & References:

The materials presented in this lecture has been taken from internet sites and books. This can be used only for academic purpose only.

INDUCTION GENERATOR

An induction machine will behave as an induction generator when:

- Slip becomes negative due to this the rotor current and rotor emf attains negative value.
- The prime mover torque becomes opposite to electric torque.

To build up voltage across the generator terminals, excitations must be provided by some means; therefore, the induction generator can work in two modes (i.e., grid connected and isolated mode). In case of a grid-connected mode, the induction generator will draw reactive power either from the grid and it will place a burden on the grid or by connecting a capacitor bank across the generator terminals. For an isolated mode, there must be a suitable capacitor bank connected across the generator terminals. This phenomenon is known as capacitor self-excitation and the induction generator is called a 'SEIG'.

Types of Induction Generator

- Grid Connected Induction Generator
- Self Excited Induction Generator

Grid Connected Induction Generator

All the conditions that mentioned in previous will become fulfilled and the machine will behave like an induction generator. Now if the speed of the prime mover is further increased such that it exceeds the negative maximum value of the torque produced then the generating efficiency of the generator vanishes. Clearly, the speed of the induction generator during the whole operation is not synchronous, therefore the induction generator is also called asynchronous generator.

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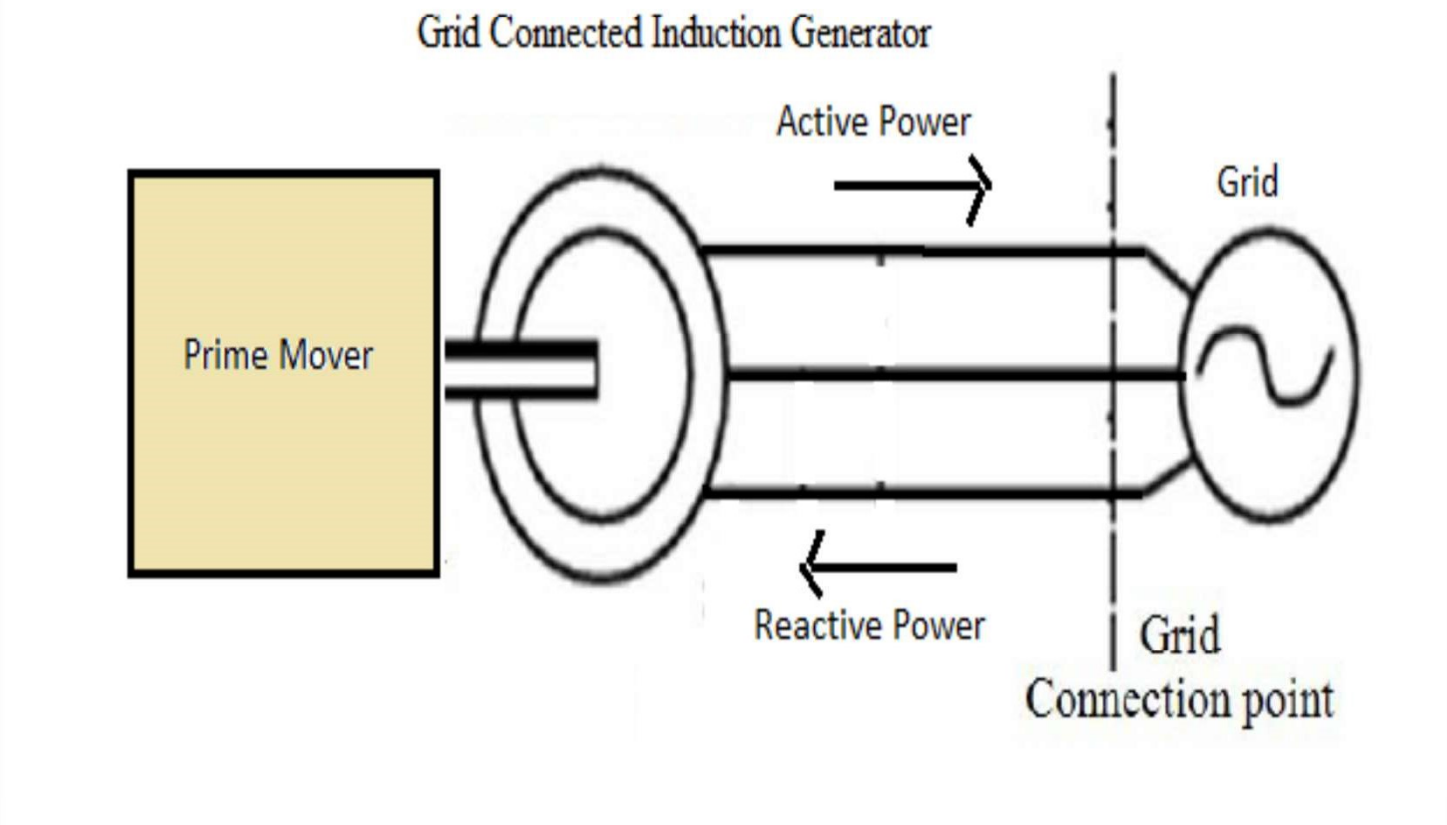
Connection of Grid connected Induction Generator

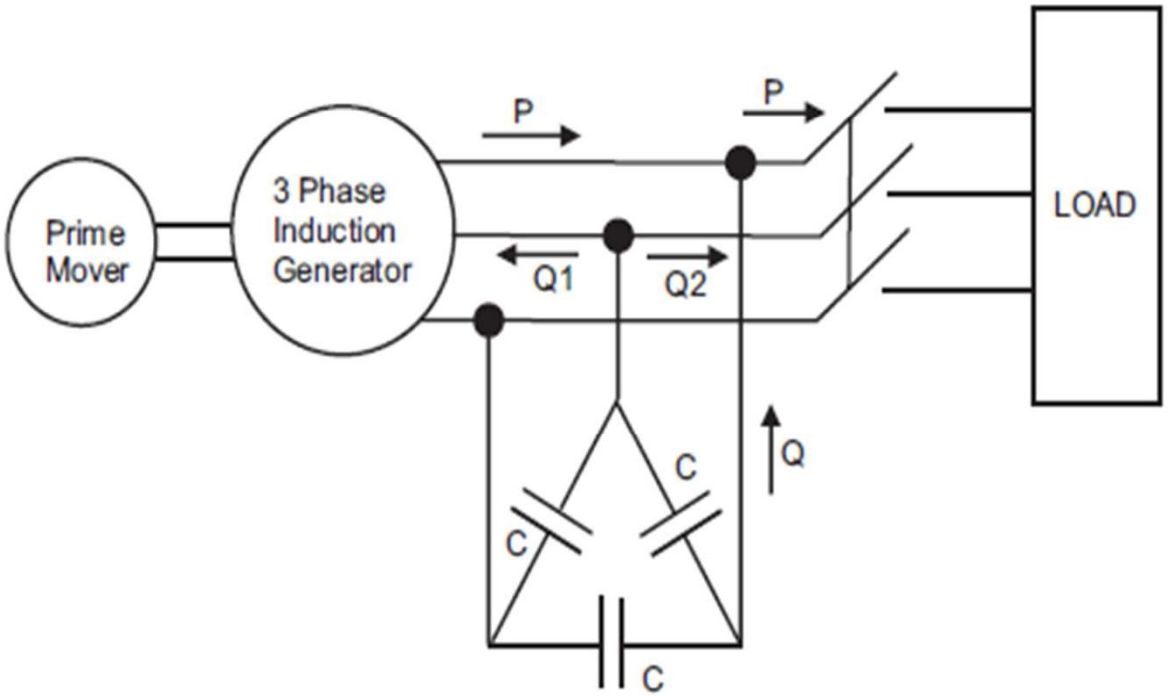


An induction generator is not a self-excited machine. Therefore in order to develop the RMF, it requires magnetizing current and reactive power. The induction generator obtains its magnetizing current and reactive power from the various sources like the supply mains or it may be another synchronous generator.

Self Excited Induction Generator

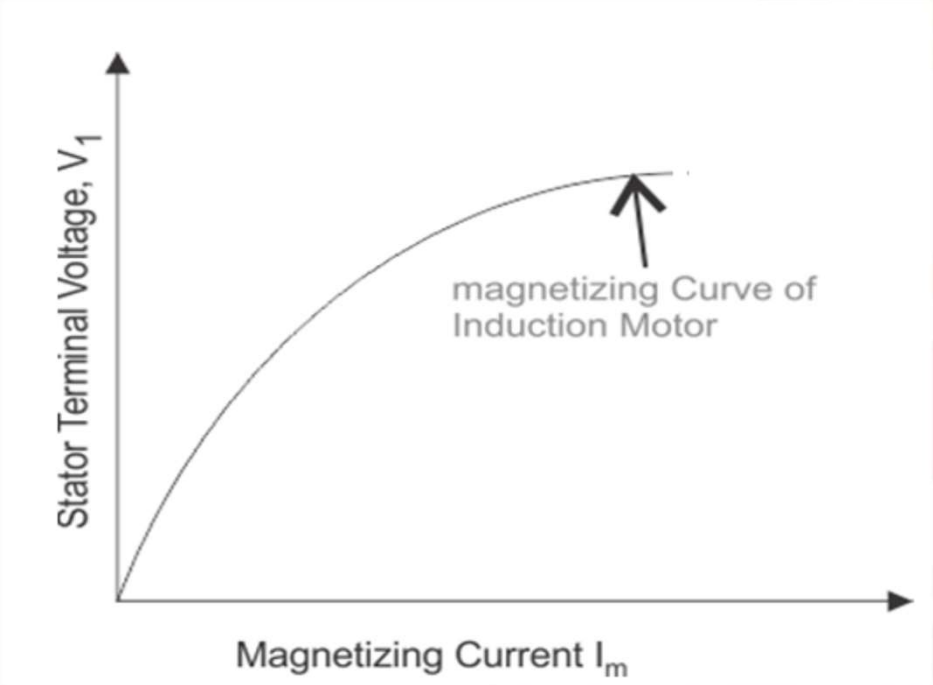
An induction generator can't work in isolation because it continuously requires reactive power from the supply system. However, we can have a self-excited or isolated induction generation if we use a capacitor bank for reactive power supply instead of an AC supply system (a feature of the best portable generators). Now discuss isolated induction generators in detail.

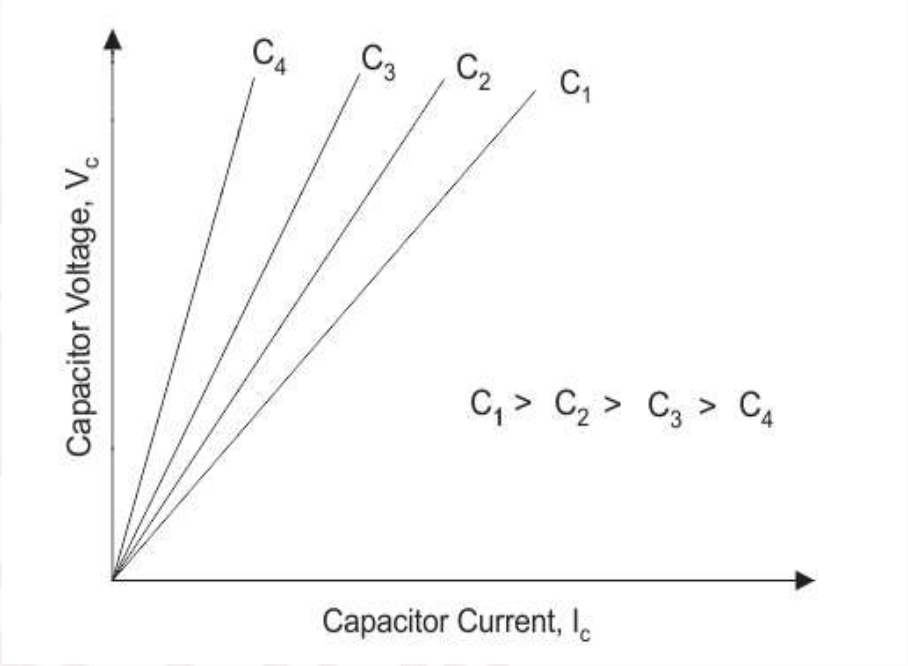
This type of generator is also known as a self excited generator. Now why it is called self-excited? It is because it uses a capacitor bank which is connected across its stator terminals as shown in the diagram given below.


Prime Mover
3 Phase Induction Generator
P
P
LOAD
Q1
Q2
Q
C
C
C

The function of the capacitor bank is to provide the lagging reactive power to the induction generator as well as load. So mathematically we can write total reactive power provided by the Capacitor Bank is equals to the summation of the reactive power consumed by the induction generator as well as the load.

There is generation of small terminal voltage across the stator terminal due the residual magnetism when the rotor of the induction machine runs at the required speed. Due to this voltage, the capacitor current is produced. The current sends current which generates the voltage.


Stator Terminal Voltage, V_1
magnetizing Curve of
Induction Motor
Magnetizing Current I_m


C_4
C_3
C_2
C_1
Capacitor Voltage, V_c
$C_1 > C_2 > C_3 > C_4$
Capacitor Current, I_c

VOLTAGE BUILDUP IN SEIG

The process of voltage build-up in an induction generator is very much similar to that of a dc generator. There must be a suitable value of residual magnetism present in the rotor. In the absence of a proper value of residual magnetism, the voltage will not build up. So it is desirable to maintain a high level of residual magnetism, as it does ease the process of machine excitation. When an induction generator first starts to run, the residual magnetism in the rotor circuit produces a small voltage. This small voltage produces a capacitor current flow, which increases the voltage and so forth until the voltage is fully built up. The no-load terminal voltage of the induction generator is the intersection of the generator's magnetization curve with capacitor load line. The magnetization curve of the induction generator can be obtained by running the machine as a motor at no load and measuring the armature current as a function of terminal voltage. To achieve a given voltage level in an induction generator