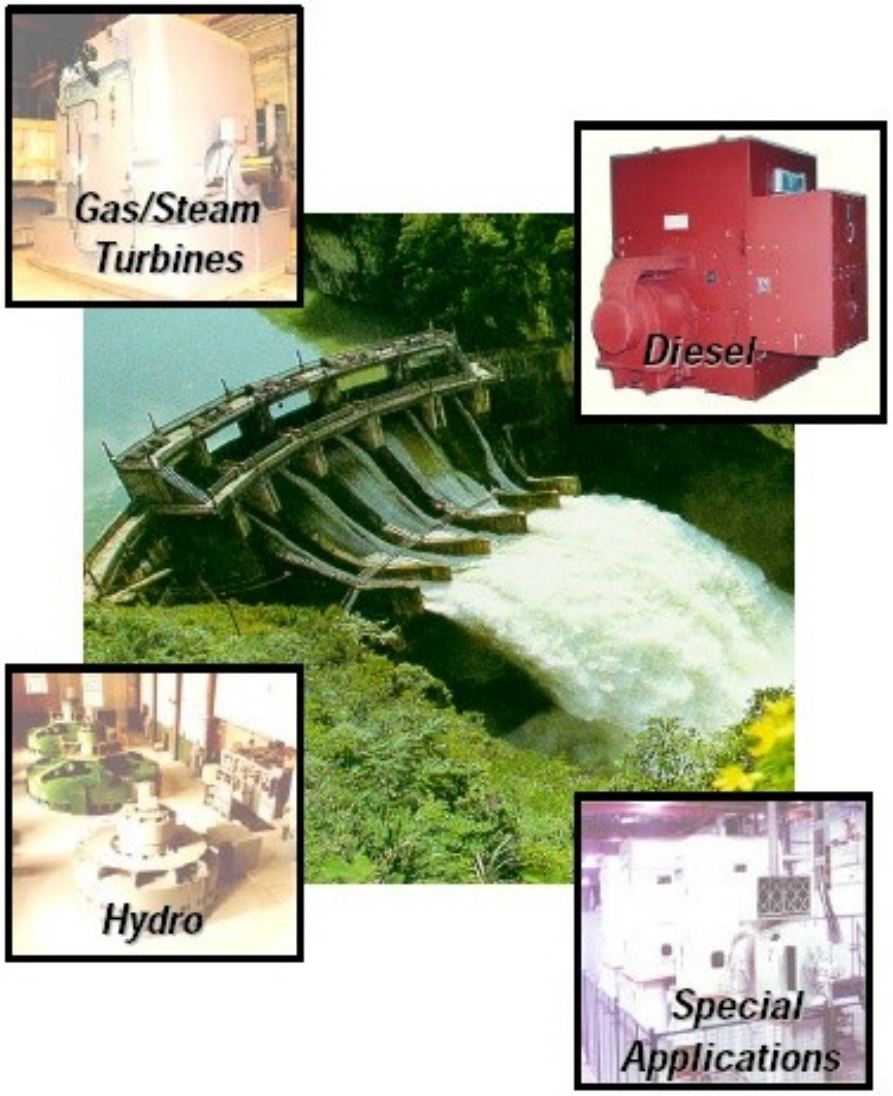
Synchronous Machines



LECTURE 1

AC Machines

- **Generator** → P_{mech} to → P_{elec}
- **Motor** → P_{elec} to → P_{mech}

- **A.C machines** →
  - Synchronous machines
  - Induction machines

Synchronous Machines

- *Synchronous generators* or *alternators* are used to convert mechanical power derived from steam, gas, or hydraulic-turbine to ac electric power
- Synchronous generators are the primary source of electrical energy we consume today
- Large ac power networks rely almost exclusively on synchronous generators
- *Synchronous motors* are built in large units compare to induction motors (Induction motors are cheaper for smaller ratings) and used for constant speed industrial drives

Construction

- **Basic parts of a synchronous generator:**

- **Rotor - dc excited winding**
- **Stator - 3-phase winding in which the ac emf is generated**

- **The manner in which the active parts of a synchronous machine are cooled determines its overall physical size and structure**

Types of Synchronous Machine

According to the arrangement of the field and armature windings, synchronous machines may be classified as *rotating-armature type* or *rotating-field type*.

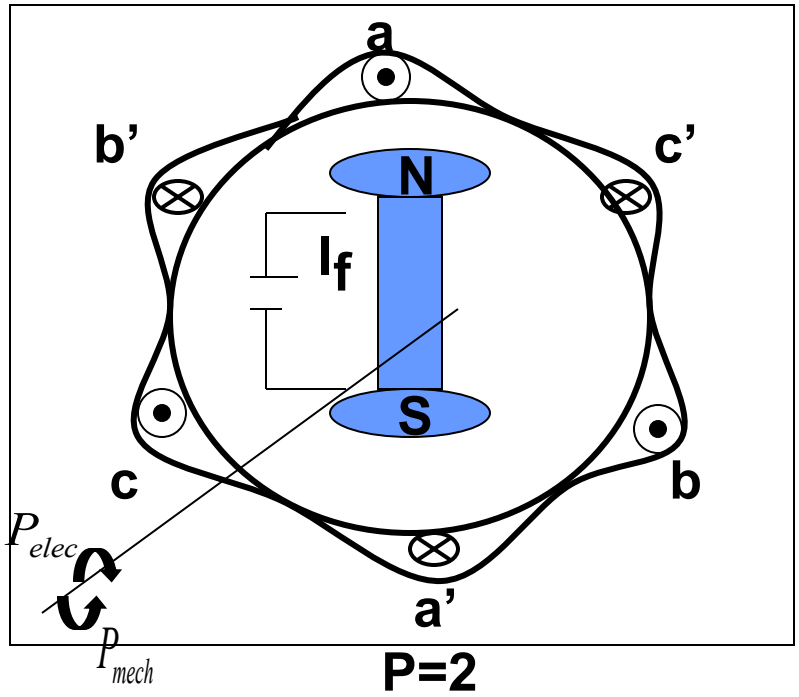
Rotating-Armature Type

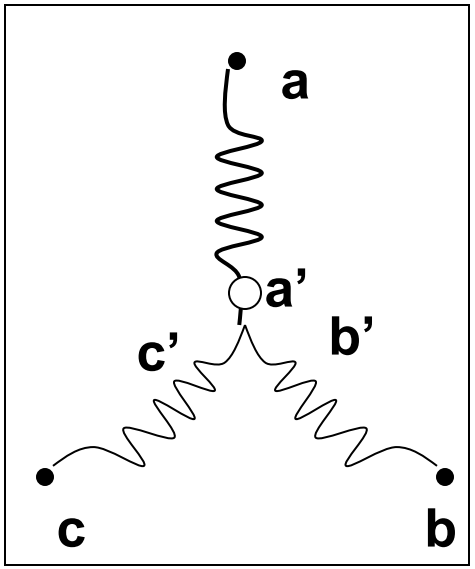
The armature winding is on the rotor and the field system is on the stator. The generated current is brought out to the load via three (or four) slip-rings. Insulation problems, and the difficulty involved in transmitting large currents via the brushes, limit the maximum power output and the generated electromagnetic field (emf). This type is only used in small units, and its main application is as the main exciter in large alternators with brushless excitation systems.

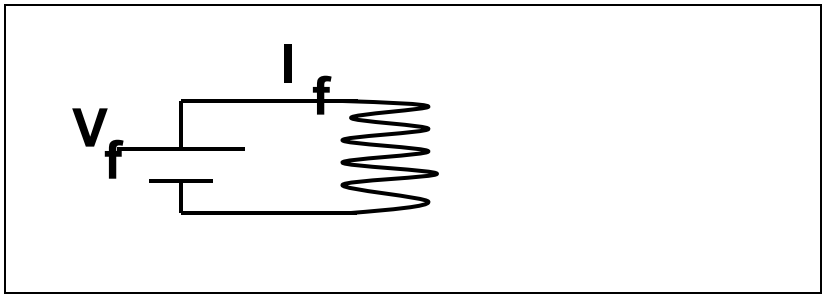
Rotating field type

The armature winding is on the stator and the field system is on the rotor. Field current is supplied from the exciter via two slip-rings, while the armature current is directly supplied to the load. This type is employed universally since very high power can be delivered. Unless otherwise stated, the subsequent discussion refers specifically to rotating-field type synchronous machines

Sychronous Machines







- Armature windings are located on the stator
- Field windings are located on the rotor

Fig. 1