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"*Reluctance and Universal Motor*"

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- The aim of this experiment was to study the operation and characteristics of Universal, and Reluctance identify their problems, controlling their speed, and observing and studying their speed-torque characteristics, efficiency and speed regulation of each motor.
- **Universal Motors** are type of Motors that can work both on AC and DC power source which makes them very suitable for specific types of applications such as, vacuum cleaners, portable drills, and blenders. They are basically a series-wound DC Motors, but with Entirely Laminated Magnet Circuits.
- A **reluctance motor** is a type of electric motor that induces non-permanent magnetic poles on the ferromagnetic rotor. The rotor does not have any windings. Torque is generated through the phenomenon of magnetic reluctance. Reluctance motors can deliver very high power density at low cost, making them ideal for many applications. Disadvantages are high torque ripple (the difference between maximum and minimum torque during one revolution) when operated at low speed, and noise caused by torque ripple
- The speed regulation of the motor at low load torques is almost zero but as soon it gets above rated speed the speed is sharply drooping, the input power is almost constant before reaching loaded torque but as soon it gets higher than 1pu load torque, it starts to increase, and draws more current to produce more torque, same thing goes with output power, motor's efficiency is designed to be at maximum at rated load any further decrease or increase in the load causes the efficiency to decrease.
- In Universal Motors, the field and armature are connected in series, which means to make the motor rotate, the torque action of magnetic field at rotor and stator has to be in the same direction, if the motor was connected, from a DC Source, the commutator has to reverse the current direction so that the torque action and current direction in both field and armature are always the same!
- The performance of a synchronous reluctance motor (SynRM) depends on the direct-axis inductance (Ld) and the quadrature-axis inductance (Lq) of the machine. Increasing the saliency ratio $\frac{Ld}{Lq}$ and making the difference between these inductances (Ld-Lq) large are

well known methods for achieving high torque density and power factor.

- Because of the absence of excitation, all magnetizing current is supplied from armature. Therefore these are operating at low PF in typical range of 0.65-0.75.

- The motor runs at synchronous speed at all loads, due to the magnetic locking between opposite poles on rotor and armature
- The aim of this experiment was achieved successfully, we were able to obtain and observe how the characteristics of the motor change on different conditions, the Reluctance Motor. We can conclude that Synchronous Reluctance Motor, despite having low PF, their cost, operating speed, and high efficiency can make them way better than other motors in specific applications. For example if we need low cost motors to run in parallel in synchronism, Reluctance Motor is the way to go!
- Universal Motor, had the ability to operate on AC and DC. However, the series and field windings are connected in series so its speed cannot be controlled by adding resistors, so it’s harder to control in such case where we have no variable voltage power supply. However, the voltage on its terminals can be easily controlled by a DC Chopper, like Buck-Boost DC/DC Converters, or using AC/AC Choppers/Converters which will vary the average RMS input voltage of the motor.
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