2.2 The Universal relay:

- Universal **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays.
- Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit.
- Relays were used extensively in telephone exchanges and early computers to perform logical operations.
- A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor.
- Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".
- Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back.
- Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.
- Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed.
- On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

- The Universal Torque Equation is a equation which governs the application of all types of relays. The equation has variables and constants which can be ignored for specific functions.

- This equation can be used to describe the operation of any Electrical Relay by changing the signs of some of the terms or ignoring them entirely.

$$T = K_1 I^2 + K_2 V^2 + K_3 VI\cos(\theta - \tau) + K$$

- For example, to describe the over current relay, K2 and K3 can be considered zero while K will be negative as it is used to describe the restraining torque. The Equation will then become

$$T = KI^2 - K$$

- In the case of a directional power relay, K1 and K2 can be considered to be zero while K can be considered to be negative.