Experiment 6: Observing of BJT as a switch.

Theory: A transistor can be used for switching operation for opening or closing of a circuit. This type solid state switching offers significant reliability and lower cost when compared to conventional relays.

Both NPN and PNP transistors can be used as switches. Some of the applications use a power transistor as switching device, at that time it may necessary to use another signal level transistor to drive the high-power transistor.

NPN Transistor as a Switch

Based on the voltage applied at the base terminal of a transistor switching operation is performed. When a sufficient voltage ($V_{IN} > 0.7$ V) is applied between the base and emitter, collector to emitter voltage is approximately equal to 0. Therefore, the transistor acts as a short circuit. The collector current V_{CC} / R_C flows through the transistor.

Similarly, when no voltage or zero voltage is applied at the input, transistor operates in cutoff region and acts as an open circuit. In this type of switching connection, load (here an LED is used as a load) is connected to the switching output with a reference point. Thus, when the transistor is switched ON, current will flow from source to ground through the load.

PNP Transistor as a Switch

PNP transistor works same as NPN for a switching operation, but the current flows from the base. This type of switching is used for negative ground configurations. For the PNP transistor, the base terminal is always negatively biased with respect to the emitter.

In this switching, base current flows when the base voltage is more negative. Simply, a low voltage or more negative voltage makes the transistor to short circuit otherwise, it will be open circuit.

In this connection, load is connected to the transistor switching output with a reference point. When the transistor is turned ON, current flows from the source through transistor to the load and finally to the ground.

Equipment and Software Requirements:

- Proteus simulation software
o   NPN transistor
o   Resistor (10k, 300)
o   Power
o   Logic probe (Togglelogic)
o   LED
- Computer with Proteus installed

Circuit Diagram:
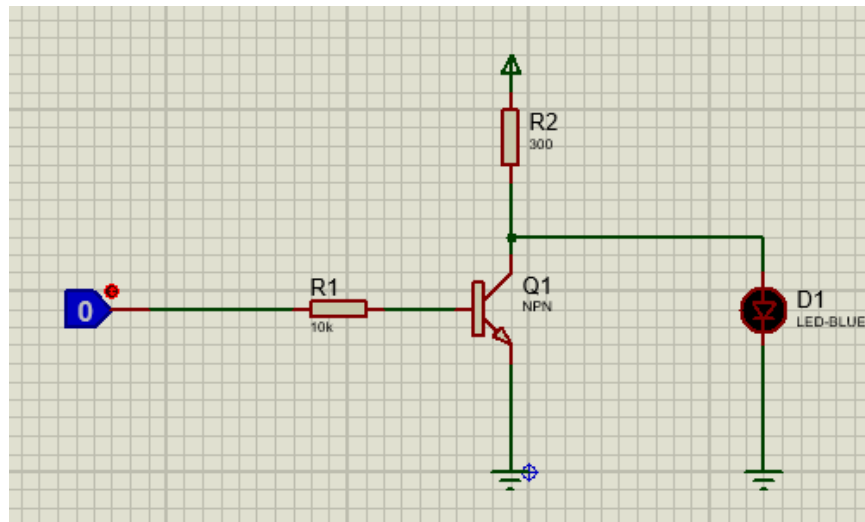
Precautions:
Ensure proper connections in the circuit.
Use appropriate units and scales for measurements.
Be cautious when using simulation software to avoid incorrect configurations.

Questions and Exercises:
1. Explain the difference between the saturation and cutoff regions of a BJT when used as a switch.
2. What are the key parameters to consider when designing a BJT switch circuit?
3. Draw the following switching circuit and find out the difference between two switching circuit.