(15) Explain the terms: FET and JFET

A Field-Effect Transistor (FET) is a type of transistor that controls the flow of current using an electric field. FETs have high input impedance and are used for amplification and switching applications. They can be classified into different types, including JFETs, MOSFETs, and others.

Junction Field-Effect Transistor (JFET):

A JFET has three terminals: Drain (D),

(16) what is meant by multistage transistor amplifier?

A multistage transistor amplifier is a configuration that uses two or more transistor stages to amplify a signal. Each stage provides additional gain, improving overall amplification, bandwidth, and input/output impedance characteristic. This design enchances performance for various applications, such as audio and radio frequency amplification.

(17) Describe the construction and operation of MOSFET.

construction of MOSFET:

i) Body: made of p-type semiconductor.

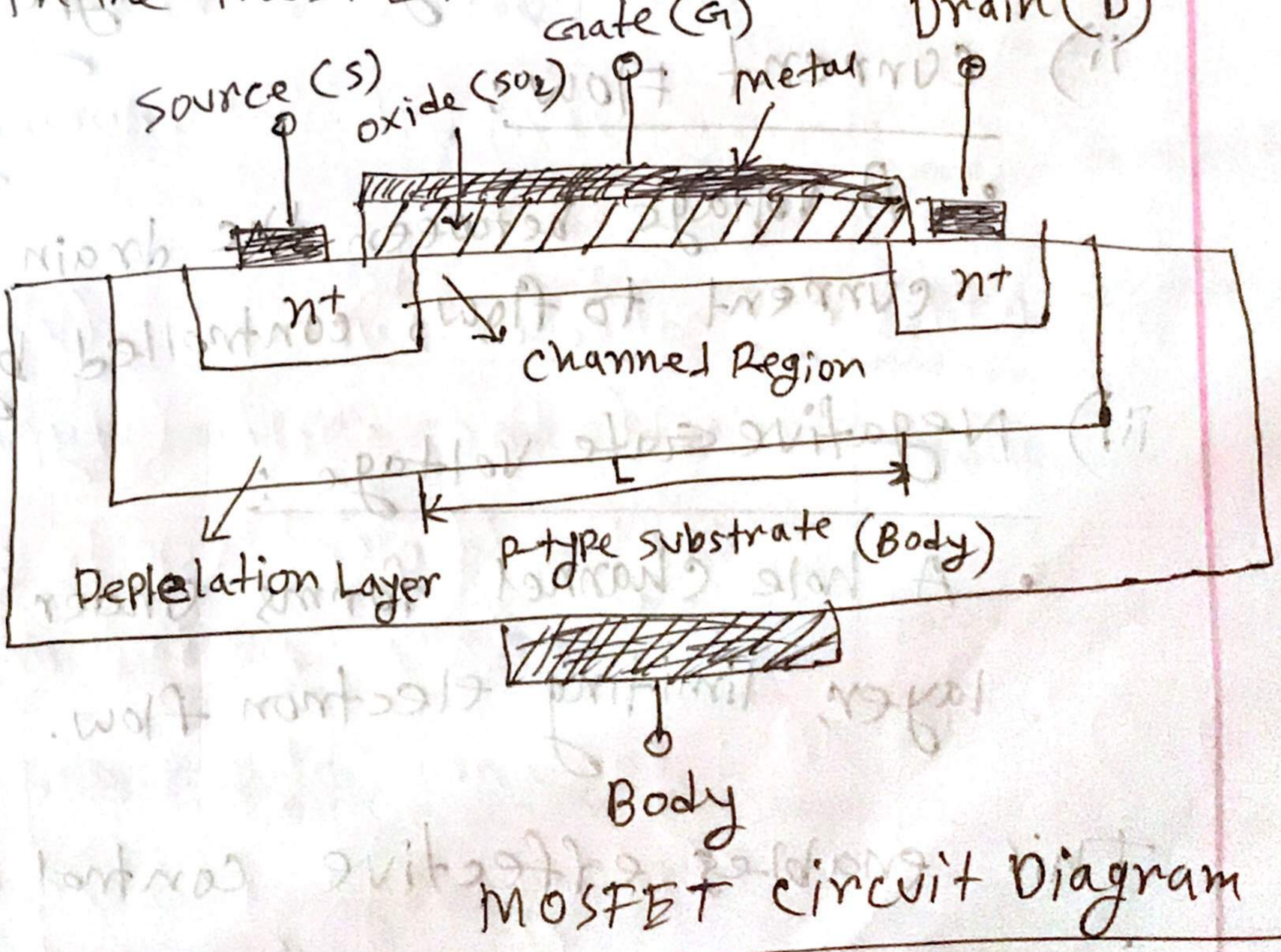
ii) Source and Drain: Heavily doped n-type regions (n+) on either side of the body.

iii) Isolation and Layer: Silicon dioxide (SiO_2) is deposited for electrical isolation.

iv) Gate: A thin metallic layer is added on the SiO_2, patterned to form the gate terminal.

v) circuit Connection: A voltage source connects the source and drain to form a DC circuit.

This structure enables effective control and current flow in the MOSFET.



MOSFET circuit Diagram

MOSFET Working operation:

The operation of a MOSFET relies on the MOS capacitor principle, where the semiconductor surface beneath the oxide layer can be inverted.

i) positive Gate voltage:

- Holes are repelled, creating a depletion region filled with negative charges.
- Electrons from the n^+ source and drain are attracted, forming an n-type channel.

ii) Current Flow:

- A voltage between the drain and source allows current to flow, controlled by the gate voltage

iii) Negative Gate Voltage:

- A hole channel forms under the oxide layer, limiting electron flow.

this enables effective control of current in circuits.

(23) write short note on:-

i) MOSFET

ii) TRIAC

iii) DIAC

iv) UJT

v) CMOS

vi) Ic fabrication process.

(i) MOSFET:

Definition: A MOSFET (metal oxide semiconductor FET) is a type of field-effect transistor that can operate in enhancement mode, increasing channel conductivity.

Key points: • Operation Modes: can operate in enhancement mode (increasing channel width), unlike JFETs, which only use depletion mode (decreasing channel width)

Advantage: • High input impedance: Requires minimal gate current.

• Low production cost: More economical to manufacture.

Applications: widely used in amplification and switching circuits due to flexibility and efficiency.

circuit 2(i) 17 ☐: MOSFET ☐ circuit.

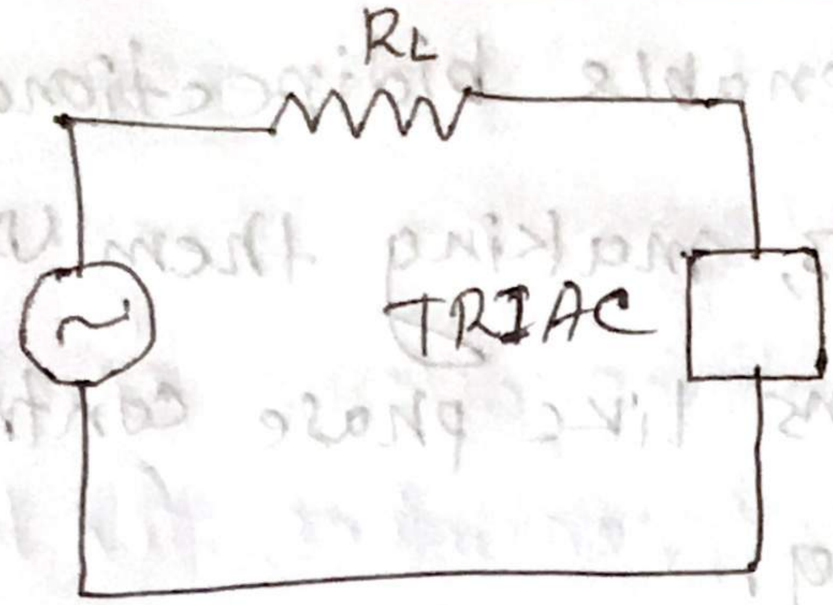
Summary: MOSFETs provide enhanced performance and versatility in electronic applications compared to JFETs.

(ii) TRIAC:

Definition: A Triac (Triode AC switch) is a three-terminal semiconductor device that controls alternating current (AC) in both directions.

Key points:
- Functionality: controls both positive and negative half-cycles of Ac, unlike SCRs.
- Operation: Adjustable control circuit allows passing specific portions of the AC waveform.
- Applications: Commonly used in light dimmers, motor controls, and other Ac power applications.

Summary: Triacs provide effective bidirectional control of Ac power, setting them apart from unidirectional devices like SCRs.



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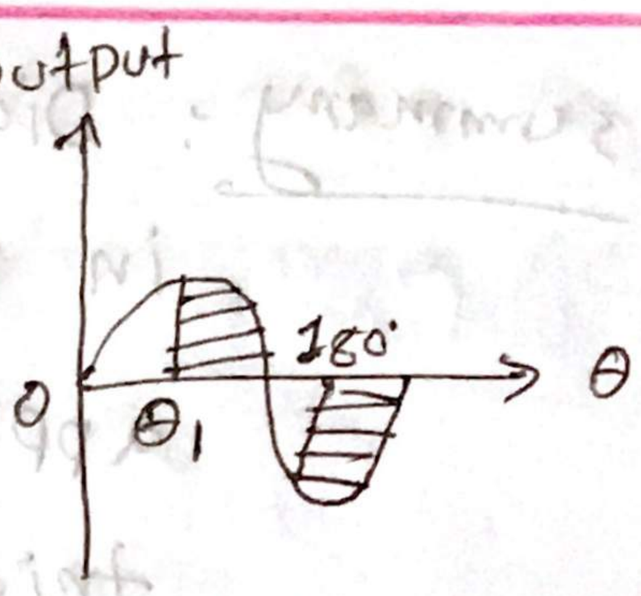


(ii)

(iii) DiAC:

Definition: A Diac is a two-terminal, three-layer bidirectional device that switches from OFF to ON state for both polarities of applied voltage.

Key points:

- **construction:** can be in either npn or pnp form, consisting of two p-regions separated by an n-region.
- **structure:** similar to a transistor but with no base terminal and symmetrical regions.
- **properties:** Identical doping concentrations in all regions, providing symmetrical characteristics.

Summary: Diacs enable bidirectional switching in circuits, making them useful in applications like phase control and triggering:

DIAC Basic construction

DIAC symbol

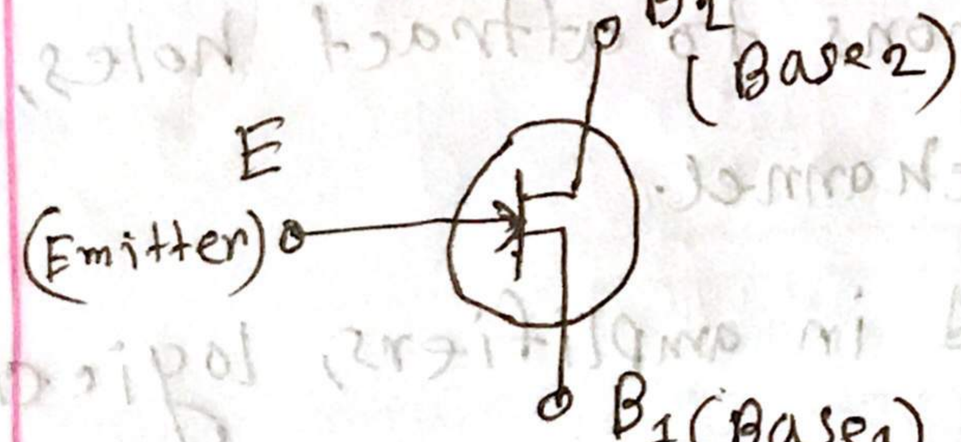
(iv) UJT (Unijunction Transistor)

Definition: A UJT is a three-terminal silicon device with one PN junction (base-1, base-2, and emitter).

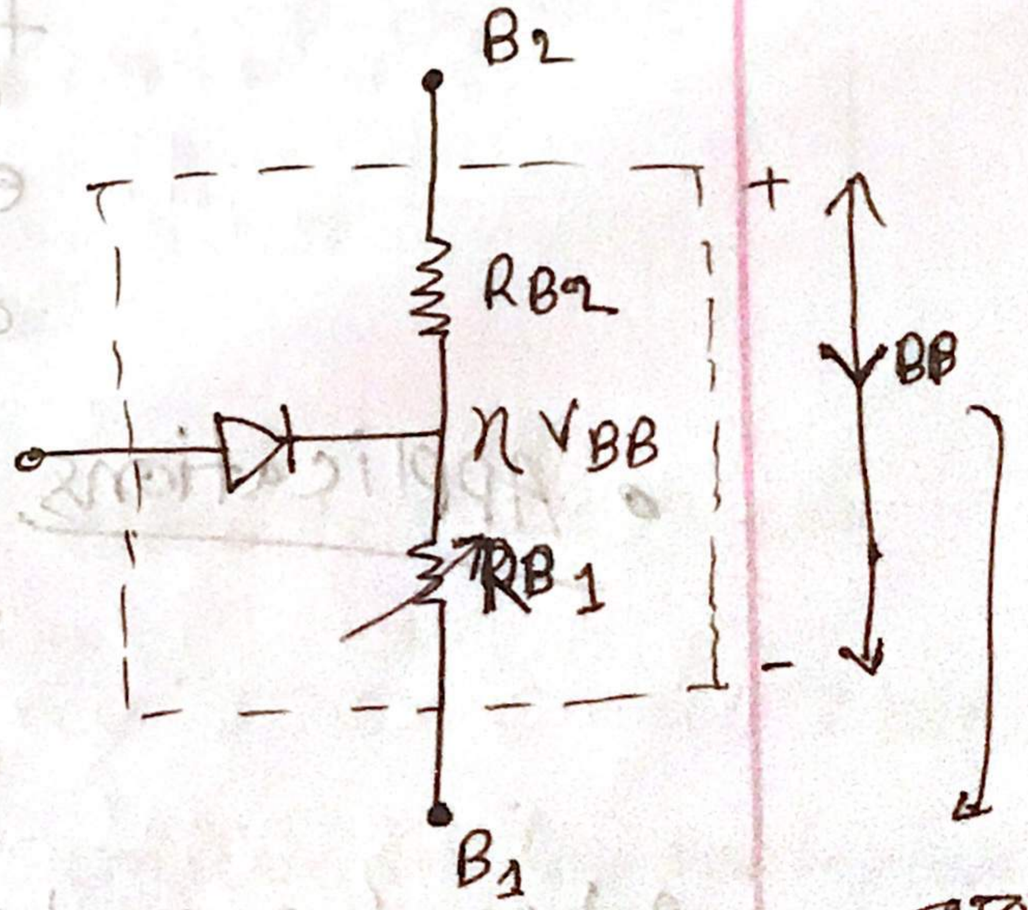
Key points: • Terminals: UJTs have three terminals, unlike ordinary diodes (two terminals).

- power control: They don't amplify like FETs but can control large AC power with small signals.
- operation: Emitter junction is forward-biased
- Negative Resistance: UJTs exhibit negative resistance, suitable for oscillators.

summary: UJTs effectively control AC power and generate oscillations due to their unique characteristics.



UJT symbol



simplified equivalent circuit

⑤ CMOS

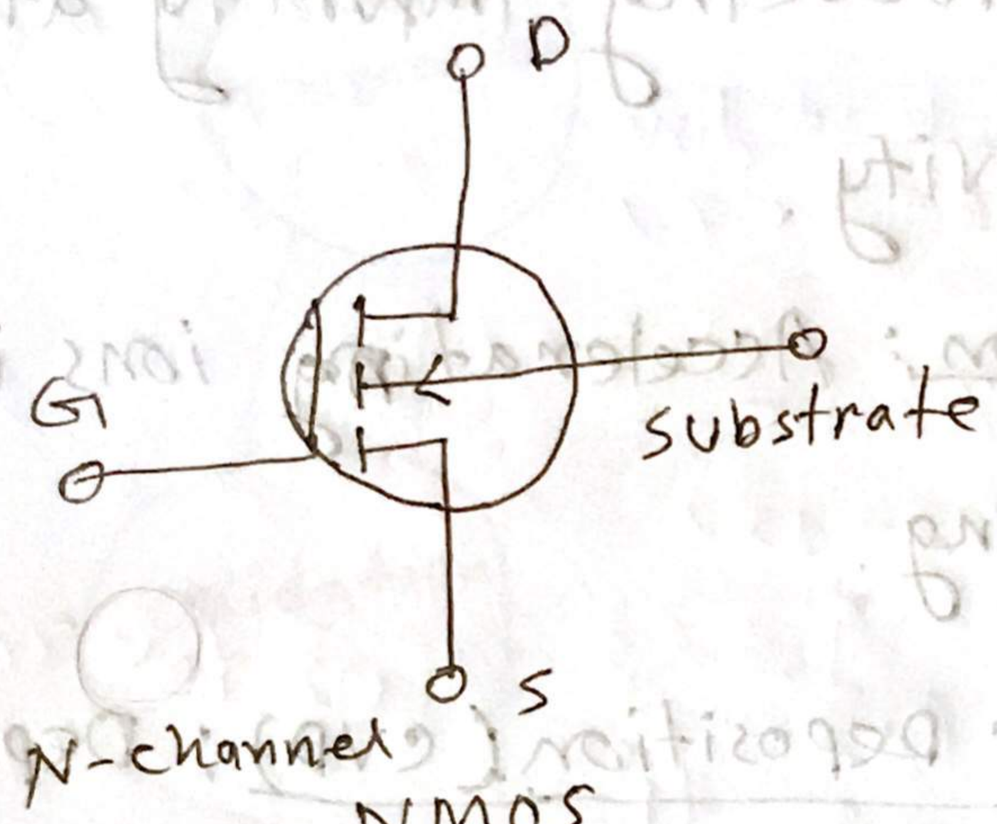
Definition: CMOS (complementary metal-oxide-semiconductor) combines NMOS and PMOS transistors for low-power and high-density logic circuits.

Key points:

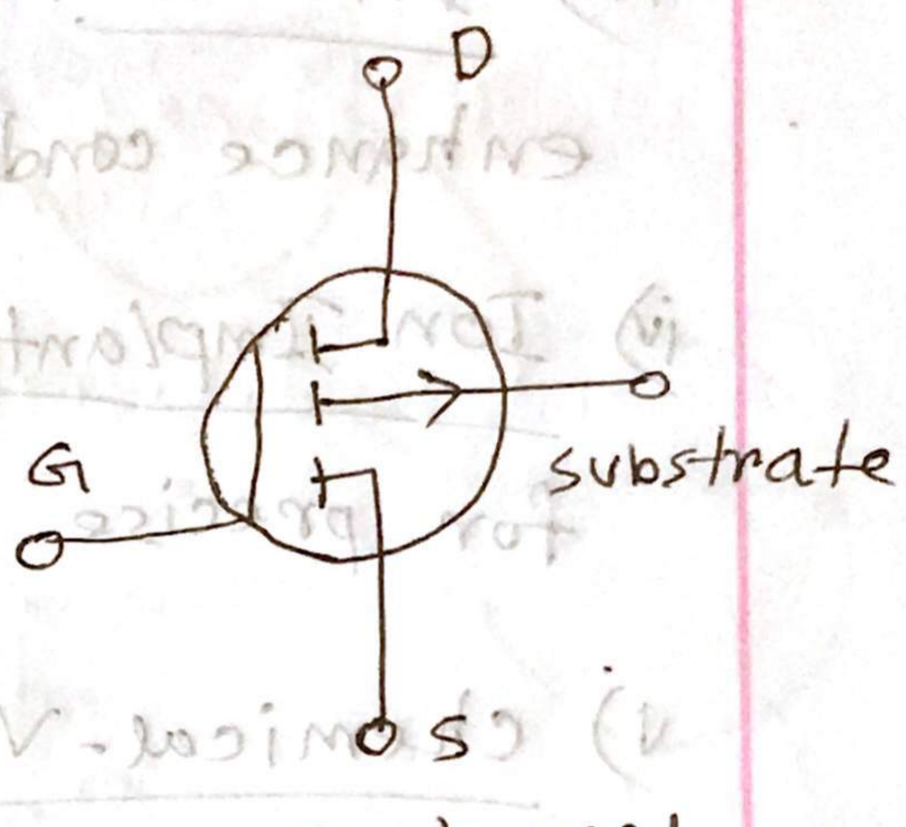
- **Transistor Types:**
  - **NMOS:** N-channel MOSFET with a P-type substrate; faster due to electron mobility.
  - **PMOS:** P-channel MOSFET with an N-type substrate; operates by repelling electrons to attract holes, forming a P-channel.
- **Applications:** Used in amplifiers, logic circuits, microprocessors, and integrated circuit chips.

Advantages: Low power dissipation, fewer manufacturing steps compared to bipolar junction transistors.

summary: CMOS technology is essential in semiconductor design due to its efficiency and performance, leveraging the strengths of both NMOS and PMOS transistors.



NMOS



PMOS

(vi) Ic Fabrication process:

definition: Integrated circuits (Ics) are electronic circuits on small chips made from semiconductor materials like Silicon and germanium.

key steps in Ic fabrication:

i) wafer preparation: cutting and polishing high-purity silicon wafers.

ii) oxidation: forming silicon dioxide for insulation and protection.

iii) Diffusion: Introducing impurity atoms to enhance conductivity.

iv) Ion Implantation: Accelerating ions into silicon for precise doping.

v) chemical-Vapor Deposition (CVD): Depositing thin films for protective layers.

vi) photolithography: using light to pattern photoresist on the wafer.

vii) Metallization: Applying metal layers for electrical connections.

viii) Packaging: Testing, separating, and sealing finished chips.

summary: The IC fabrication process combines various techniques to produce complex electronic circuits, vital for modern technology.