Unit Wise Question Bank

Department: IT Engineering **Semester: I** **Academic Year: 2024-2025**

Class: FY BTech **Date : 27/12/2024**

Course: Basic Electrical and Electronics Engineering

UNIT 5 : Transistors and Amplifiers

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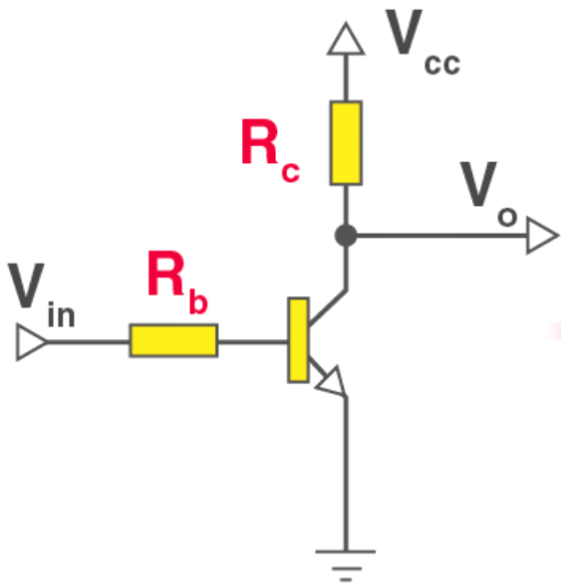
<tr><td>Ans</td><td colspan="4">Comparison : 1 Mark each point
<table>
<tr><th></th><th>Parameter</th><th>CB Configuration</th><th>CC Configuration (Emitter Follower)</th><th>CE Configuration</th></tr>
<tr><td>1</td><td>Input Terminal</td><td>Emitter</td><td>Base</td><td>Base</td></tr>
<tr><td>2</td><td>Output Terminal</td><td>Collector</td><td>Emitter</td><td>Collector</td></tr>
<tr><td>3</td><td>Common Terminal</td><td>Base</td><td>Collector</td><td>Emitter</td></tr>
<tr><td>4</td><td>Current Gain</td><td>Slightly less than 1 (α)</td><td>High (β+1)</td><td>High (β) (25 to 100)</td></tr>
<tr><td>5</td><td>Output Terminal</td><td>Collector</td><td>Emitter</td><td>Collector</td></tr>
<tr><td>6</td><td>Voltage Gain</td><td>High</td><td>Approximately 1</td><td>Moderate to High</td></tr>
<tr><td>7</td><td>Power Gain</td><td>Moderate</td><td>High</td><td>Very High</td></tr>
</table></td></tr>
<tr><td>2.</td><td>With the help of suitable diagram, explain working principle of CE transistor as a switch.</td><td>5</td><td>CO 5</td><td>Applying</td></tr>
<tr><td></td><td colspan="4">Circuit diagram : 2 Marks</td></tr>
</table>

Ans



Working 2 Marks

1. A transistor can be used as a switch to turn things on and off by regulating the collector current.
2. A transistor has two operating regions:

Saturation region: When the transistor is fully on, transistor will be biased so the maximum amount of the current is applied, which results in the maximum collector current results in the minimum collector emitter voltage drop which cause in depletion layer as a small as possible and maximum current flowing through the transistor so the transistor is switched "Fully ON".

Cut-off region: When the transistor is fully off In the cut-off region of the transistor, it operates under conditions of zero input base current (Ib), zero output collector current (Ic), and maximum collector voltage (Vce). This configuration creates a significant depletion layer, preventing the flow of current through the device and effectively switching it off.

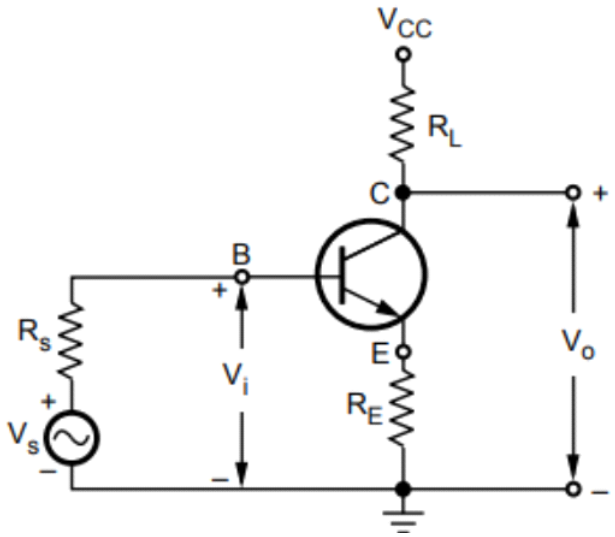
Applications 1 Marks

1. **Controlling lamps, relays, or motors**
2. **Modifying the speed of a motor**

3.	With the help of circuit diagram explain CE amplifier.	5	CO 5	Understanding

Ans

Circuit diagram : 2 Marks



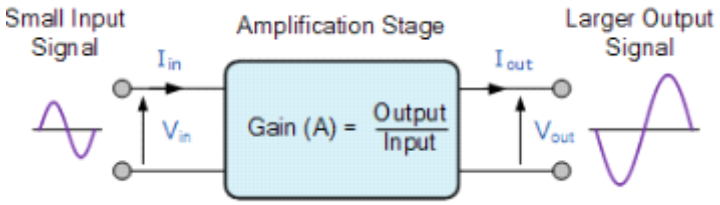
Explanation 3 Marks

- This is widely used transistor amplifier configuration
- It is NPN - BJT with the emitter terminal common to both the input and output.
- Input applied to the base-emitter junction.
- Output taken from the collector-emitter junction.
- Biasing resistor Rs must ensure that transistor operates in the active region by applying perfect value of base voltage & current (proper biasing)
- Input signal: A weak input signal can be applied to the base of the transistor for amplification purpose
- Base current: A small base current flows.
- Collector current: A much larger current flows through the collector load resistor.
- Voltage output: The current flowing through the collector load resistor produces the voltage output of the amplifier

4.	What is an amplifier? Explain with diagram.	5	CO 5	Understanding

Ans

Circuit / Block diagram : 2 Marks



Explanation / Definition 1 Mark

An amplifier is an electronic device that increases the amplitude of an input signal, making it stronger without significantly altering its waveform. It is widely used in audio systems, communication devices, and various other electronic applications

Components of an Amplifier 1 Mark

- Input Signal (small quantity)
- Transistor / Operational Amplifier
- Power Supply
- Load

Types 1 Mark

Voltage amplifier
Current amplifier
Power amplifier
Operational amplifier

5.	What are the three regions of operation for a Bipolar Junction Transistor (BJT)?	5	CO 5	Understanding

Ans

List all regions 1 Mark

1. Cut-off region
2. Active region
3. Saturation region

Explanation all regions 3 Marks
Applications 1 Mark

1. **Cutoff Region**:

   Both the base-emitter and base-collector junctions are reverse-biased.

   The transistor is "off," with negligible current flow between the collector and emitter.

   Application : Used in digital circuits to represent a logic "0" or **open switch**.

2. **Active Region**:

   The base-emitter junction is forward-biased, and the base-collector junction is reverse-biased.

   The transistor operates as an amplifier, with a linear relationship between the input (base current) and the output (collector current).

   Application : Used in analog circuits., **Amplifier**

3. **Saturation Region**:

   Both the base-emitter and base-collector junctions are forward-biased.

   The transistor is "on," with maximum current flowing between the collector and emitter, limited only by external circuitry.

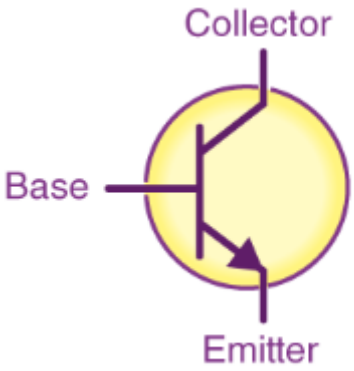
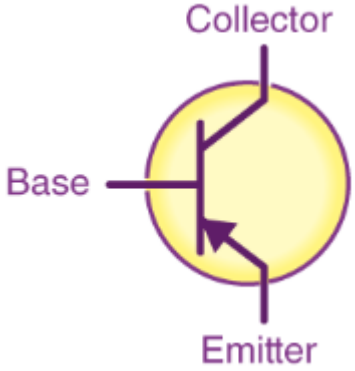
   Application : Used in digital circuits as a **closed switch** representing logic "1."

Each region has distinct characteristics and applications, making BJTs very useful components in electronic circuits

6.	What are the differences between NPN and PNP transistors?	5 **(any 5 points)**	CO 5	Analyzing

Ans

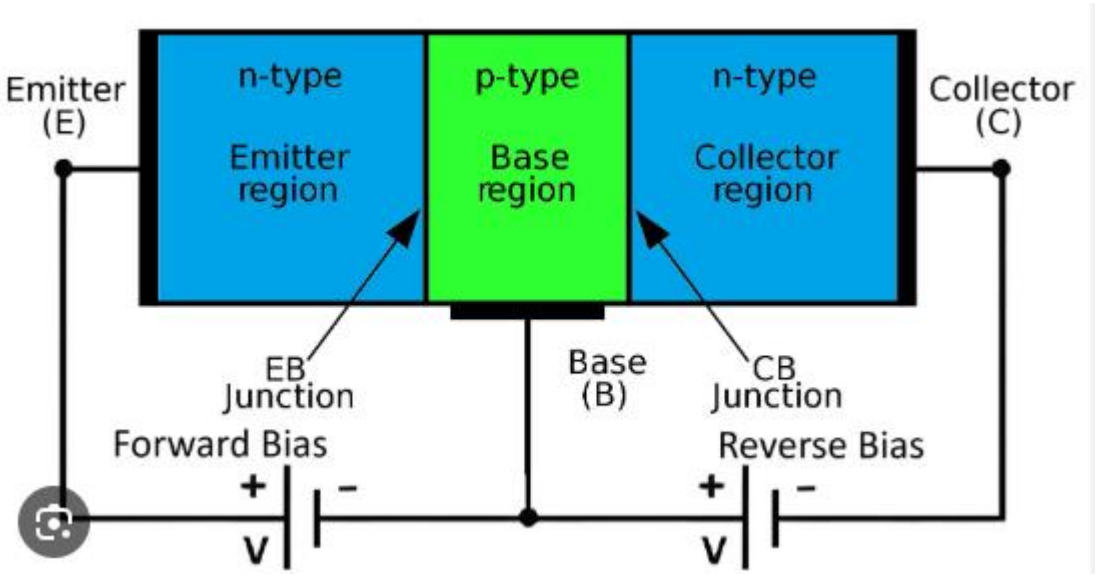
Comparison : 1 Mark each point

	Parameter	NPN	PNP
1	**Symbol**		
2	**Material Structure**	N-type emitter, P-type base, N-type collector	P-type emitter, N-type base, P-type collector
3	**Direction of Current**	Current flows from collector to emitter (conventional flow)	Current flows from emitter to collector (conventional flow)
4	**Biasing for Operation**	Base-Emitter junction: Forward-biased; Collector-Base junction: Reverse-biased	Base-Emitter junction: Forward-biased; Collector-Base junction: Reverse-biased
5	**Majority Carriers**	Electrons	Holes
6	**Base Current Flow**	Enters the base	Leaves the base

7.	Explain construction of NPN transistor.	5	CO 5	Understanding

Ans

Diagram 2 Marks



Explanation 3 Marks

1. Emitter (E): Highly doped n-type region, Emits electrons into the base.
2. Base (B): Thin, lightly doped p-type region, Facilitates the flow of electrons from the emitter to the collector.
3. Collector (C): Moderately doped n-type region, Collects electrons from the emitter via the base, physically larger than the emitter to handle more heat and current.

- It works based on the movement of charge carriers (electrons and holes)
- The NPN transistor has three terminals: emitter, base, and collector. The emitter-base junction and the collector-base junction are formed by connecting two diodes back to back. The emitter-base diode is between the emitter and base terminals, and the collector-base diode is between the collector and base terminals.
- When a small voltage is applied to the base, electrons move through the base region and complete the circuit, allowing current to pass through the transistor. This turns the transistor from a current blocker to an open circuit

8.	A transistor has α=0.99, If it is connected in CE mode, what would be the change in collector current for a change of 10 µA in base current?	5	CO 5	Applying

Ans

Given data :
α=0.99
ΔIb = 10 µA
Calculate ΔIc ?

Solution :
CE mode Gain - β,

β= α/1- α = 99 — 2 Marks

β= Δ Ic/ΔIb — 1 Marks

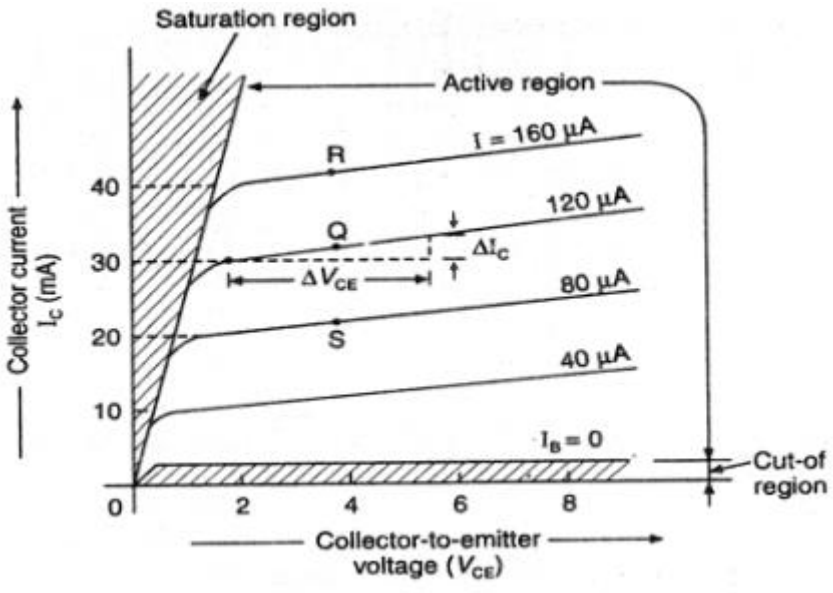
so ΔIc = 99*10 µA = 0.99 mA — 2 Marks

9.	Draw and explain the output characteristics of a BJT in CE configuration.	5	CO 5	Understanding

Ans

Diagram — 2 Marks

Common Emitter Output Characteristics



Explanation 3 Marks

- **Output characteristics**
- The output characteristics of a BJT in a common emitter (CE) configuration is the relationship between the collector current (I_C) and the collector-emitter voltage (V_{CE}) at a constant base current (Ib)

Plot the collector current (Ic) on the Y-axis and the collector-emitter voltage (V_{CE}) on the X-axis. Keep the base current (Ib) constant.

Characteristics are shown with different values.

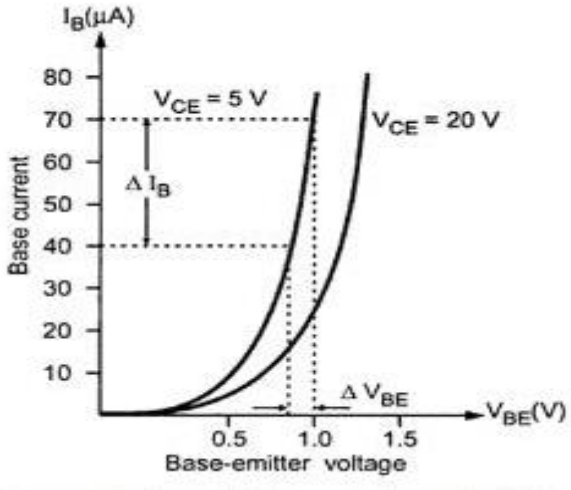
Cut off, Active and saturation regions of a transistor are different regions as shown in diagrams.

10.	Draw and explain the input characteristics of a BJT in CE configuration.	5	CO 5	Understanding

Ans

Diagram 2 Marks

Common Emitter Input Characteristics



Explanation 3 Marks

- **Input characteristics**
- The input characteristics of a bipolar junction transistor (BJT) in a common emitter (CE)

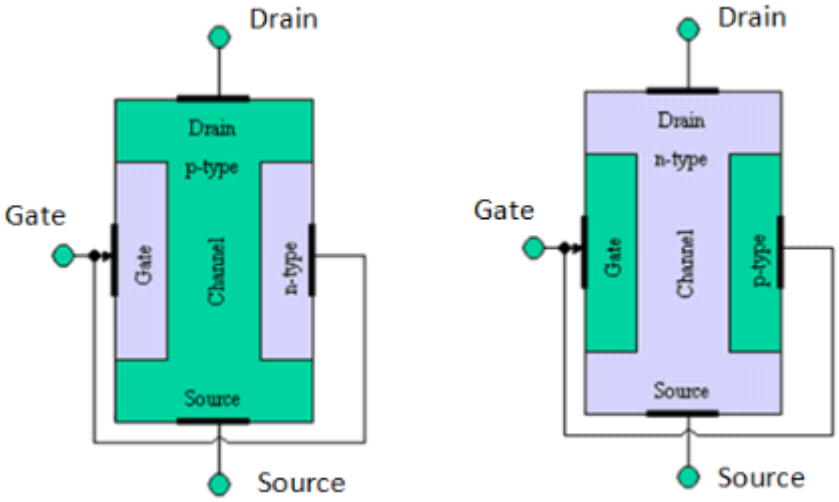
	configuration are the variation of the base current (I_B) with the base-emitter voltage (V_{BE}). Plot the base current (I_B) on the Y-axis and the base-emitter voltage (V_{BE}) on the X-axis. Keep the collector-emitter voltage (V_{CE}) constant Characteristics are shown with different values. The input characteristic curve is similar to the forward-bias characteristic of a diode because the base-emitter junction is a PN junction.			
11.	Derive the relation between α (common base current gain) and β (common emitter current gain) for a BJT.	5	CO 5	Applying
Ans	Ic, Ib, Ie Ic is the collector current. Ie is the emitter current. Ib is the base current. As we know that $\beta=\alpha / (1-\alpha)$ $\alpha = \beta / \beta+1$ $\alpha = Ic / Ie$, $\beta = Ic / Ib$ $Ie = Ib + Ic.$ (1) Divide eq (1) by Ic, we get $1/\alpha = (1/\beta) + 1$ (2) $1/\alpha = (\beta + 1) / \beta$ Hence $\alpha = \beta / (\beta + 1)$ …….proved (3) from eq. (2) $(1/\alpha) - 1 = 1 / \beta$ $(1 - \alpha) / \alpha = 1 / \beta$ $\alpha / (1-\alpha) = \beta$ Hence $\beta = \alpha / (1-\alpha)$ ……. ……proved (3)			

12.	Explain construction of FET.	5	CO 5	Understanding

Ans

Diagram 2 Marks

P Channel JFET **N Channel JFET**



Construction 3 Marks

Field-Effect Transistor (FET) : It is a semiconductor device that controls current flow through an electric field.

Main types of FETs:

Junction Field-Effect Transistors (JFETs)

Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs).

Junction Field-Effect Transistor (JFET - N Channel) Construction

A JFET has three terminals: **Source (S)**, **Drain (D)**, and **Gate (G)**. It is constructed using **n-type** semiconductor material, forming a channel for current flow between two P-Type materials.

Two P-type materials connected together to form a Gate terminal. Two p-type regions are diffused into the n-type material, creating a pn-junction. The ends of the n-type bar are connected to the Source and Drain terminal (Channel has two terminals. One terminal is Drain and other is Source.)

Gate material is highly doped compared to channel.

Gate (G): This terminal controls the flow of current between the source and drain by creating an electric field

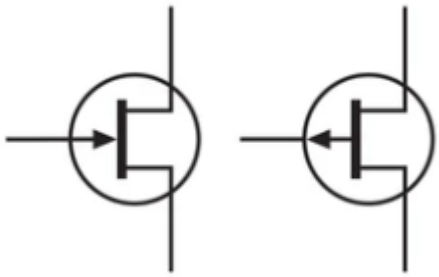
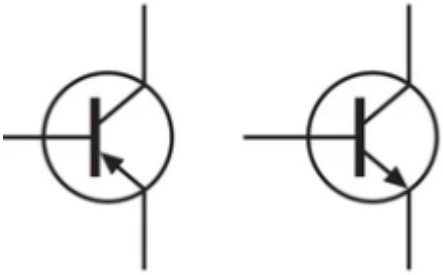
Source (S): This is the terminal through which carriers (electrons or holes) enter the FET.

Drain (D): This is the terminal through which carriers leave the FET.

13.	Compare FET and BJT.	**5 (any 5 points)**	CO 5	Analyzing

Ans

Comparison : 1 Mark each point

	Parameter	FET	BJT
1	**Symbol**	**N Channel JFET P Channel JFET** 	**PNP** **NPN** 
2	**Type**	JFET, MOSFET	NPN, PNP
3	**Controlling (Device types)**	Voltage-controlled device	Current-controlled device
4	**Terminals**	Gate, Source, Drain	Base , Emitter, Collector
5	**Configurations**	Common Source Common Gate Common Drain	Common Emitter Common Base Common Collector
6	**Controlling Terminal**	Gate (G) controls the current flow between Drain (D) and Source (S)	Base (B) controls the current flow between Collector (C) and Emitter (E).

Course faculty