Name :- Aqib Shukaib
ID :- 6978
Subject :- Electronic devices & circuit.

Question 1:-
The 1N4747 zener diode used in the regulator circuit in fig is 20V

$V_Z = 20V$ $I_Z = 12.5mA$
$I_{ZK} = 0.25mA$ $Z_Z = 22\Omega$

a) for I_{ZK}

$V_{out} = V_Z - \Delta I_Z \cdot I_Z$
$= 20V - (I_Z - I_{ZK}) Z_Z$
$= 20V - (12.5mA - 0.25mA)\ 22\Omega$
$= 20V - (12.25mA)\ 22\Omega$
$= 20V - 0.267V$
$V_{out} = 19.73V$

For I_{ZM}

$P_{D(Max)}/V_Z = 1W/20V = 50mA$

$V_{out} = V_Z + \Delta I_Z Z_Z$
$= 20V + (I_{ZM} - I_Z) Z_Z$
$= 20V + (50mA - 12.5mA)\ 22\Omega$
$= 20V + (37.5mA)\ 22\Omega$
$= 20V + 0.825$
$= 20.825V$

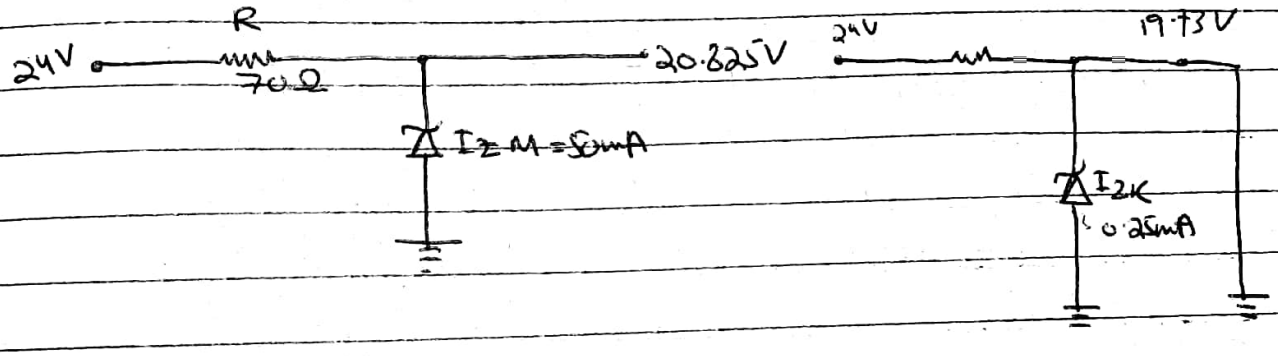
b)

$$R = \frac{V_{in} - V_{out}}{I_{ZM}}$$

$$= \frac{24V - 20.825V}{50\,mA}$$

$$R = 63.5\,\Omega$$

$$R = 70\,\Omega$$



c) for maximum load Resistance (max current) the zener diode current minimum ($I_{ZK} = 0.25$)

$$I_j = V_{IN} - V_{out} / R$$

$$= \frac{24V - 19.73V}{70\,\Omega}$$

$$= 0.061A$$

Question 2:-

Sol:- $V_{BE} = 0.7V$

$\Rightarrow I_B = \frac{V_{BB} - V_{BE}}{R_B} = \frac{5V - 0.7V}{3.9k\Omega} = \boxed{1102\mu A}$

$\Rightarrow I_C = \beta_{DC} \cdot I_B \Rightarrow (150)(1102\mu A) = \boxed{165.3mA}$

$\Rightarrow I_E = I_C + I_B = 165.3mA + 1102\mu A = \boxed{166.4mA}$

Solve for V_{CE} & V_{CB}

$V_{CE} = V_{CC} - I_C R_C = 15V(165.3mA)(180\Omega)$

$= 15V - 29.7V = \boxed{-14.7V}$

$V_{CB} = V_{CE} - V_{BE} \Rightarrow -14.7V - 0.7V$

$= -15.4V$

Since the collector is at a lower voltage than the base, the collector base junction is forward biased.

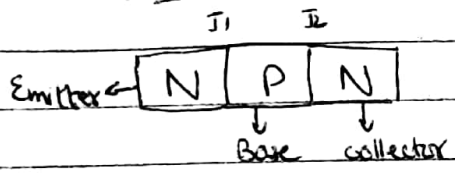
Question 3:-

=> BJT:-

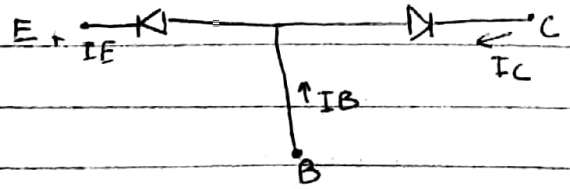
1) It was invented in Dec 1947 at bells lab USA.
2) It is a three terminal device and it is used for amplification of weak signals in switching operation.

Structure

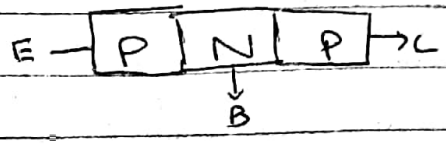
NPN



- 2 Junction (N)
- 1 Junction (P)
- J_1 → emitter - base
- J_2 → collector base
- There is depletion region at J_1
- There is depletion region at J_2.

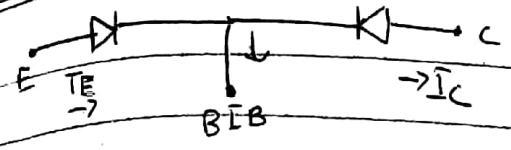


PNP



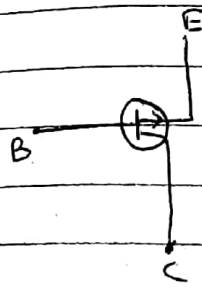
width C > E > B

doping = E > C > B

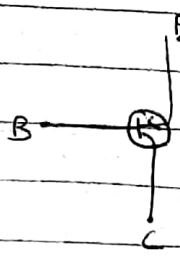


Cross Section View

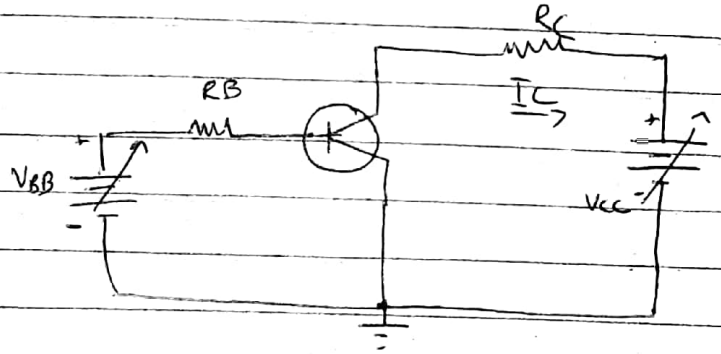
NPN



PNP



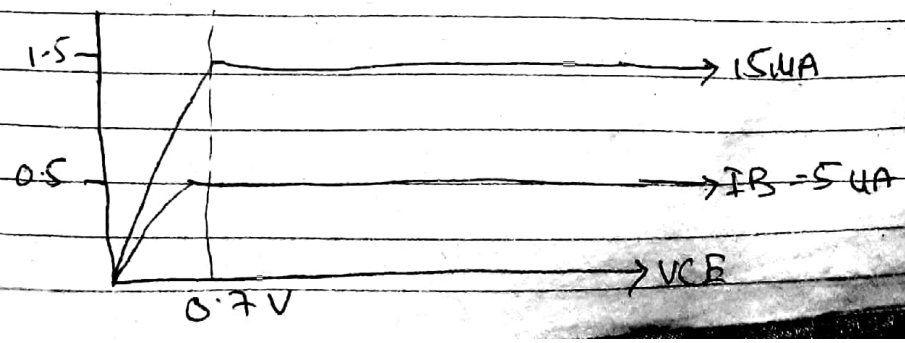
Part 2nd



Using the relationship $I_C = \beta_{DC} I_B$ value of I_C are calculated and tabulated in below table. The resulting curves are plotted.

Table

I_B	
5μA	= 0.5 mA
15μA	= 1.5 mA

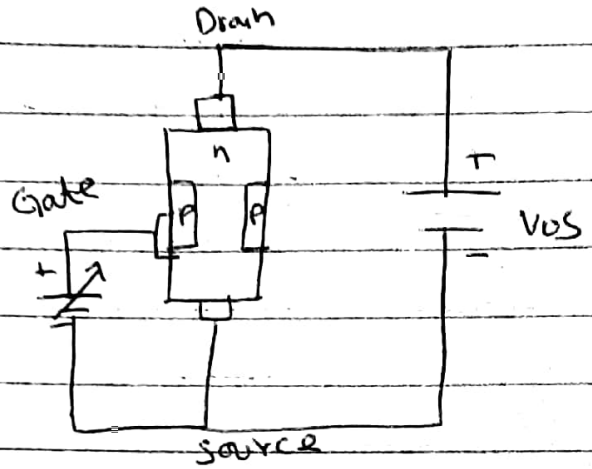


Question 4:-

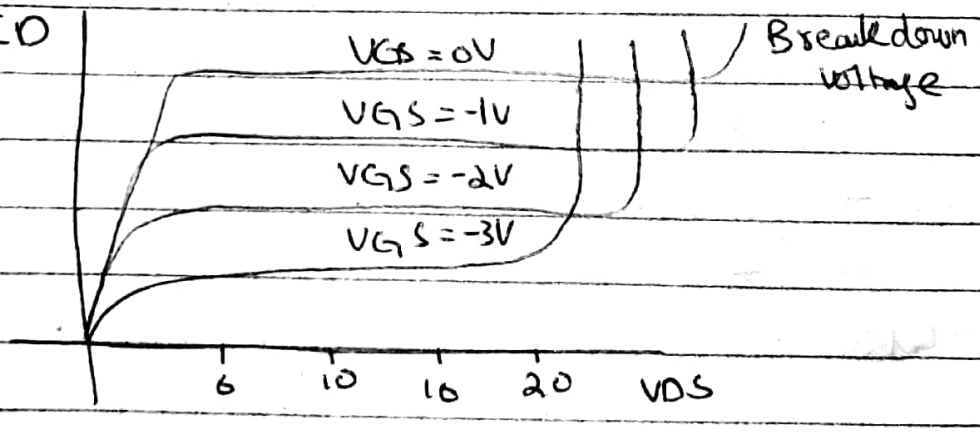
Transistor Fully ON (ON)
Transistor Fully OFF (OFF)
Input and base are at 0V (OFF)
Collector current $I_C = 0$ (OFF)
$V_{CE} = V_{cc}$ (OFF)
BE junction is reverse bias (OFF)
BC junction is forward bias (OFF)
Maximum of saturation current I_c flows (ON)
BE junction is forward bias (ON)
BC junction is forward bias (ON)
$V_{CE} = 0V$ (ON)
BE junction is less than 0.7V (OFF)

Question 5 :-

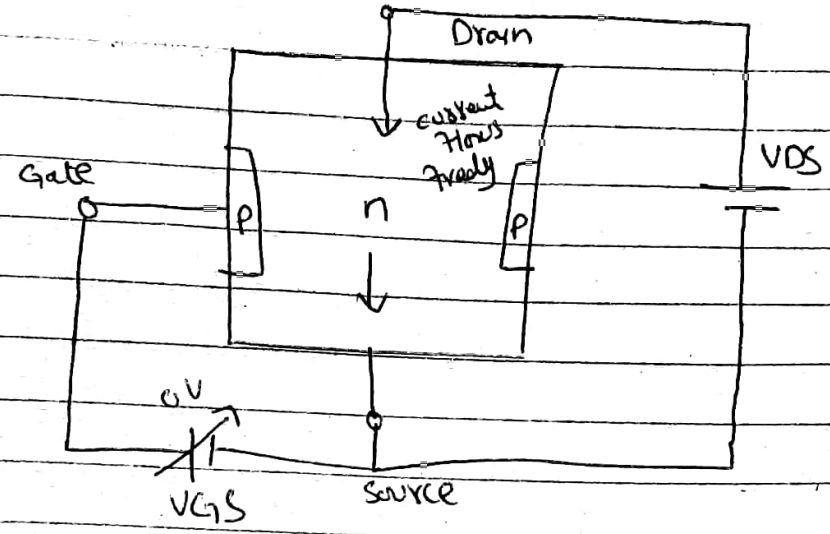
JFET is a type of junction field effect transistor which is voltage controlled device as differ from BJT which is current controlled.



In FET the drain to source current is controlled by the width of the channel the electric field is produced by the gate to source voltage.

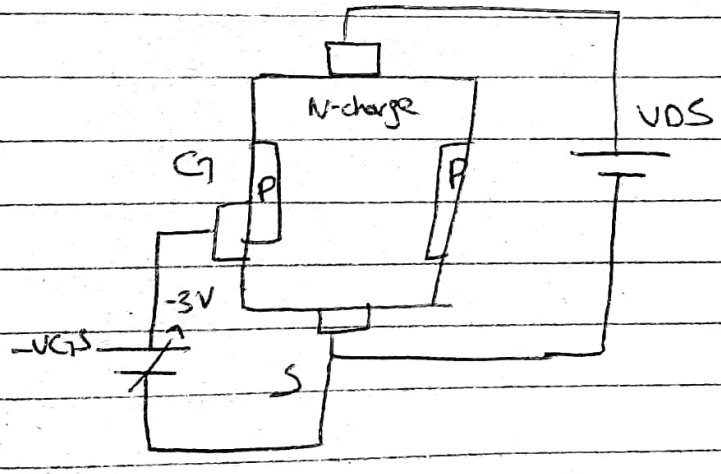


So if we see to the graph with no voltage applied to the gate then the current flows freely.



The channels are wider and drain current moves freely.

If we move VGS to negative value the channel width start to decrease and current cannot move.



So VGS is more negative so no current flows & this effect is called Pinch off region no current or less current flows.

Question 6:-

a) VCE = ? Vin 0V

When Vin = 0V then transmitter is in cutoff mode.
VCE = VCC = 10V

(b) min IB = ?
BDC = 125
VCE(sat) = 0.4V

$$I_{C(sat)} = \frac{V_{CC}}{R_C} = \frac{10V}{1.0K\Omega}$$
$$= 10mA$$

$$I_{B(min)} = \frac{I_{C(sat)}}{BDC} = \frac{10mA}{125}$$

$$I_{B(min)} = [redacted] 80\mu A$$