Department of Electrical Engineering
Midterm Exam
Date: 29/09/2020

Course Details

Course Title: Electronic Devices and Circuits **Module:** _____

Instructor: _____ **Total Marks:** 50 _____

Student Details

Name: _____ **Student ID:** _____

Student Signature: _____

Q1. The 1N4747A zener used in the regulator circuit of Figure 1 is a 15 V diode, determine the following: Marks 10

(a) Determine V_{OUT} at I_{ZK} and at I_{ZM}.
(b) Calculate the value of R that should be used.
(c) Determine the minimum value of R_L that can be used.

The electrical characteristics and values of V_Z, I_Z, IZ_K, Z_Z can be found in diode datasheet Fig 3-7 (in course reference book) and online.

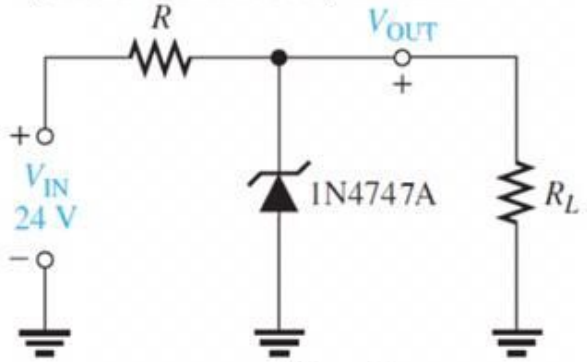

Figure 1

CLO 02

Q2. Determine I_B, I_C, I_E, V_{BE}, V_{CE} and V_{CB} in the circuit shown in Figure 2. Marks 05

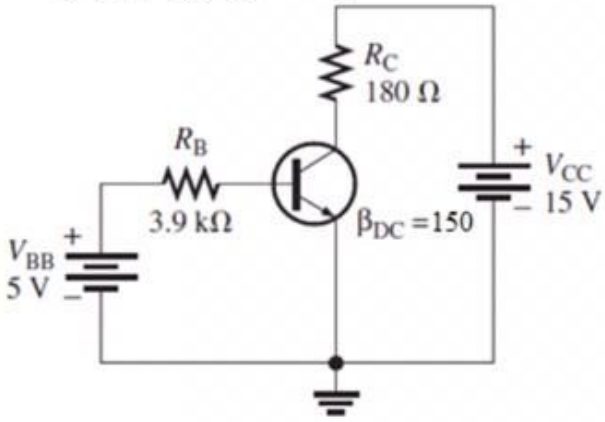

Figure 2

CLO 02

CLO 03

Q4. **For a transistor to act as a "switch", you need to join each of the following conditions on the left to "ON" or "OFF" state.** Marks 05

Transistor fully ON

Transistor fully OFF

Input and base are at 0V

Collector current $I_c = 0$ — OFF

$V_{CE} = V_{CC}$

BE junction is reverse bias

BC junction is forward bias

Maximum of saturation current I_c flows

BE junction is forward bias — ON

BC junction is forward bas

$V_{CE} = 0V$

BE junction is less than 0.7V

CLO 02

Q5. Discuss that how JFET (n-channel) can be used as voltage control device when the value of $V_{GS} < 0V$ and $V_{DS} > 0V$. Draw schematics with polarity conventions and explain the operation in detail. Marks 10 CLO 03

Q6. For the transistor circuit given in Fig. 3, calculate the following: Marks 10

a) What is V_{CE} when $V_{IN} = 0V$?

b) Determine the minimum value of I_B is required to saturate this transistor if β_{DC} is 125 and $V_{CE(sat)}$ is 0.4V.

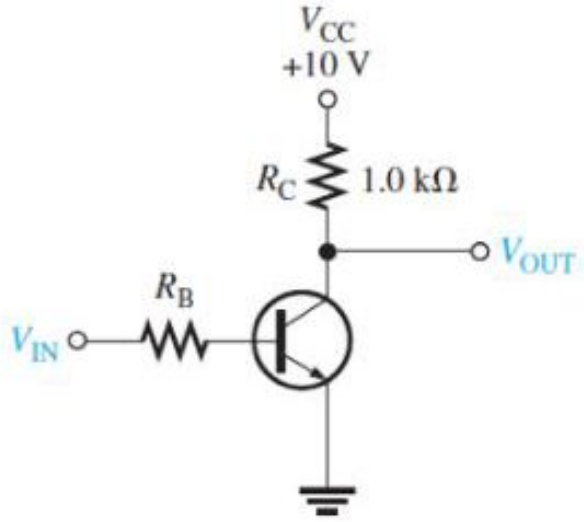

Figure 3

CLO 03

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ID : 14622

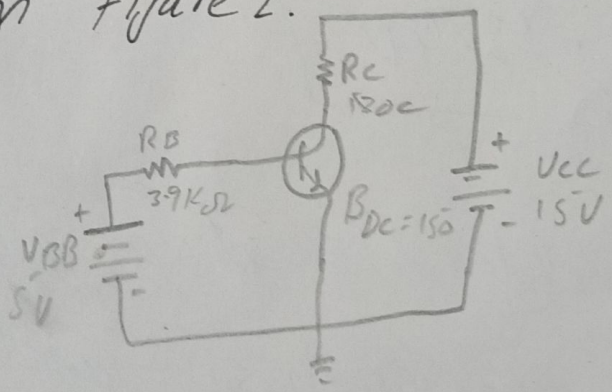
Date : 29/09/2020

Course Title: Electronic Devices & circuits.

Department: Electrical engineering

Instructor: Dr Shahryar sir.

Q NO2: Determine I_B, I_C, I_E, V_{BE}, V_{CE} and V_{CB} in the circuit shown in Figure 2.



Sol:- From Equation 4.3

$$V_{BE} \cong 0.7V$$

Now

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

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

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

Nos Solve for V_{CE} & V_{CB}

$$V_{CE} = V_{cc} - I_c R_c = 15V - (165.3mA)(180\Omega)$$

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

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

$$\boxed{= -15.4V}$$

Since the collector is at a lower than the base, the collector-base junction is forward baised.

QNo4:- For a transistor to act as a "switch" you need to join each of the following condition on the left to "ON" or "OFF" state.

P.T.O.

Ans:-

Transistor fully ON

Transistor fully OFF

Input and base are at 0V

Collector current $I_c = 0$

$V_{CE} = V_{cc}$

BE junction is reverse bais

BC junction is forward bais

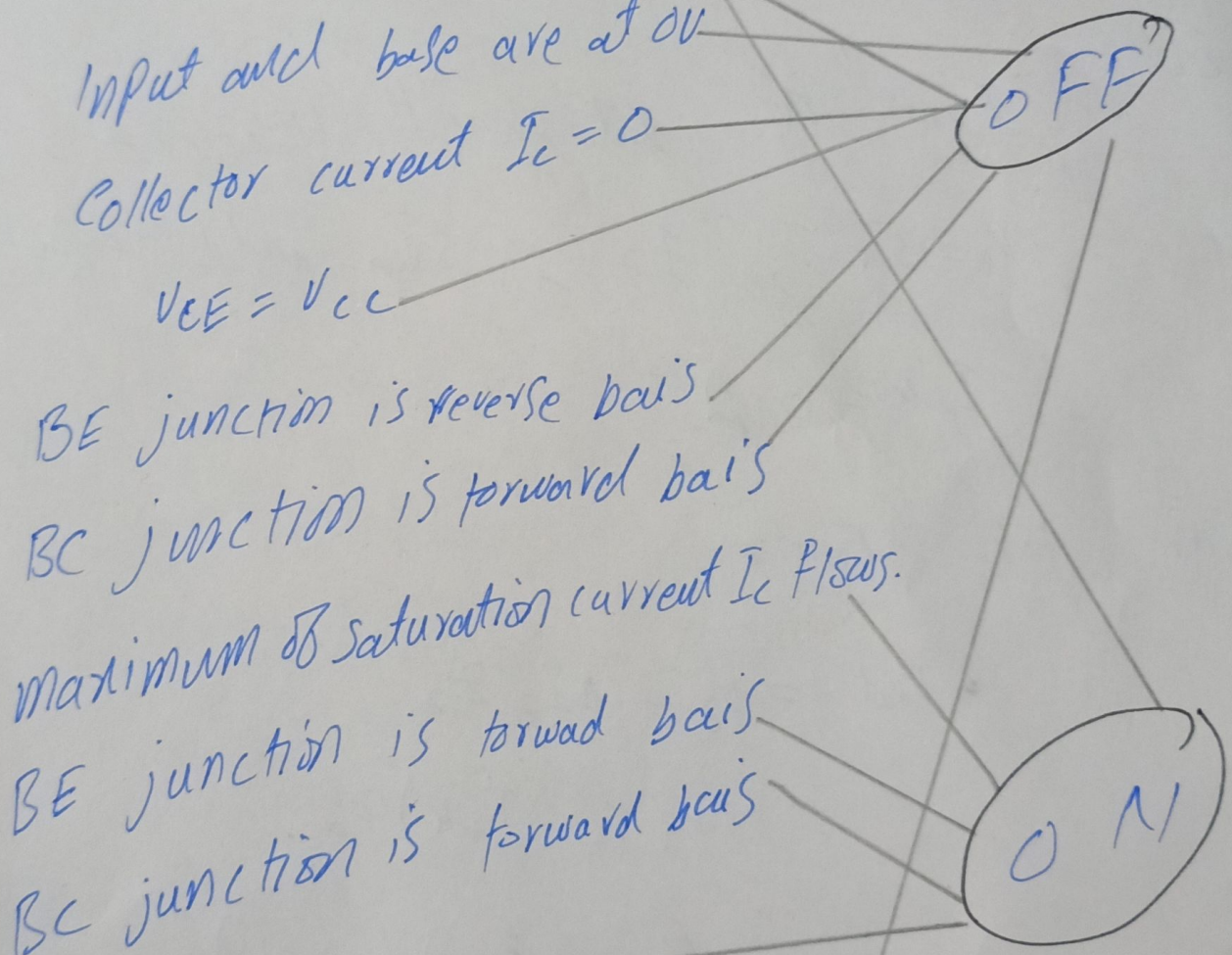
maximum of saturation current I_c flows.

BE junction is forwad bais

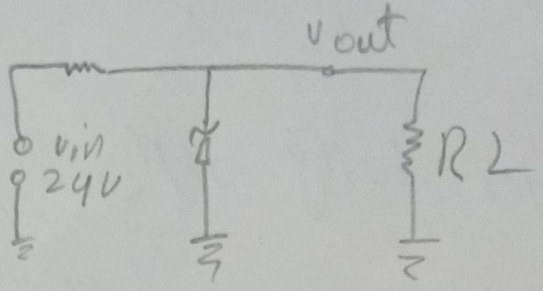
BC junction is forward bais

$V_{CE} = 0V$

BE junction is less than 0.7V



Q No 1:- Figure.



Sol:-

From the datasheet IN4747A

$V_z = 15\bar{}V$, $I_z = 12.5\bar{}mA$ and $Z_z = 22\Omega$

$I_{zk} = 0.25\bar{}$

a) for I_{zk}

$$V_{out} = V_z - \Delta I_z Z_z$$

$$= 15\bar{} - (I_z - I_{zk}) Z_z$$

$$= 15\bar{} - (12.25\bar{}mA)(22\Omega)$$

$$= 15\bar{}V - (0.01225\bar{})(22)$$

$$= 15\bar{}V - 0.269\bar{}$$

$$= 14.7305\bar{}V$$

Calculating zener max current the maximum power disipation is 1w.

$$I_{zm} = \frac{P_{D(max)}}{V_z} = \frac{1W}{15} = 0.066667A.$$

$$\boxed{I_{zm} = 66.7mA}$$

for I_{zm}:

$$V_{out} = V_z + \Delta I_z Z_z$$

$$= 15V + (I_{zm} - I_z) Z_z$$

$$= 15V + (54.2mA)(22\Omega)$$

$$= 15V + (0.0542)(22)$$

$$= 15V + 1.1924$$

$$= 16.1924V$$

b) calculat value of R for max zener current that occurs when there is no load.

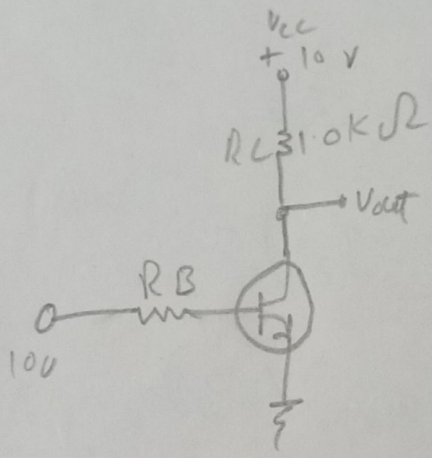
$$R = \frac{V_{IV} - V_{out}}{I_{zm}}$$

$$R = \frac{24V - 16.1924V}{66.7mA}$$

$$R = 116.5313$$

$$R = 120\Omega$$

Q NO 6 :-



Sol:-

Given data

$\beta_{DC} = 125$

$V_{CE(sat)} = 0.4V$

$V_{CC} = 10V$

$R_L = 1K\Omega$

Required

$V_{CE} = ?$, $I_B = ?$

a) $V_{CE} = ?$ $V_{IN} = ON$

When $V_{IN} = ON$, so transistor is in cut off mode and

$$V_{CE} = V_{cc} = 10V$$

b) $\min I_B = ?$ $\beta_{DC} = 125$, $V_{CE} = 0.4V$

$$I_{C(sat)} = \frac{V_{cc}}{R_L} = \frac{10}{1K\Omega} = 10mA$$

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

$= 0.08\mu A$

Q NO 3:-

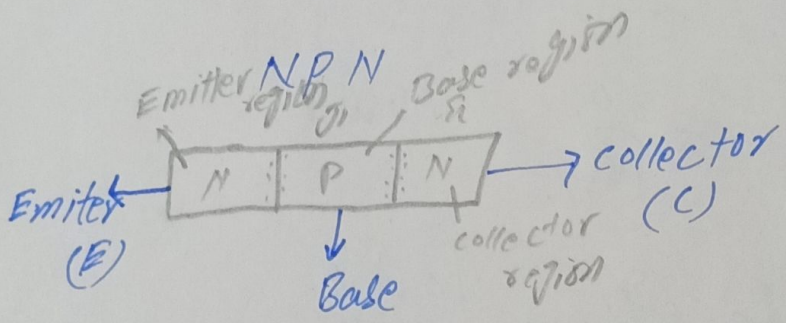
Ans:- Bipolar Junction Transistor:

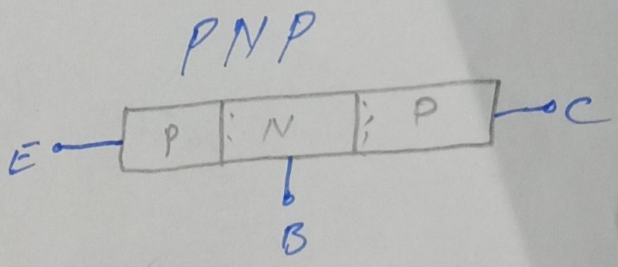
* BJT invented in dec 1947 at bell labs at USA.

* BJT is a three terminal

device and it is used in amplification of weak signals used in Switching operation.

* physical structure:





* 2 junction (N)
* 1 junction (P)
* J_1 → emitter-base
* J_2 → collector-base
* there is a diffletion region at J_1
* There is a depletion region at J_2.

width C > E > B

doping = E > C > B

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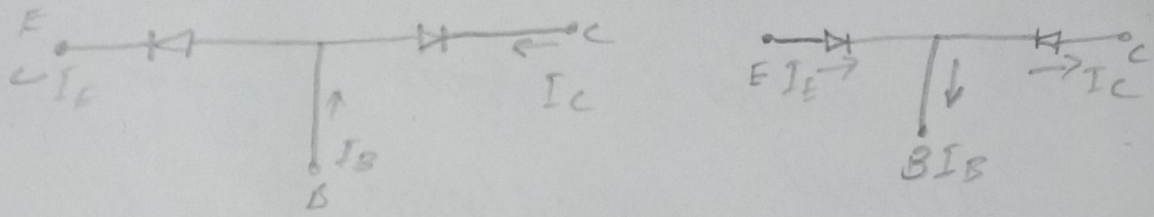
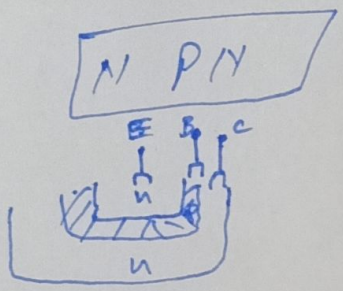
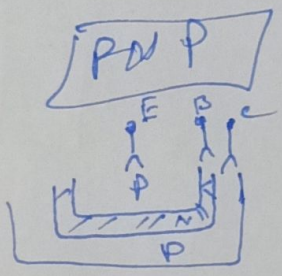
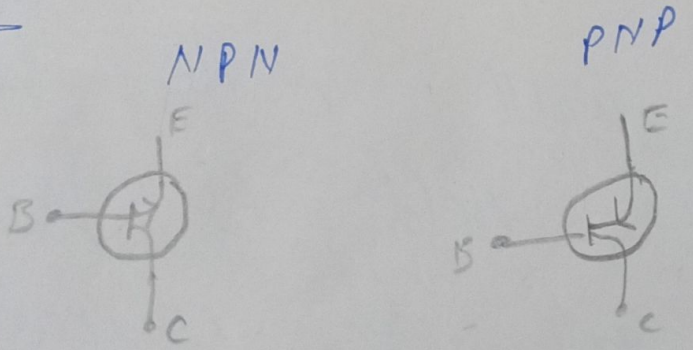


Cross section view





Symbol

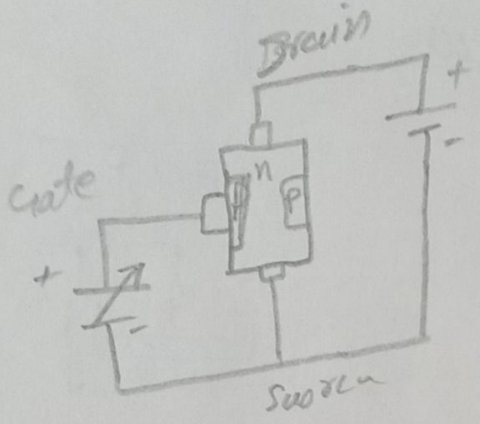


• increase of NPN then will more from B → E.

Q NOS :-

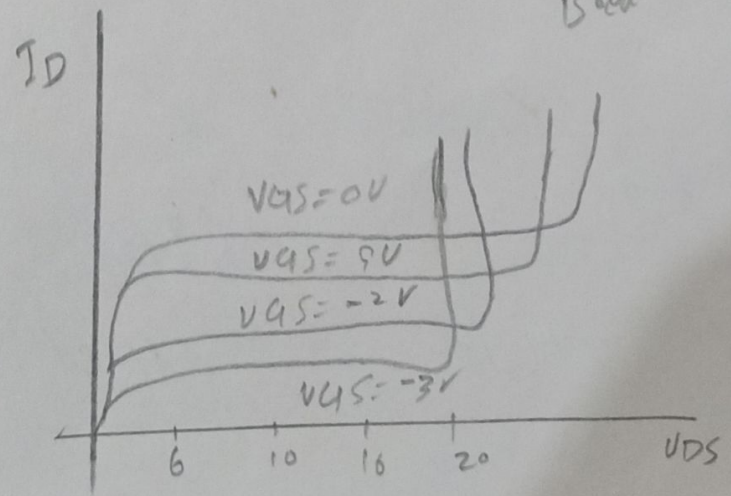
Ans :- JFET is type of junction field effect transistor

which is voltage controlled device as differ from BJT which is current controlled.

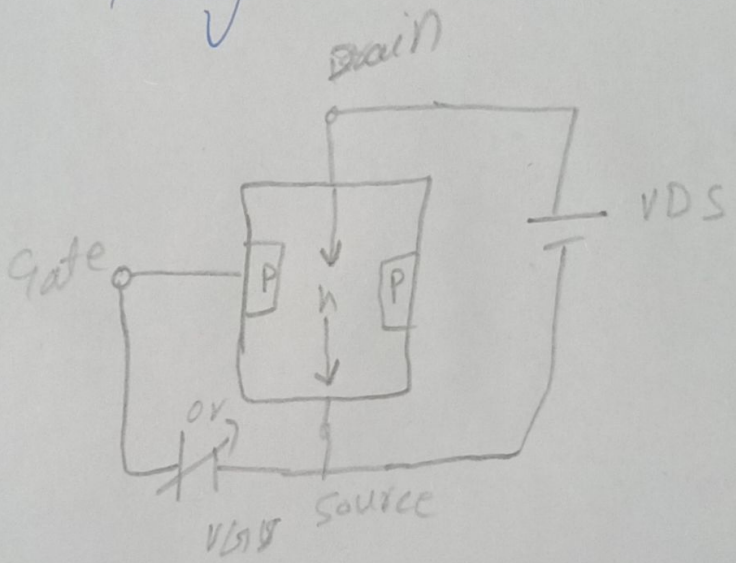


Actually in FET the drain to Source current is controlled by the width of the channel the electric field is produced by the gate to source voltage.

Break down voltage.

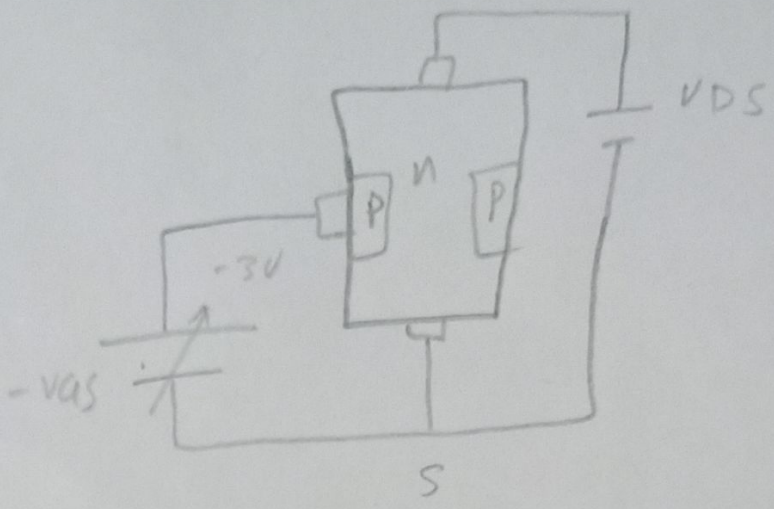


so if we see to the graph with the no voltage applied to the gate the current flows freely



the channel are wider and Drain current moves freely

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



So VGS is more negative

So no current flows and

this effect is called

Pinch off region no current

or less current flow.