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

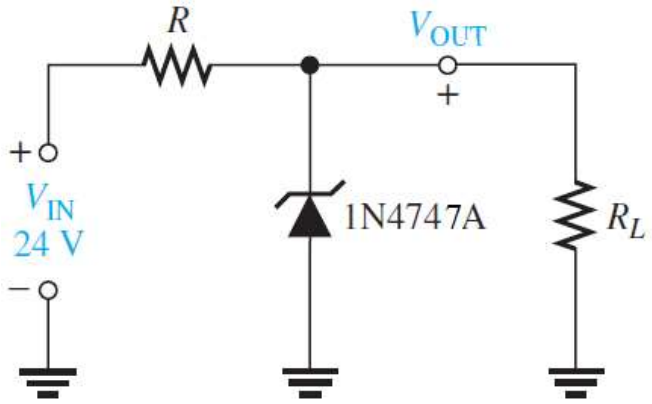
Course Details

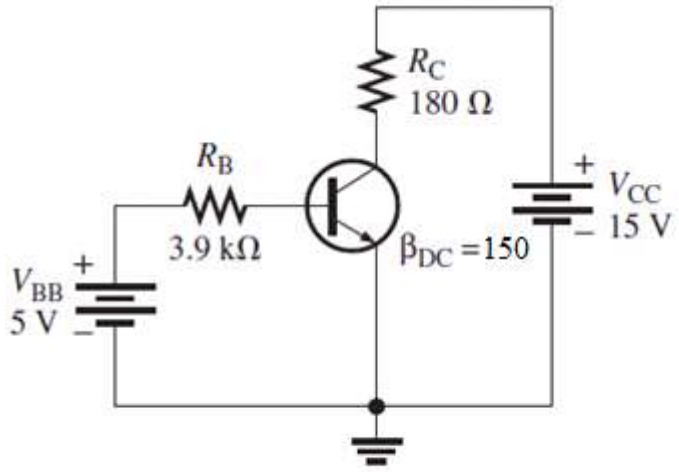
Course Title: Electronic Devices and Circuits **Module:** 4th semester
Instructor: Dr shehryar **Total Marks:** 50

Student Details

Name: M.Salman shahid **Student ID:** 15006

Student Signature: _____

Q1.		The 1N4747A zener used in the regulator circuit of Figure 1 is a 15 V diode, determine the following: (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**	Marks 10 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 CLO 02

		 **Figure 2**	
Q3.		Discuss how is BJT used as an amplifier with the help of schematic diagram for a basic BJT amplifier? Which basic configurations are required for it? Consider input AC and DC values as 5μA and 15μA respectively, assume β = 200.	Marks 10 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.** 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	Marks 05 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: 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.	Marks 10 CLO 03

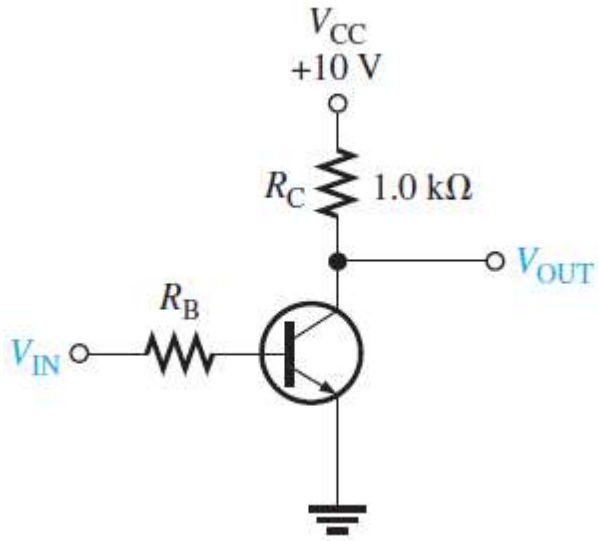
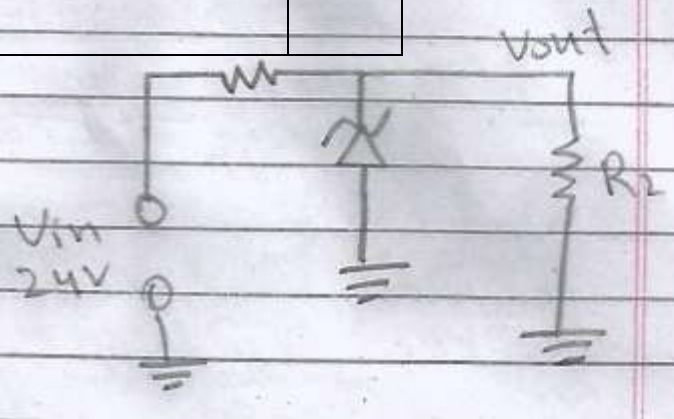


Figure 3

Q 1.		The 1N4747A zener used in the regulator circuit of Figure 1 is a 15 V diode, determine the following: (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**	Marks 10 CLO 02



a) for I_{ZM}

$$V_{out} = V_Z - \Delta I_Z Z_Z$$

$$= 20 - (12.25\,mA)(22\Omega)$$

$$= 19.7305\,V.$$

Now for zener max current
Power dissipation 1W

$$I_{ZM} = \frac{P_{D(MAX)}}{V_Z} = \frac{1}{20} = 0.05$$

$$I_{ZM} = 50\,mA$$

for I_{ZM} :-

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

$$= 20V + (I_z - I_z) Z_z$$

$$= 20V + (0.0542)(20)$$

$$= 21.1924V$$

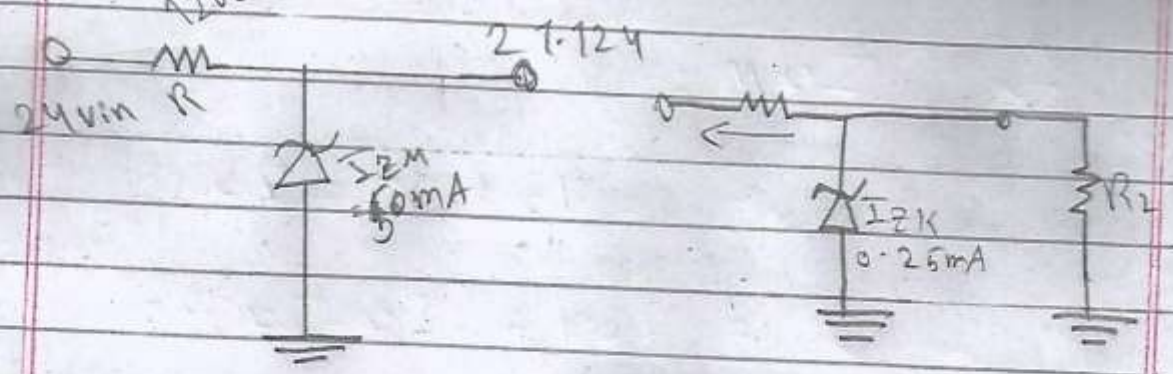
b) Calculating value of R for Max zener current that occurs when there is no load.

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

$$= \frac{24V - 21.1924V}{50mA} = \frac{2.8076}{}$$

$$= 56.152\,\Omega$$

$$R = 50\,\Omega$$



C) For the minimum load resistance (max load current) the zener current is $I_{ZK} = 0.25\,mA$

$$I_T = \frac{V_{IN} - V_{out}}{R} = \frac{24 - 19.0735}{60\,\Omega}$$

$$= 0.07491667$$

$$= 74.9166\ mA$$

$$I_L = I_T - I_{ZK}$$

$$= 74.9166 - 0.25$$

$$= 74.666\,mA$$

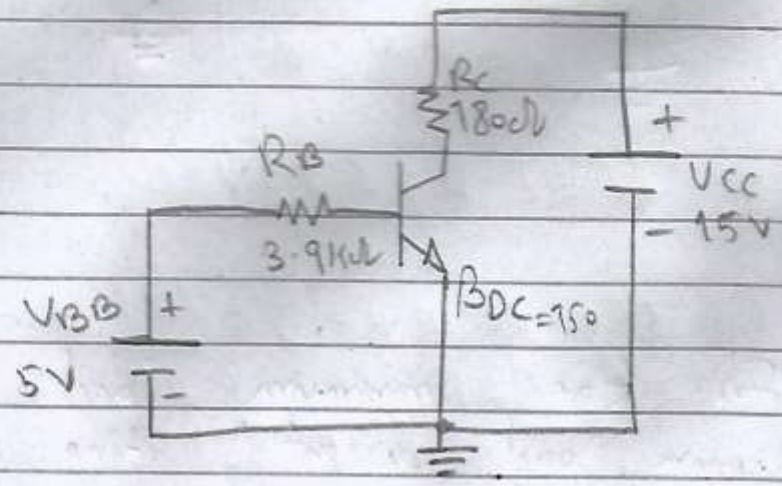
$$R_{L(min)} = \frac{V_{out}}{I_L} = \frac{19.7335}{74.666\,mA}$$

$$= [redacted]$$

$$= 264\,\Omega$$

Q2.		Determine I_B, I_C, I_E, V_{BE}, V_{CE} and V_{CB} in the circuit shown in Figure 2.	Marks 05 CLO 02

Figure 2



Sol:- As we know from Base to emitter voltage drop is equal to $V_{BE} = 0.7V$

So Base current

$$I_B = \frac{V_{BB} - V_{BE}}{R_B} = \frac{5 - 0.7}{3.9k\Omega}$$

$$= 0.001102\,5A$$

$$= 1102.564\mu A$$

$$I_C = \beta_{DC} I_B = (150)(1102.564A)$$

$$= 165384$$

$$= 165.384mA$$

$$I_E = I_C + I_B$$

$$= 165.384mA + 1102.584\mu A$$

$$= 1267.948mA$$

Now for V_{CE} & V_{CB}

$$V_{CE} = V_{CC} - I_C R_C$$

$$= 15 - (165.384\,mA)(180\,\Omega)$$

$$= 15 - (0.0653)(180)$$

$$= 15 - (11.79)$$

$$V_{CE} = 3.21$$

$$V_{CB} = V_{CE} - V_{BE}$$

$$3.21 - 0.7 = 11.79$$

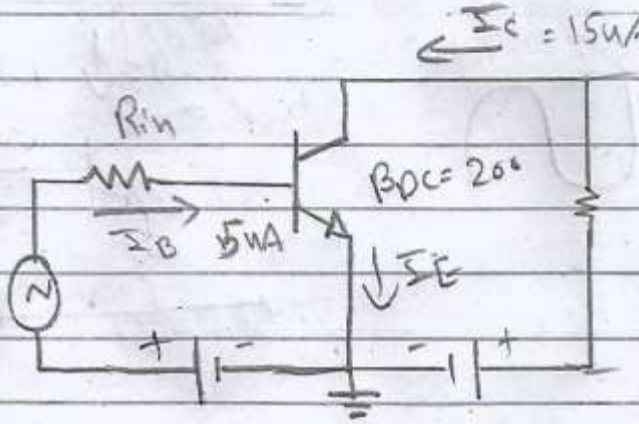
Q3.		Discuss how is BJT used as an amplifier with the help of schematic diagram for a basic BJT amplifier? Which basic configurations are required for it? Consider input AC and DC values as 5μA and 15μA respectively, assume β = 200.	Marks 10 CLO 03

Ans:-

for using BJT as an amplifier we need to set them in Active region because BJT working as an amplifier when use is active region.

Transistor has three Basic configuration for using it in Amplification mode.

Common Base :- Voltage Gain no Current
Common Emitter Both gain
Common Collector Current gain no voltage



So this is common emitter Configuration of transistor which has both voltage & current amplification.

$$I_C = \beta \cdot I_B$$

$$= 200 + 5\mu A$$

$$I_C = 200.00005\mu A$$

$$I_E = I_C + I_B$$

$$I_E = 200.00005\mu A + 15\mu A$$

$$\boxed{I_E = 200,00002}$$

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 CLO 02

Q4:-

(Transistor fully ON)

: BE junction is forward Biased

: Max saturation current I_c flows

(Transistor fully off)

: Input & Base are at 0V

: Collector Current $I_c = 0$

: $V_{CE} = V_{CC}$

: BE junction is reversed Biased

: BC junction is forward Biased.

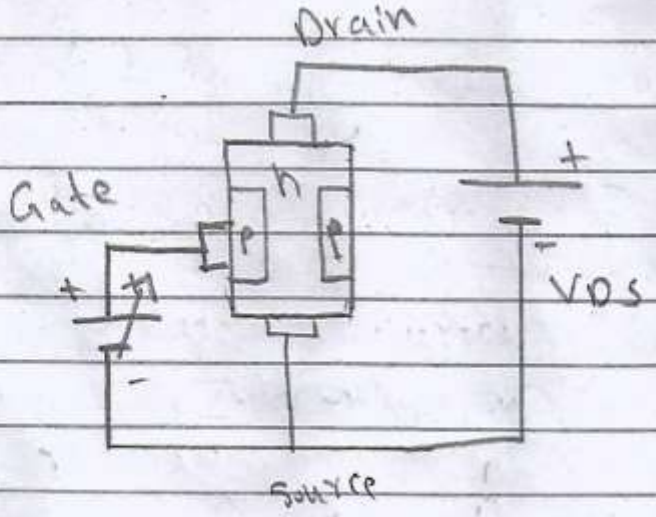
: $V_{CE} = 0V$

: BE junction is less than 0V

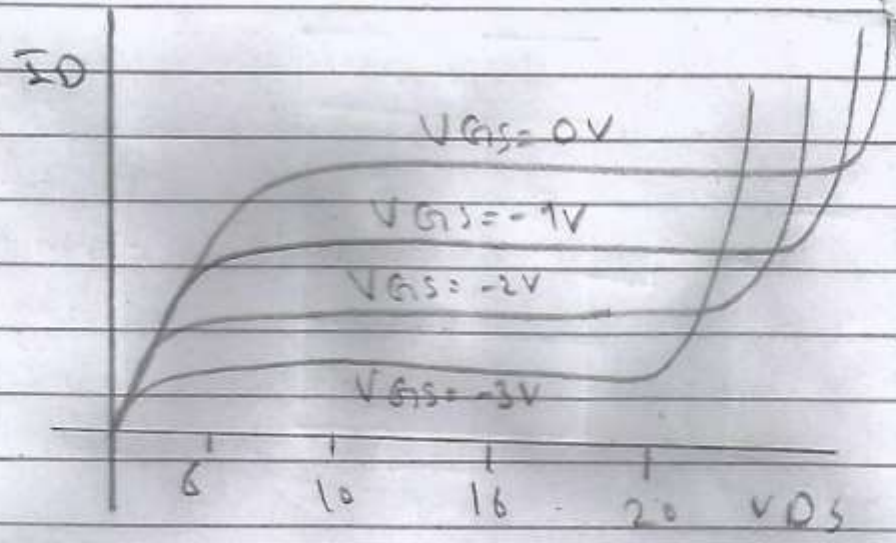
Q5.		Discuss that how JFET (n-channel) can be used as voltage control device when the value of V_{GS} < 0V and V_{DS} > 0V. Draw schematics with polarity conventions and explain the operation in detail.	Marks 10 CLO 03

Q5:-

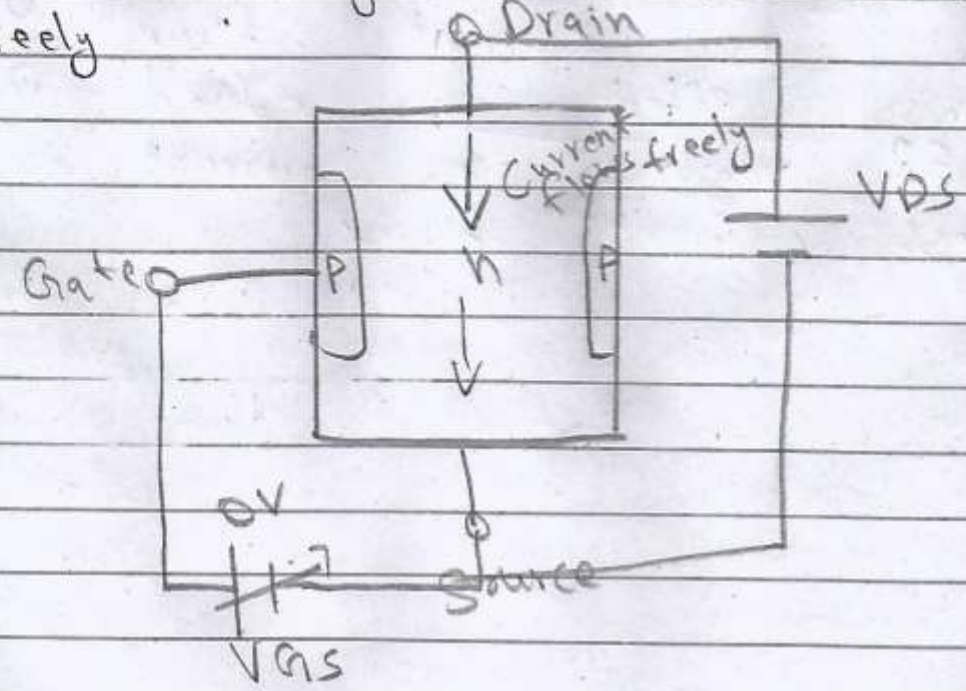
Ans:- JFET is a type of junction field effect transistor which is voltage controlled device as differ from BJT which is current controlled.



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.

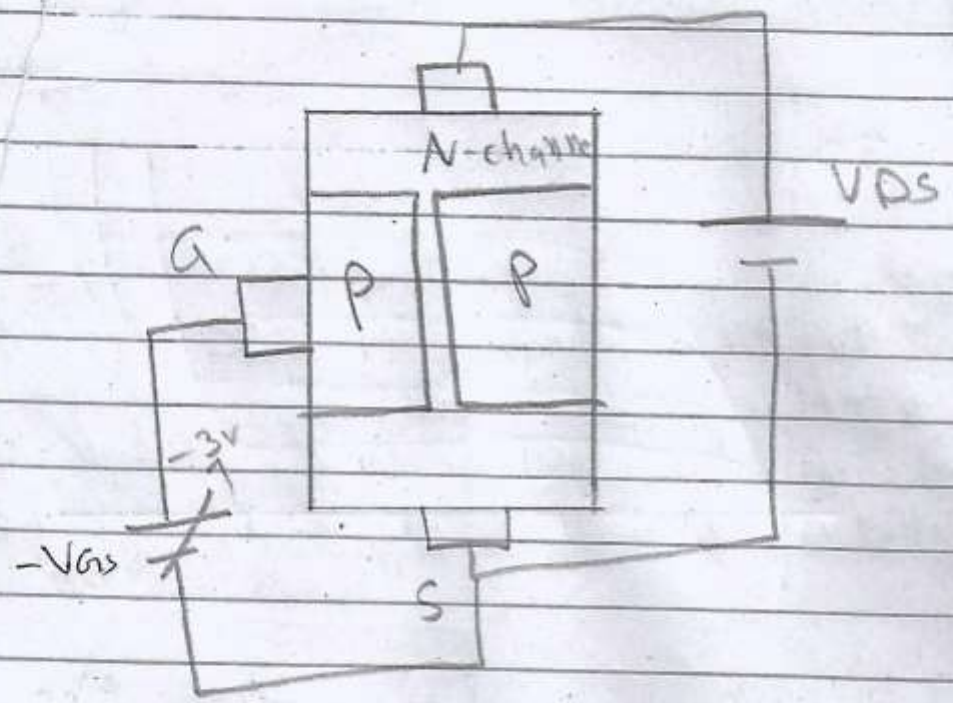


So if we see to the graph whith the no voltage applied to the gate the current flows freely.



the channel are wider and Drain current moves freely

if we move ~~VGS~~ to negative value the channel width start to decreases and current cannot moves.



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

Q6.		For the transistor circuit given in Fig. 3, calculate the following: 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.	Marks 10 CLO 03

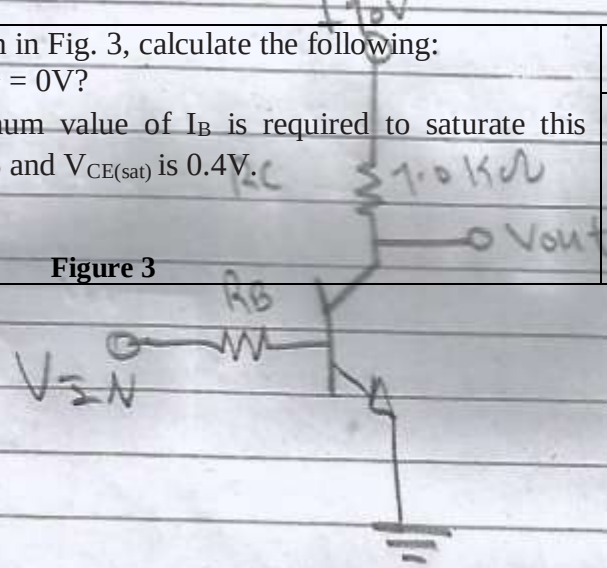


Figure 3

Sol - a) When $V_{IN} = 0V$ the transistor is in cutt off so act like open switch

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

b)

Minimum value of I_B to saturate the transistor.

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

So required IC

$V_{CC} = 10V \quad R_C = 1.0k\Omega$

$$I_{C(sat)} = \frac{V_{CC}}{R_C} = 0.01$$

So $I_{B(min)} = \frac{I_{C(sat)}}{\beta_{DC}}$

$$= \frac{0.01}{125} = 0.00008$$

$= 0.08 mA$