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Subject Name: Basic Electronics
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Note: Attempt all Questions

Q1:

a. Explain how JFET works, including the pinch off and gate-source cutoff voltage?

The MOSFET works by electronically varying the width of a channel along which charge carriers flow (electrons or holes). The charge carriers enter the channel at source and exit via the drain. The width of the channel is controlled by the voltage on an electrode is called gate which is located between source and drain.

Pinch off voltage: Pinch off voltage is   the   drain   to source voltage after   which   the   drain to source current becomes almost constant and JFET enters into saturation region and is defined only when gate to source voltage is zero.

b. Draw the drain curves and the trans conductance curve for a JFET?

The trans conductance curve, as for all semiconductor devices, is nonlinear, for most of the curve, meaning changes to VGS do not directly increase or decrease drain current, ID. Below are the trans conductance curves of N-Channel JFET transistors and P-Channel JFET Transistors.

(a) Drain curves

(b) Transconductance curve

(c) Transconductance curve of any JFET

(d) Normalized transconductance curve
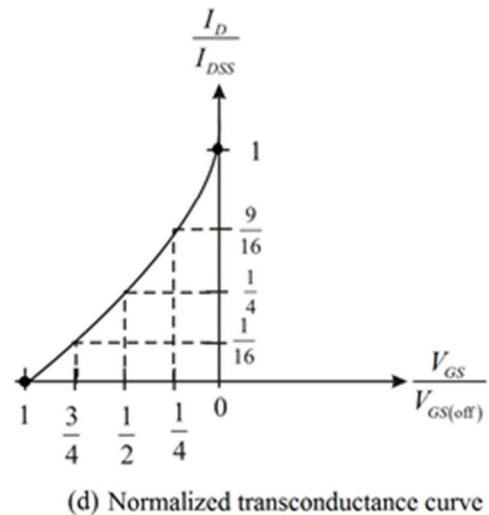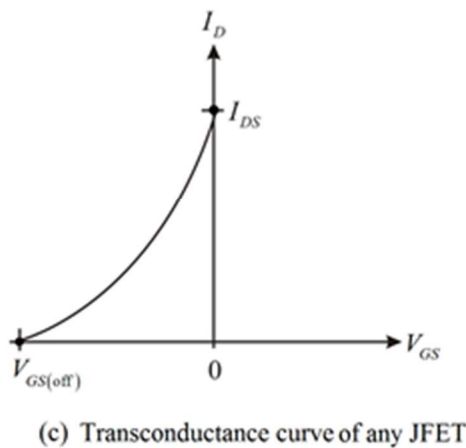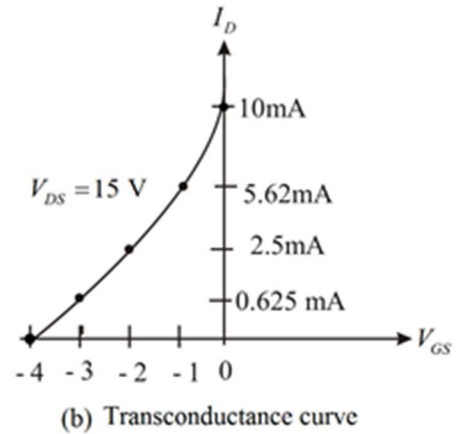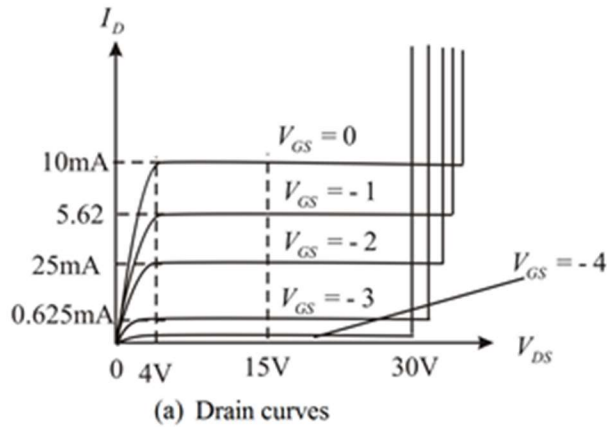
c. **Compare the JFET and the bipolar junction transistor. Also explain the advantages and disadvantages of each?**

	BJT is known as Bipolar Junction Device because it uses both electrons and holes for conduction.	JFET is known as unipolar device because current is due to one charge carriers i.e. electrons or holes
input Resistance	BJT offers low input resistance.	JFET offers large input resistance order of $1M\Omega$ to $5M\Omega$.
Biasing used	Fixed bias, Collector base bias, Voltage divider biasing.	Self bias& Voltage divider biasing.
Operating Region	Active, Saturation & Cut off region.	Ohmic & Pinch off region

Thermal Runaway	Thermal runaway occurs at high temperature.	No thermal runaway.
Type of device	Current controlled device.	Voltage controlled device.
Terminals	Base, Emitter & Collector.	Gate, Drain & Source.
Input current	Input current is order of mA (milli ampere).	Gate current is order of nA (nano ampere).
Applications	Low Current application.	Low voltage application.

There are some advantages BJT of JFET which are given below,

The JFET has high input impedance.
The JFET can be fabricated in small size area.
It is a majority charge carrier device, hence it has less noise.
It is a low power consumption device.
It can be fabricated in small size area.
It occupies less space in circuits due to its smaller size.

It has a negative temperature coefficient of resistance, so they possess higher Temperature Stability.
The BJT has a large gain bandwidth.
It shows better performance at high frequency.
It has a better voltage gain.
It can be operated in low or high power applications.
It has high current density.
There is a low forward voltage drop.

disadvantages BJT of JFET which are given below,

The main disadvantage of the JFET is the relatively low gain bandwidth product.
The performance of JFET goes downs as frequency increases due to feedback by internal capacitance.

- The BJT is more an effect of radiation.

- It has a very complex base control. So it may lead to confusion and requires a skilful handling.

- The switching frequency of a BJT is low.

- It more noise produced.

- It has a low thermal stability.

a. Draw an npn transistor showing the n and p regions. And then bias the transistor properly and explain how it works?
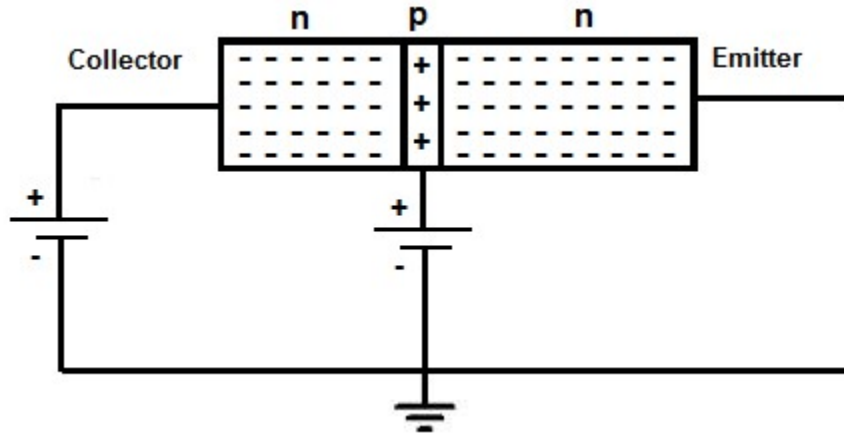
b.

How an NPN Transistor Works. A NPN transistor is a transistor which is made up of 3 regions, the base, the emitter, and the collector. The collector and emitter regions are made up of N-type material, which means they are predominately composed of electrons. Electrons are negative charges. The base region is made up of P-type material.

c. **Draw a set of collector curves.**
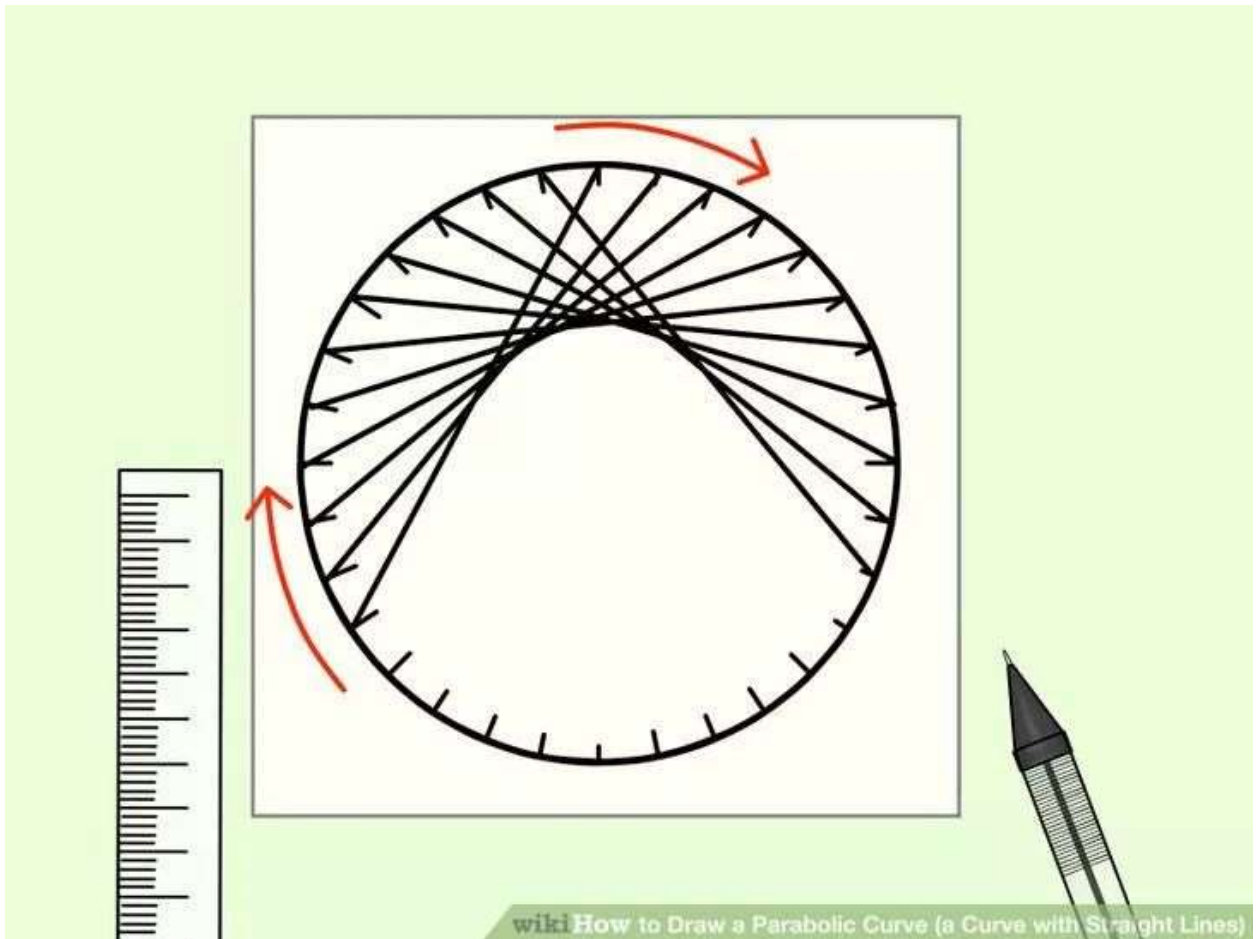
d. **Then, using these curves show how the four operating regions of a transistor?**

e. These biasing methods make the transistor circuit to work in four kinds of regions such as Active region, Saturation region, Cutoff region and Inverse active region (seldom used). This is understood by having a look at the following table.