AMRITA SCHOOL OF COMPUTING CHENNAI

AMRITA VISHWA VIDYAPEETHAM

22AIE114 INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING

ASSIGNMNENT - 2

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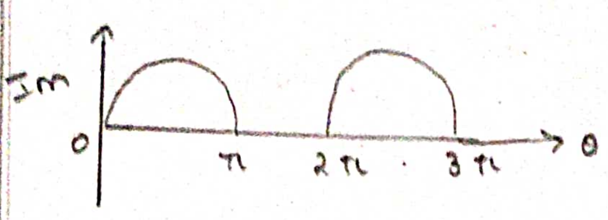
1)

Part a)



a) Average value = $\frac{\text{Area}}{\text{Time period}}$

$$= \frac{2V_m}{2\pi}$$

$$\boxed{\text{Average value} = \frac{V_m}{\pi}}$$

b) Rms value = $\sqrt{\frac{\text{Square of area}}{\text{Time period}}}$

$$= \sqrt{\frac{\int_0^{\pi} V_m^2 \sin^2\theta \, d\theta}{2\pi}}$$

$$= \sqrt{\frac{V^2 \int_0^{\pi} \frac{1}{2} - \frac{\cos 2\theta}{2}) \, d\theta}{2\pi}}$$

$$= \sqrt{\frac{\frac{V_m^2 \times \pi}{2}}{2\pi}}$$

$$= \sqrt{\frac{V_m^2}{4}}$$

$$\boxed{\text{rms value} = \frac{V_m}{2}}$$

c) Form factor:

$$\text{form factor} = \frac{V_{rms}}{V_{avg}} = \frac{\frac{V_m}{2}}{\frac{V_m}{\pi}} = 1.57$$

d) Peak factor:

$$\text{peak factor} = \frac{V_m}{V_{rms}} = \frac{V_m}{V_m/2} = 2$$

1) part b

a) Average value:

$$\text{Average value} = \frac{\text{Area}}{\text{Time period}}$$

$$\Rightarrow \frac{2V_m}{\pi}$$

b) rms value $= \sqrt{\frac{(\text{Area of squared value})}{\text{Time period}}}$

$$\text{rms value} = \sqrt{\frac{V_m^2 \times \cancel{\pi}}{2 \times \cancel{\pi}}}$$

$$= \frac{V_m}{\sqrt{2}}$$

c) form factor:

$$\text{form factor} = \frac{V_m}{V_{rms}} = \frac{V_m}{V_m/\sqrt{2}} = \sqrt{2}$$

d) peak factor:

$$\text{Peak factor} = \frac{\frac{V_{\cancel{m}}}{\sqrt{2}}}{\frac{2V_{\cancel{m}}}{\pi}} = \frac{\pi}{2\sqrt{2}}$$

$$= 1.11$$

(2) $v(t) = 171.4 \sin 314t$

a) Max voltage :-

$$\boxed{V_m = 171.4V}$$

* Amplitude is the max voltage

b) Average voltage :-

$$V_{avg} = \frac{V_m}{\pi}$$

$$= \frac{171.4}{\pi}$$

$$= 54.55V$$

c) Rms voltage :-

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$= \frac{171.4}{\sqrt{2}}$$

$$= 121.19V$$

d) frequency :-

$$\omega = 314$$

$$f = \frac{\omega}{2\pi}$$

$$= \frac{314}{2\pi}$$

$$\boxed{f = 49.97Hz}$$

e) Time :-

$$T = \frac{1}{f}$$

$$= \frac{1}{49.97}$$

$$\boxed{T = 0.02s}$$

(or)

$$\boxed{T = 20ms}$$

f) Instantaneous Voltage, when $t=4ms$:-

$$v(t) = 171.4 \sin(314 \times 4 \times 10^{-3})$$

$$= 171.4 \sin(1.256)$$

$$= 171.4 \times 0.0219$$

$$\boxed{V(4) = 3.757V}$$

3)

$$v(t) = 283 \sin 314t$$

$$i(t) = 4 \sin(314 - 45^\circ)$$

a) Resistance:-

$$\phi = 45^\circ$$

$$Z = \frac{V_m}{I_m} = \frac{283}{4} = 70.75\,\Omega$$

$$\cos\phi = \frac{R}{Z}$$

$$R = \cos 45^\circ \times Z$$

$$R = 0.707 \times 70.75$$

$$\boxed{R = 50.02\,\Omega}$$

b) Inductance:

$$Z = \sqrt{R^2 + X_L^2}$$

$$X_L = \omega L$$

$$\boxed{X_L^2 + R^2 = Z^2}$$

$$X_L^2 = Z^2 - R^2$$

$X_L = \sqrt{Z^2 - R^2}$

$= \sqrt{(70.75)^2 - (50.02)^2}$

$= \sqrt{2503.562}$

$\boxed{X_L = 50.03\Omega}$

$X_L = \omega L$

$L = \frac{X_L}{\omega}$

$L = \frac{50.03}{314}$

$\boxed{L = 0.15H}$

(or)

$\boxed{L = 15mH}$

Power factor :-

$\cos\phi = \frac{R}{Z}$

$\cos\phi = \frac{50.02}{70.75}$

$\boxed{\cos\phi = 0.7069}$

4) a) Resistance,

$Z = \frac{V_m}{I_m} = \frac{200}{10} = 20\Omega$

$\boxed{Z = 20\Omega}$

b) Reactance:-

$\cos\phi = \frac{R}{Z}$

$R = \cos\phi \times Z$

$\boxed{R = 17.32\Omega}$

c) Inductance :-

$Z = \sqrt{R^2 + X_L^2}$

$X_L = \sqrt{Z^2 - R^2}$

$X_L = \sqrt{(17.32)^2 - (20)^2}$

$\boxed{X_L = 10.008\Omega}$

$X_L = \omega L$

$L = \frac{X_L}{\omega} \Rightarrow \frac{10.008}{314.15}$

$\boxed{L = 0.3\,H \text{ or } 31\,mH}$

5) $I_m = 10\,mA$

$\tan\phi = \frac{V_C}{V_R}$

$= \frac{40}{30}$

$\phi = \tan^{-1}\left(\frac{4}{3}\right) \Rightarrow \boxed{\phi = 53.06}$

$V_m = \sqrt{V_R^2 + V_C^2}$

$= \sqrt{40^2 + 30^2}$

$\boxed{V_m = 50\,V}$

$Z = \frac{V_m}{I_m}$

$= \frac{50 \times 10^3}{10}$

$\boxed{Z = 5\,k\Omega}$

6) $V_m = 130\,V,\ R = 145\,\Omega$

$\omega = 2\pi f$

$= 2\pi \times 60$

$\boxed{\omega = 376.8\ rad/s}$

a) capacitor value:-

$X_C = \frac{1}{\omega C}$

$Z = \sqrt{R^2 + X_C^2}$

$X_C^2 = Z^2 - R^2$

$X_C = \sqrt{Z^2 - R^2}$

$X_C = \sqrt{(208)^2 - (145)^2}$

$= \sqrt{22239}$

$\boxed{X_C = 149.12\,\Omega}$

b) power:-

$P = VI$

$Z = \frac{V_m}{I_m} \Rightarrow I_m \Rightarrow \frac{130}{208} \Rightarrow 0.625\,A$

$P = 130(0.625)$

$\boxed{P = 81.25\,W}$

c) power factor :-

$\cos\phi = \frac{R}{Z} \Rightarrow \phi \cos^{-1}\left(\frac{R}{Z}\right)$

$\cos\phi = \cos^{-1}\left(\frac{145}{208}\right)$

$\cos\phi = 0.697$

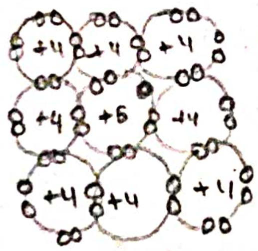
$\boxed{\cos\phi = 0.697}$

7 PN-Juntion:

The PN-Juntion is formed between the p-type and hava n-type semiconductors. In this p-N juntion is an interface or a bondary between two semiconductor material types, namely the P-type and the n-type inside a semi-conductor.

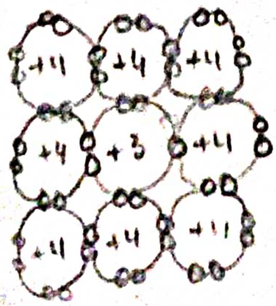
N-type:

* When extra valence electrons are introduced into a material such as silicon and n-type material is produced. The extra valence electrons are introduced by putting impurities or dopant into the silicon. The dopant used to create an n-type material are group V element. The most commonly used. dopant from Group V are arsenic, antimony and phosphorous

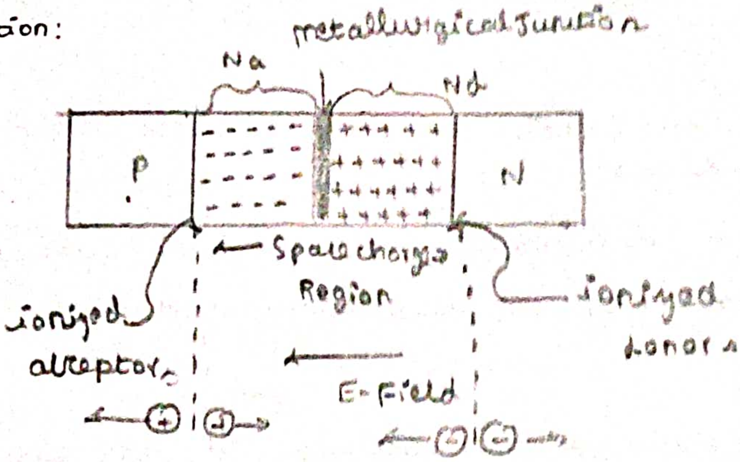


P-type:

P-type material is produced when the dopant that is introduced is from Group III. Group III elements have only 3 valence electrons and therefore there is an electron missing. This creates a hole (h+), or a +ve charge that can move around in the material. Commonly used Group III dopant are aluminium, boron and gallium.



PN – Junction:



Characteristics of P-N Junction Diode:

forward bias: In forward bias the depletion region shrinks slightly in width. with this shrinking the energy required for charge carriers to cross the depletion region decreases exponentially. therefore, as the applied voltage increases, current starts to flow across the junction

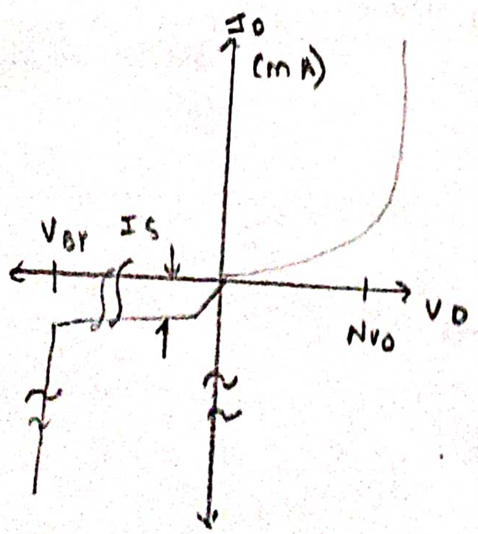
$V_{applied} > 0$

Reverse bias:

Under Reverse bias the depletion region widens. This causes the electric field produced by the ions to cancel out the applied reverse bias voltage. A small leakage current. Is (saturation current) flows under reverse bias condition

$V_{applied} < 0$

I - v characteristic graph



VD ⇒ Bias voltage

ID ⇒ current through Diode. ID is -ve for reverse bias & +ve for FB

Is ⇒ Saturation current

VBR ⇒ Breakdown voltage

Vϕ ⇒ Barrier potential voltage

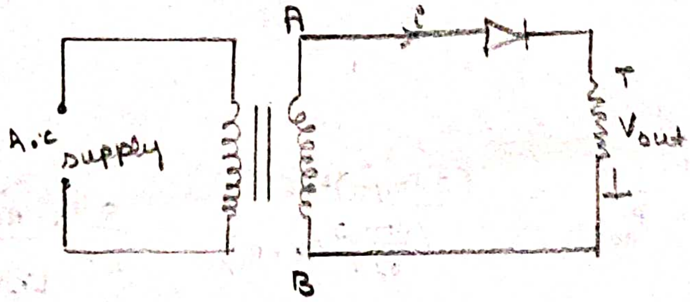
8) Work principle of half-wave & Full wave wave Rectifier and also obtain the efficiency of the both rectifier

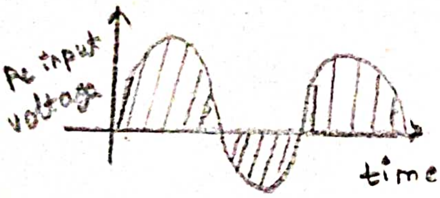
half-wave-rectification

• In half-wave rectification, the rectifier conducts current only during the +ve half-cycles of input a.c supply

* The -ve half-cycle of a.c supply are suppressed (i.e during -ve half cycles, no current is conducted and no voltage appears across the load. therefore current always flows in one direction (i.e) d.c through the load through after half-cycle

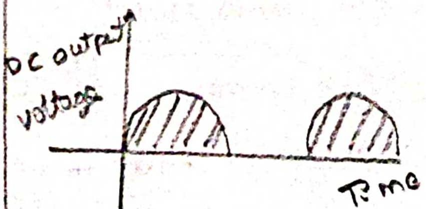
Working of half-wave Rectifiers





* During +ve half cycle ⇒

the half wave rectifier allows only the +ve part of an AC signal. the -ve part is blocked this pulsating DC voltage is then sent to load resistor



* During 2nd half cycle ⇒

the current flows in the opposite direction from -ve to +ve

Efficiency of half-wave Rectifier

$$\text{efficiency of Rectifier} = \frac{\text{d.c power output}}{\text{Input a.c power}} \Rightarrow \frac{(I_m/\pi)^2 \times R_C}{(I_m/2)^2\ (r+R_C)} = \frac{0.406 R_C}{1+\frac{R_f}{R_C}}$$

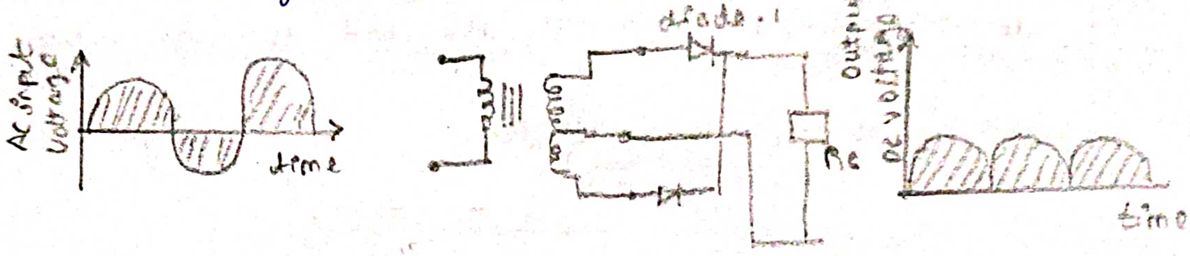
Max. rectifier efficiency = 40.6%

Full wave - Rectifier

• In full wave rectification current flows through the load in the same direction for both half-cycles of input a.c voltage.

This can be achieved with two diodes working efficiently and alternatily

• For the +ve half-cycle of input Voltage. one diode supplies current to the load and for the -ve half-cycle. the other diode does so the current always been in the same direction



efficiency⇒

$$n = \frac{P_{dc}}{P_{ac}} = \frac{(2I_m/\pi)^2 R_L}{\left(\frac{I_m}{\sqrt{2}}\right)^2 (r + R_c)} = \frac{8}{\pi^2} \times \frac{R_c}{[r_f + R_c]}$$

$$= \frac{0.812}{1 + \frac{r_f}{r_c}}$$

Max. efficiency = 81.2%.

(9) the characteristics of common emitter transistor with sketch.

• Common Emitter transistor → two terminals are needed for input and two terminals for output. Transistors have three terminals. So one terminal have to be taken as common terminal for both input and output

→ In common emitter, terminal emitter is taken as common for both input and output. so input is given b/w base and the emitter terminals.

→ the one of the most used common emitter transistor configuration is BJT.

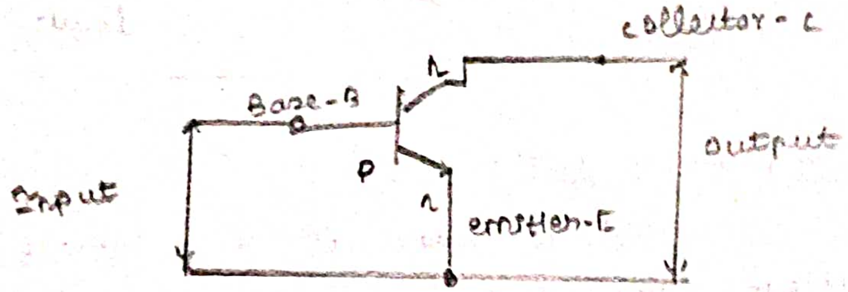
Input characteristics:-

* The input characteristics of BJT shows the relationship b/w the base current and the base - emitter voltage.

* It exhibits an exponential relationship, where a small change in VBE results in a significant change in the base current.

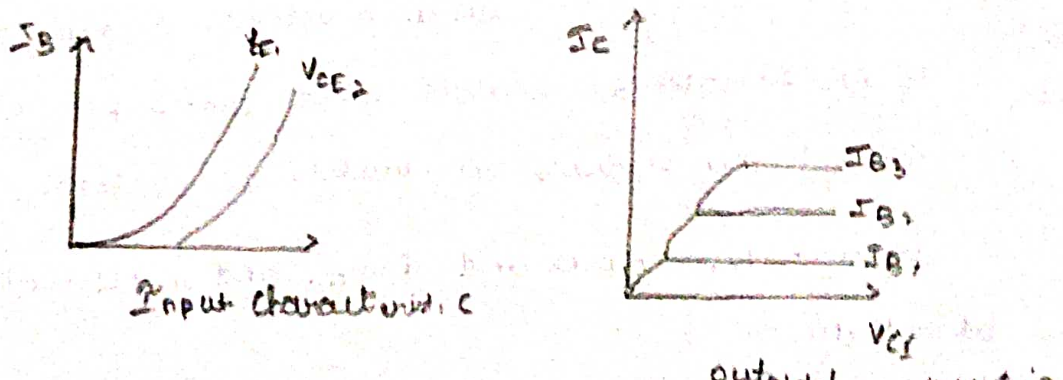
Output characteristics:-

* The output characteristic of the curve illustrates the relationship between collector current and the collector - emitter voltage.



Common emitter (CE) configuration

I-V characteristic curve of BJT



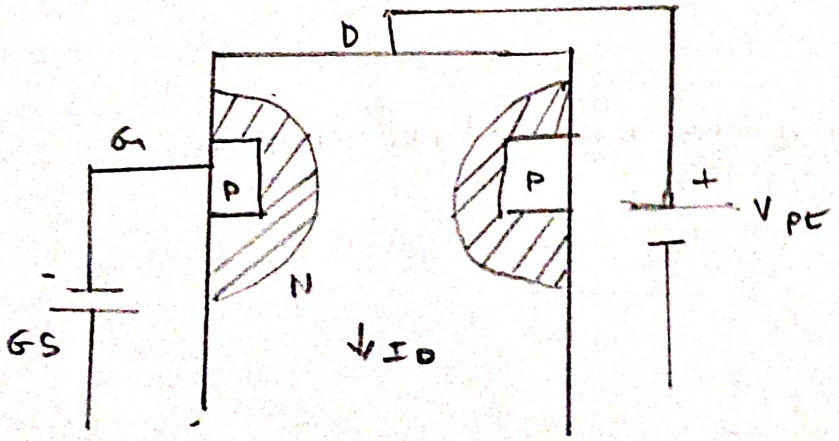
10) Write Difference BJT and FET & Explain

BJT		FET
3	No. of terminals	3
npn (or) pnp	Semi-conductor material	N-type or p-type
controlled by base current	current flow	current controlled by gate voltage
higher	Gain	Lower
slower	Switch speed	faster.
Higher	Noise level	lower.

Working principle for N-channel JFET:

An N-channel JFET is a type of FET that uses an N-type semiconductor material for the channel. the gate is insulated from the channel by a thin layer of oxides

when a voltage is applied to the gate of it creates an electric field that repels electrons in the channel. this reduces the number of electrons than can flow between the source and drain, and hence the current that flows between them.



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