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Electronic Devices & Circuits
BE(E) Mid Exam.
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Q5 A) What is Power Supply filter? Discuss its operation with help of a Circuit diagram.

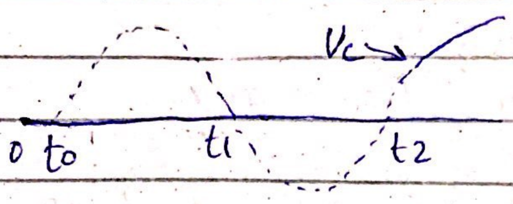
Ans:- A Power Supply filter ideally eliminates the fluctuations in the output Voltage of a half wave or full wave rectifier & Produces a Constant level dc-voltage

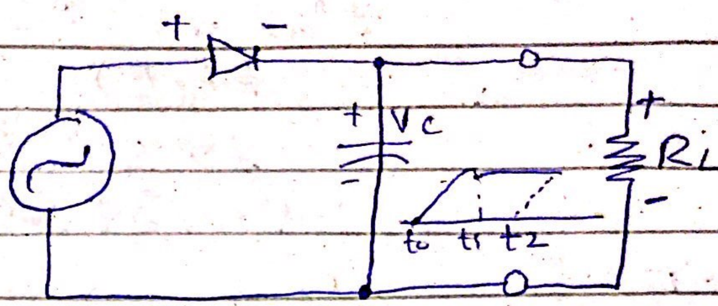
The filter is Simply a Capacitor Connected from the rectifier output to ground.

The output of a filter is nearly Smooth dc output Voltage.

The small amount of fluctuation in the filter output Voltage is called ripple.

# Operation of Power Supply filter.




a) Initial Charging of the Capacitor (diode is forward-biased) happens only once when Power is turn on.

b) The Capacitor discharges through $R_L$ after peak of Positive alternation when diode is reverse biased. The discharging occurs during the Portion of the input voltage indicated by the Solid dark blue curve

c) The Capacitor Charges back to Peak of input when the diode becomes forward biased. This Charging occurs during the portion of the input Voltage indicated by Solid dark blue curve

Q5 b) How are n-type and ptype Semiconductor formed?

Ans:- N-type & P-type Semiconductors are formed through a process called doping - which resist in extrinsic (impure) Semi Conductor materials.

Doping is a process of controlled addition of impurities to intrinsic (pure) Semiconductor material so their conductivity can drastically increased.

N-type Semiconductor are formed by adding a pentavalent impurity atom in a Silicon Crystal structure For example antimony (Sb) is added & its extra electron becomes a free electron.

P-type Semiconductor are formed by adding a trivalent impurity to increase the no. of holes For Silicon (Si), Boron (B, trivalent impurity is added

Q5 c) What is a diode limiter? What is difference B/w a positive limiter & Negative limiter?

Ans:- Diode Circuit Called limiters or clippers are sometimes used to clip off portions of signal voltage above or below certain levels.

There are two types of basic diode limiter / clippers positive limiter or negative limiter.

Diode Positive limiter limits or clips off the positive part of the input Voltage whereas diode negative limiter limits or clips of a certain negative part of there input Voltage just by turning around the diode of the Circuit.

Q5 d) What component in a Clamping Circuit effectively act as battery?

Ans:- Capacitor is the Component in a Clamping Circuit that effectively act as a battery.

Q5 e) When a 60HZ Sinusoidal Voltage is applied to the input of a halfwave rectifier What is output frequency?

ANS:- When a 60HZ Sinusoidal Voltage is applied to the input of a halfwave rectifier The output frequency remain Same that is 60HZ.

Q5 f) If the load resistance Connected to a filtered Power Supply is decrease What happens to ripple Voltage?

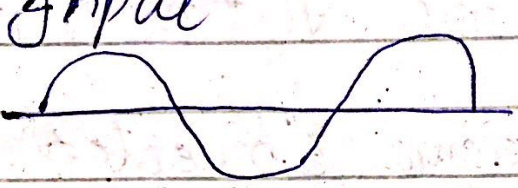
ANS:- If the load resistance Connected to a filtered Power Supply is decrease then the ripple Voltage is increased.

Q5 g) Discuss how Diode limiters & diode Clampers differ in term of their function?

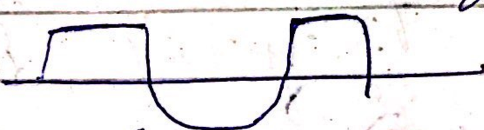
ANS:- Diode limiters are used to Clip off portions of Signal Voltages above or below Certain levels, whereas Clampers are circuits used to add a DC offset or a DC level to an AC Voltage
→ limiters are also Called as clippers & clampers are also Called as DC restorers.

→ Diode limiters are of two types. positive clippers or Negative clippers & clampers are of two types; positive Clamper or negative clampers.

Input

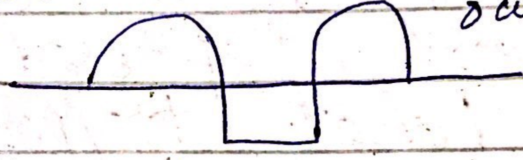


Positive limit



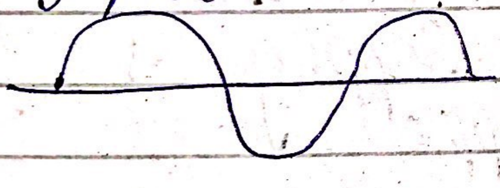
output.

negative limiter

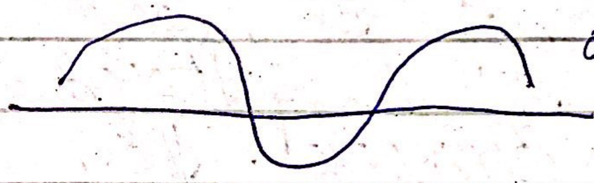


output

Input

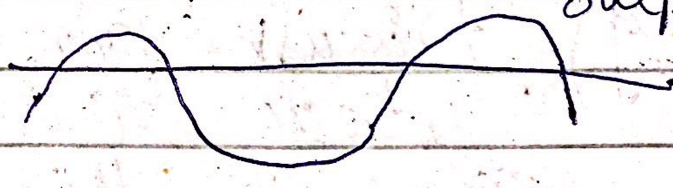


Positive clamper



output

negative clamper



output.

Q1 a) What type of Circuit is this?

ANS:: It is Called Center-tapped full Wave rectifier.

b) What is total Peak Secondary Voltage?

ANS:: $\frac{n_p}{n_s} = \frac{V_{p(P)}}{V_{p(S)}}$

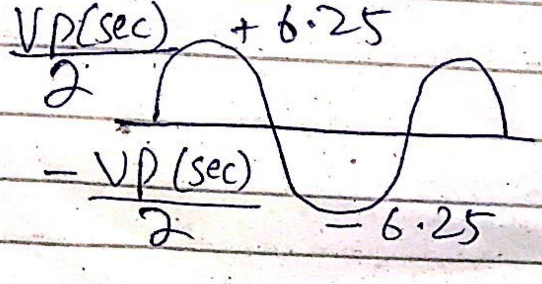
$\frac{4}{1} = \frac{50}{V_{p(S)}}$

$V_{p(S)} = \frac{50}{4} = V_{p(S)} = 12.5$

$\boxed{V_{p(S)} = 12.5V}$

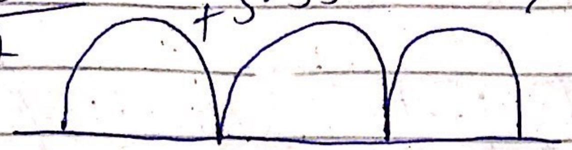
c) Find the peak Voltage across each half of the Secondary?

As we know from above $V_p(sec) = 12.5V$ So we can Show that the total peak Voltage can be given




$\frac{V_p(sec)}{2} = \frac{12.5}{2} = 6.25V$

& Voltage across each half after rectification.




$\Rightarrow \frac{Vp(sec)-0.7}{2} = \frac{12.5-0.7}{2}$

$= 5.55V$.

d) What is the peak Current through each diode?

let $I_{D1}$ & $I_{D2}$ be the Current through diode $D_1$ & $D_2$

Let $I_{D1} = I_{D2} = I_D$

from the figure in the question

$$I_D = \frac{V_D}{R_L} = \frac{\frac{Vp(sec)}{2} - 0.7}{R_L}$$

Putting the Values.

$$= \frac{\left(\frac{12.5-0.7}{2}\right)V}{10K\Omega} = \frac{5.55V}{10\times10^3\Omega}$$

$$= 0.555\times10^{-3} A$$

$$\boxed{I_D = 0.555 mA}$$

e) What minimum PIV rating must the diodes have?

Each diode must have a minimum PIV rating of

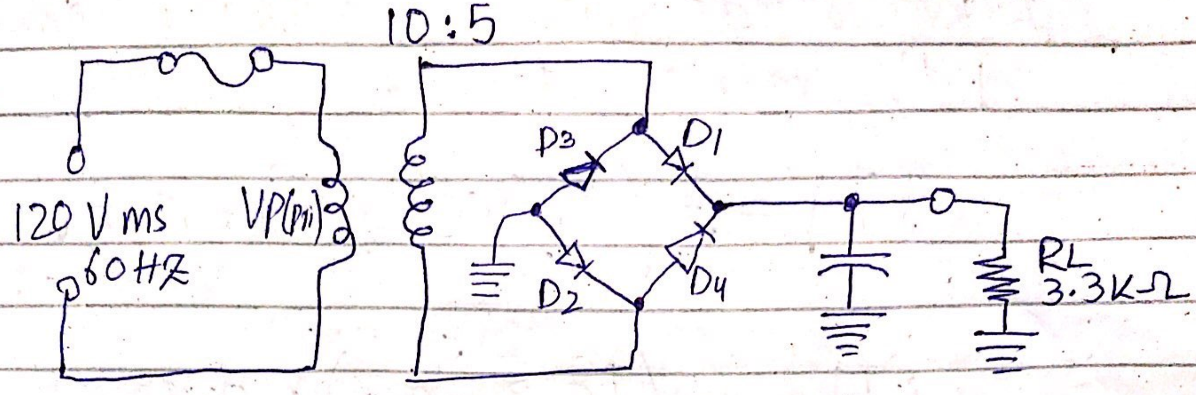
$$PIV = 2\left(\frac{V_{P(sec)}}{2} - 0.7\right) + 0.7V$$

$$PIV = 2\left(\frac{12.5}{2} - 0.7\right) + 0.7V$$

$$PIV = 2(5.55) + 0.7$$

$$\boxed{PIV = 11.8V}$$

Q2 Determine the ripple factor for the filtered bridge rectifier with a load as indicated




As from turn ratio we know

$$n = \frac{N_s}{N_p} = \frac{5}{10} = 0.5$$

We also know that

$$V_{P(pri)} = \sqrt{2} \times V_{rms}$$

$$= 1.414213 \times 120$$

$$= 169.705 \simeq 170V$$

$$\boxed{V_{P(pri)} = 170V}$$

Also for peak Secondary Voltage

$$\frac{N_s}{N_p} = \frac{V_{P(sec)}}{V_{P(pri)}}$$

$$\Rightarrow V_{P(sec)} = \frac{N_s}{N_p}\left(V_{P(pri)}\right)$$

$$= \frac{5}{10}(170V) = 0.5 \times 170$$

$$\boxed{V_{P(sec)} = 85V}$$

The rectified Voltage before filter will be:

$$V_p(rect) = V_p(sec) - 1.4V$$

$$= 85V - 1.4 = 83.6V$$

As we know the output frequency of a full wave rectifier is twice as of the input ie: $60 \times 2 = 120\ HZ$.

So the approximate output peak to peak ripple Voltage will be:

$$V_r(pp) \cong \left(\frac{1}{fR_LC}\right) V_p(rect)$$

$$= \left(\frac{1}{(120HZ)(3.3K\Omega)(100\mu F)}\right) 83.6V$$

$$V_r(pp) = (0.0252525)\ 83.6V$$

$$\boxed{V_r(pp) \cong 2.11110}$$

The approximate output Voltage.

$$V_{DC} = \left(1 - \frac{1}{2fR_LC}\right) V_p(rect)$$

$$V_{DC} = \left(1 - \frac{1}{2(120HZ)(3.3K\Omega)(100\mu F)}\right) 83.6V$$

$V_{DC} = (1 - .012626)\, 83.6\, V$

$V_{DC} = (0.987373)\, 83.6\, V$

$$\boxed{V_{DC} = 82.5444\, V}$$

Now atleast we can calculate ripple factor

$$r = \frac{V_r(pp)}{V_{DC}}$$

Putting Values.

$$r = \frac{2.1111\, V}{82.5444\, V}$$

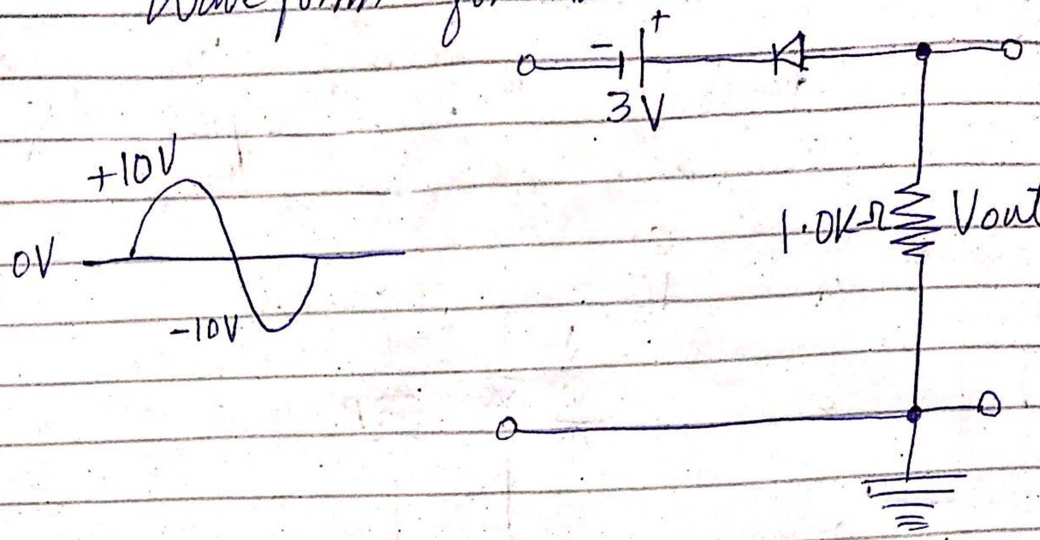
$r = 0.02557544$

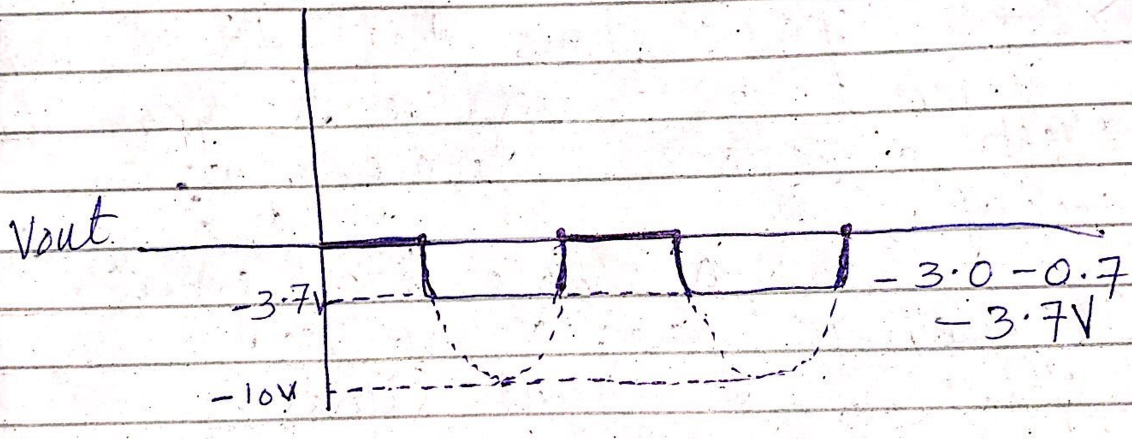
The Percent ripple will be

2.557%

Answered

Q3 Determine the output Voltage Waveform for the Circuit.



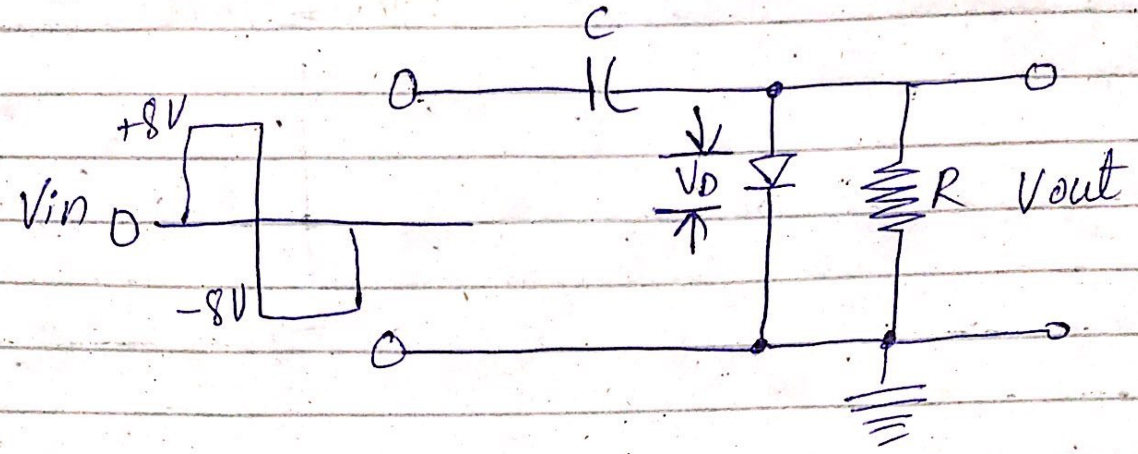

→ As from the figure we can see that there will be no output Voltage for the Positive Cycle & it is Completely clipped as Shown in Vout graph.

AND for the negative half the Waveform holds a negative Value of:

$-V_{BIAS} - 0.7$

$= -3.0 - 0.7 = -3.7V$

Q4. Determine the output Voltage Waveform for the Circuit. Assume RC time Constant is much greater than the period of the input.




→ The figure shows that the Circuit is a negative clamper With a square wave input Voltage.

So as a whole the negative Clamper will add a -ve dc offset to the input Signal.