Name: Sajid Ahmed
ID: 12671

Subject: P.E
Programme: (BECE)

(1)

Q#1

1-Φ Half wave Controlled Rectifier (R load)

- The circuit consists of a thyristor T, a voltage source Vs and a resistive load R.
- During the positive half cycle of the input voltage, the thyristor T is forward baised but it does not conduct until a gate signal is applied to it.
- When a gate pulse is given to the thyristor T at ωt=α, it gets turned ON and begins to ~~do~~ conduct.
- When the thyristor is ON the input voltage is applied to the load.

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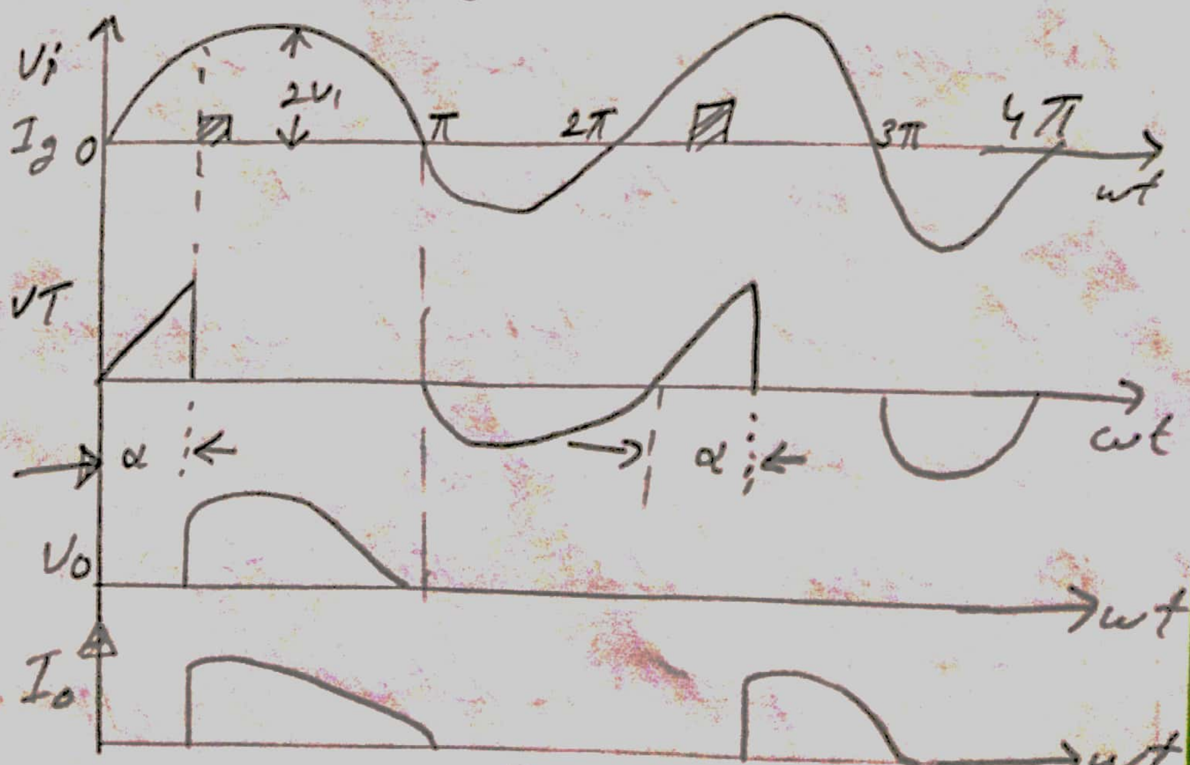
* During the negative half cycle the thyristor T gets reverse baised and gets turned off.
* So the load receives voltage only during the positive half cycle only.
* The average value of output voltage can be varied by varying the firing angle α.

Ⓑ Wave form.



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ID: 12671 ③ ③ Programme: BECE

* The circuit consists of a thyristor T, a voltage source Vs, an inductive load L and a resisti load R.
* During the positive half cycle of the Input voltage, the thyristor T is forword baised but it does not conduct until a gate Signal is applied to it.
* When a gate pulse is given to the thyristor T at ωt = α, it gets turned ON and begins to conduct.
* During the negative half cycle the thyristoo T gets reverse baised but the current through the thyristors is not zero due to inductor.

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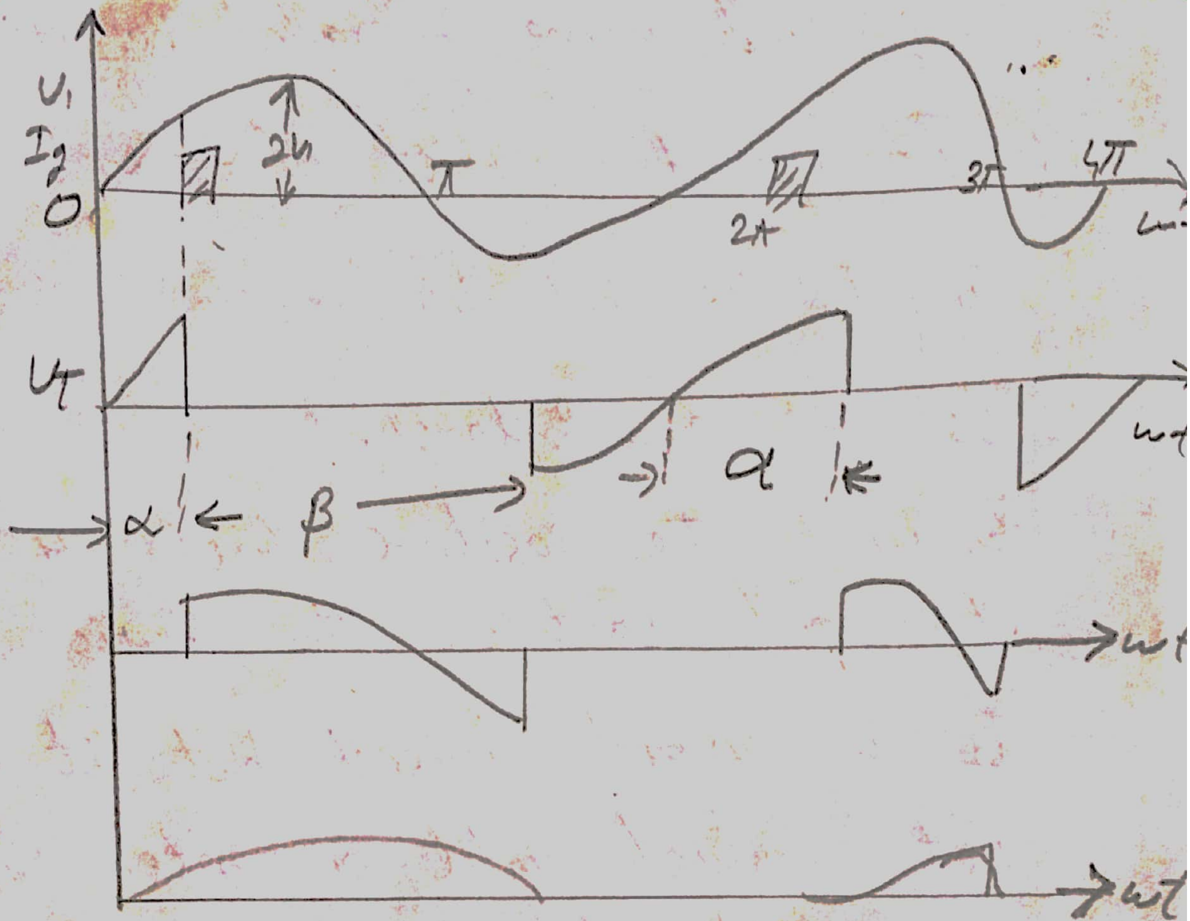
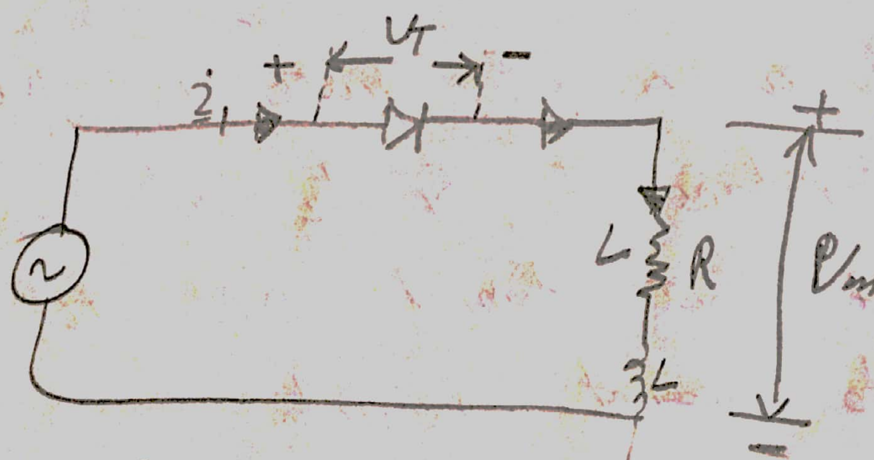


Wave digram



Circuit diagram.

$$V_i = V_m \sin \omega t = \sqrt{2} V_s \sin \omega t$$

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1-Φ full wave Contralled Rectifier (R load)

⊛ The circuit consist of four thyristors T_1, T_2, T_3 and T_4, a voltage source V_s and a R load.

⊛ During the positive half cycle of the Input voltage, the thyristor T_1 & T_2 is forward baised but it does not conduct until a gate Signal is applied to it.

⊛ When a gate pulse is given to the thyristors T_1 & T_2 at $\omega t = \alpha$, it gets turned ON and begins to ~~connect~~ conduct.

⊛ When the T_1 & T_2 is ON, the Input voltage is applied to the load through the path $V_s - T_1$ - load - $T_2 - V_s$ -

P.T.O

Q2 Explin detail the diffrince b/w I phase uncontrolled half wave Rectifer and I phase uncontrolled Retifier Bridge rectifer

Ans2 Single phase Half Wave Rectifer:

(x) During each "postive" half cycle of AC sine wave, the diode is forward baised as the anode is positive with respect to the cathode resulting in current flowing through the diode

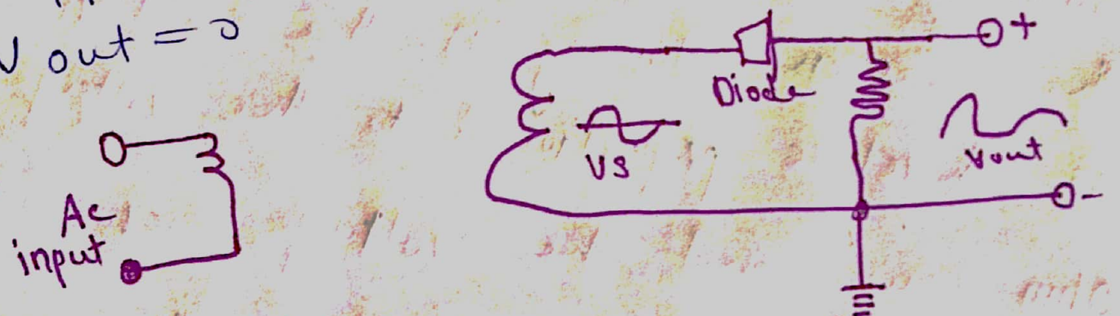
(x) Since the DC load is resistive (resistor R), the current flowing in the load resistor is therefore proportional to the voltage (Ohm's law) and the voltage across the load resistor will therefore be the same as the supply voltage Vs (minus V_f), that is the "DC" voltage across the load is sinusoidal for the first half cyscle only so $V_{out} = V_s$

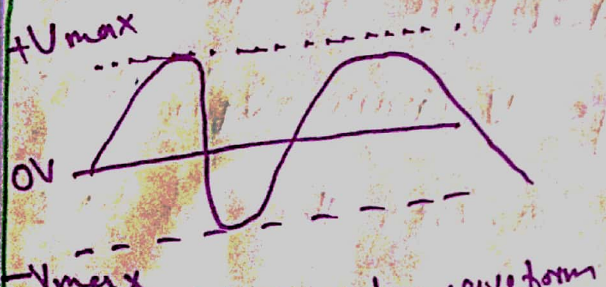
⊗ During each "Negative" half of the Ac sinusoidal input wave form the diode is reverse baised at the anode is negative with respect to the cathode.

single phase Wave Rectifier:

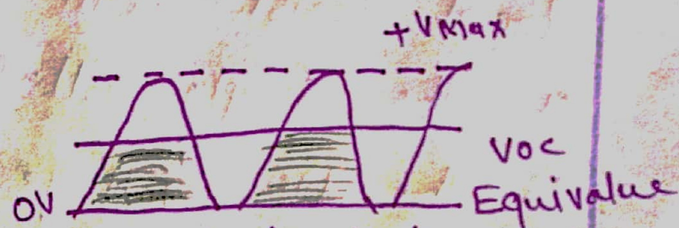
Therefore No current flows through the diode or circuit. then in the negative half cycle of the supply, no current flows in the load resistor as no voltage appears across it so therefore

$V_{out} = 0$





Ac input waveform



Resultant output Waveform

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Single phase Half wave Rectifier
(R load)

(x) Av out voltage $V_0 = \frac{1}{2\pi}\left[\int_0^{\pi} V_m \sin \omega t\, d(\omega t)\right]$

$\frac{V}{2\pi} \left| -\cos\omega t \right|_0^{\pi} = \frac{V_m}{\pi}$

(x) RMS output voltage $V_{rms} = \left[\frac{1}{2\pi}\int_0^{\pi} V_m^2 \sin^2 \omega t\, d\right]^{1/2}$

$\frac{V_m}{\sqrt{2\pi}}\left[\int_0^{\pi} \frac{1-\cos 2\omega t}{2}\, d(\omega t)\right]^{\frac{1}{2}} = \frac{V_m}{2}$

(x) Av. load current $I_0 = \frac{V_0}{R} = \frac{V_m}{\pi R}$

(x) Rms load current $I_{rms} = \frac{V_{rms}}{R} = \frac{V_m}{2R}$

(x) input power factor $= \frac{R}{V_{rms} * I_{rms}}$ $\frac{\sqrt{2V_s}}{2V_s} = 0.707$

Single phase Half waves Rectifier (RL Load)

(x) current I_0 continous to flow even after source voltage V_s is negative because of

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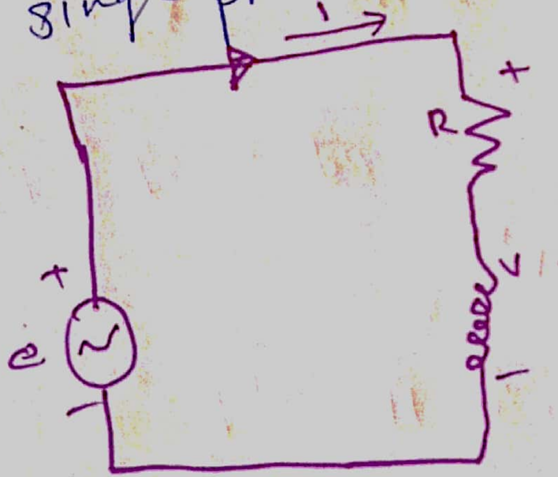
the presence of induced L in loaded

(x) After + ve half cycle diode remains ON so so -ve half cycle appers load current until I_0 decays to zero

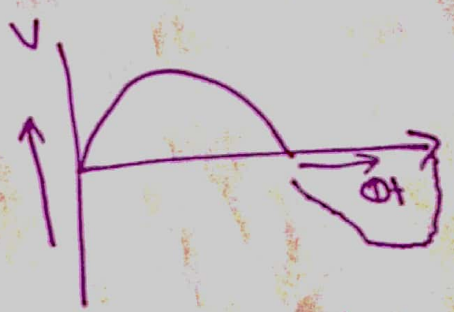
(x) A β diode voltage V_D jumps from 0 to $V_m \sin \beta$ where $\beta > \pi$

(x) Here $\beta = \gamma$ is the conduction angle of the diode

(x) single phase Half wave Rectifier (RL load)



(a) Rectifier



(b) waveform

P.T.O

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Program: BE(E)

(A) (10)

Ans# 3
(3) Buck Chopper:-

- Output voltage is less then input voltage
- The thyristor in the circuit acts as a switch.
- When thyristor is ON, supply voltage appears across the load.
- When thyristor is OFF, the voltage across the load will be zero.
- Practical arrangment includes an Inductor (L) and a diode which are used to eliminate current pulsations providing a smooth DC current.
- With S closed, D is off and it remains off as long as S is on.

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- The i/p current builds up exponentially and flows through L and load
- V o equals V_1
- With S off or open, the current through L decays to zero.
- this causes an inductive voltage with opposite polarity across L.
- V_L forward biases diode D.
- Currents flows through L, load and D
- This arrangement permits the use of simple filter Inductance L to provide a satisfacity smooth DC load current.
- With higher switching frequency smaller Inductance is sufficient to get desired o/p.

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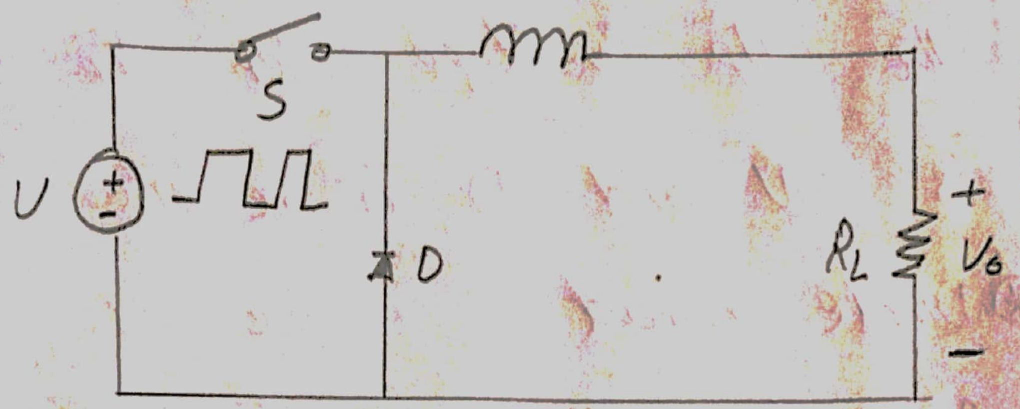
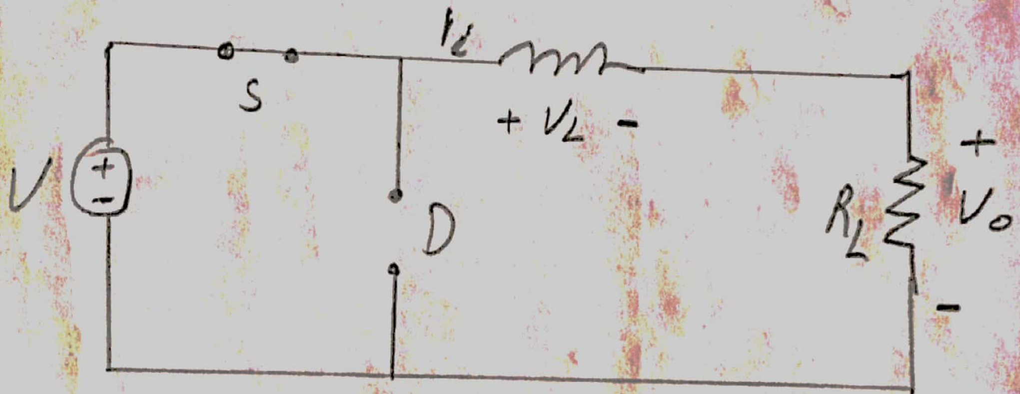
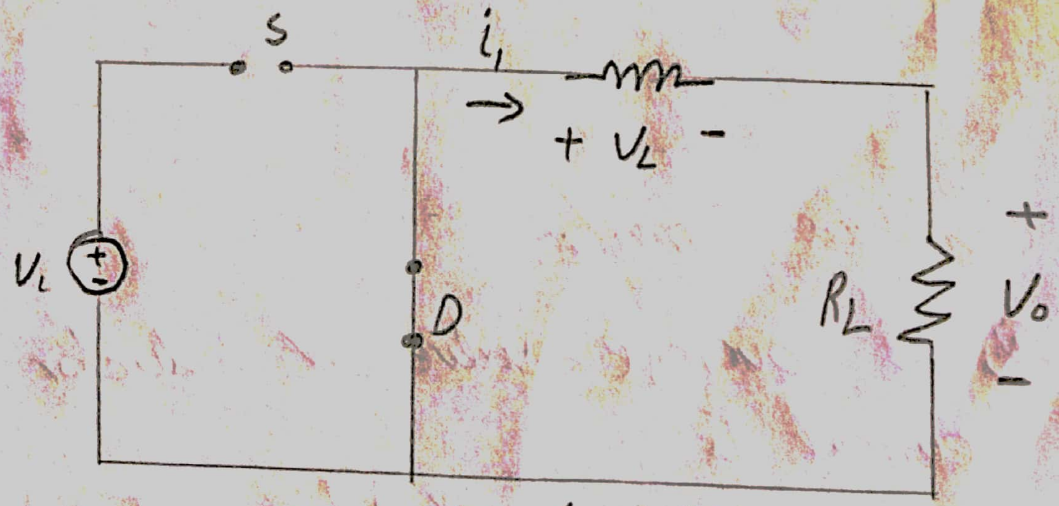


Circuit of Buck converter



Circuit when switch is closed



Circuit when switch is opend.

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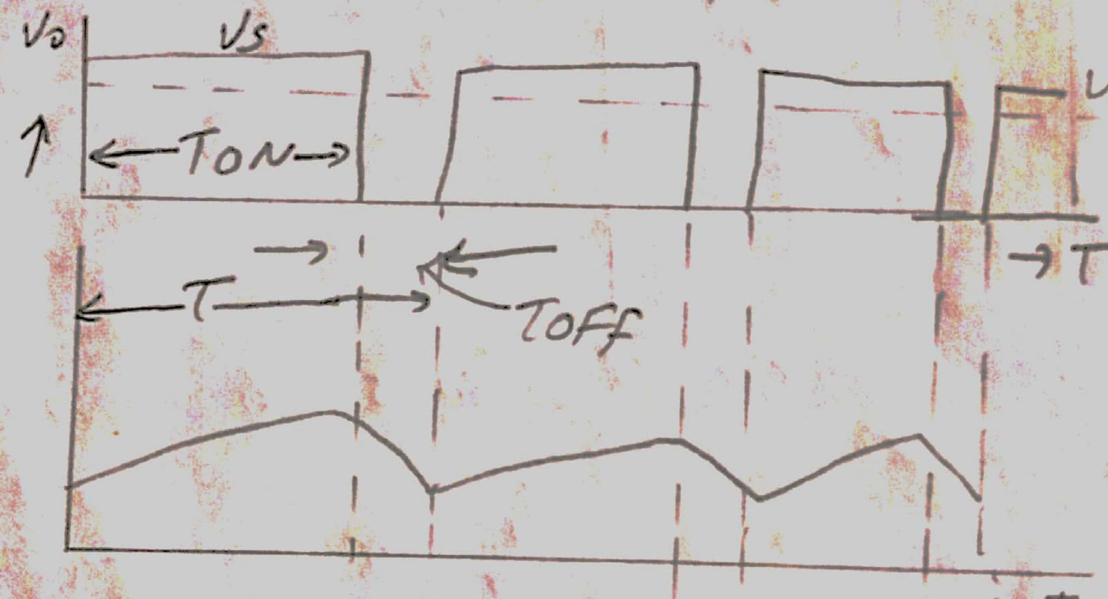
- The o/p voltage is equal to the i/p voltage when the switch is ON and D is reverse baised.
- Diode current is same as the load current during T OFF.
- During T ON, I_0 is same I_I.



Continous Current:-

- the average value of Inductor current is

$$I_L = \frac{I_{max} + I_{min}}{2} = I_o = \frac{V_o}{R}$$

(*) Again

$$V_L = V_0 = L\frac{di_0}{dt} \rightarrow \frac{di_0}{dt} = \frac{V_0}{L} \rightarrow \Delta i_0 = \frac{V_0}{L}\Delta t$$

with switch open

Peak to Peak current I

$$P\text{-}P = \Delta i_0 = I_{max} - I_{min} = \frac{V_0}{L} t_{off}$$

Hence,

$$I_{max} = \frac{V_0}{R} + \frac{V_0}{L} T_{off} \; ; \quad I_{min} = \frac{V_0}{R} - \frac{V_0}{L} T_{off}$$

$$I_D = \frac{I_{off} I_0}{t} \; ; \quad I_0 = \frac{1}{d} \; ; \; d = dy \; dt$$

(*) As elements are ideal, DC power drawn from source must equal the DC power absorbed by load.

$$P_0 = P_1 \rightarrow V_0 = V_{it}$$

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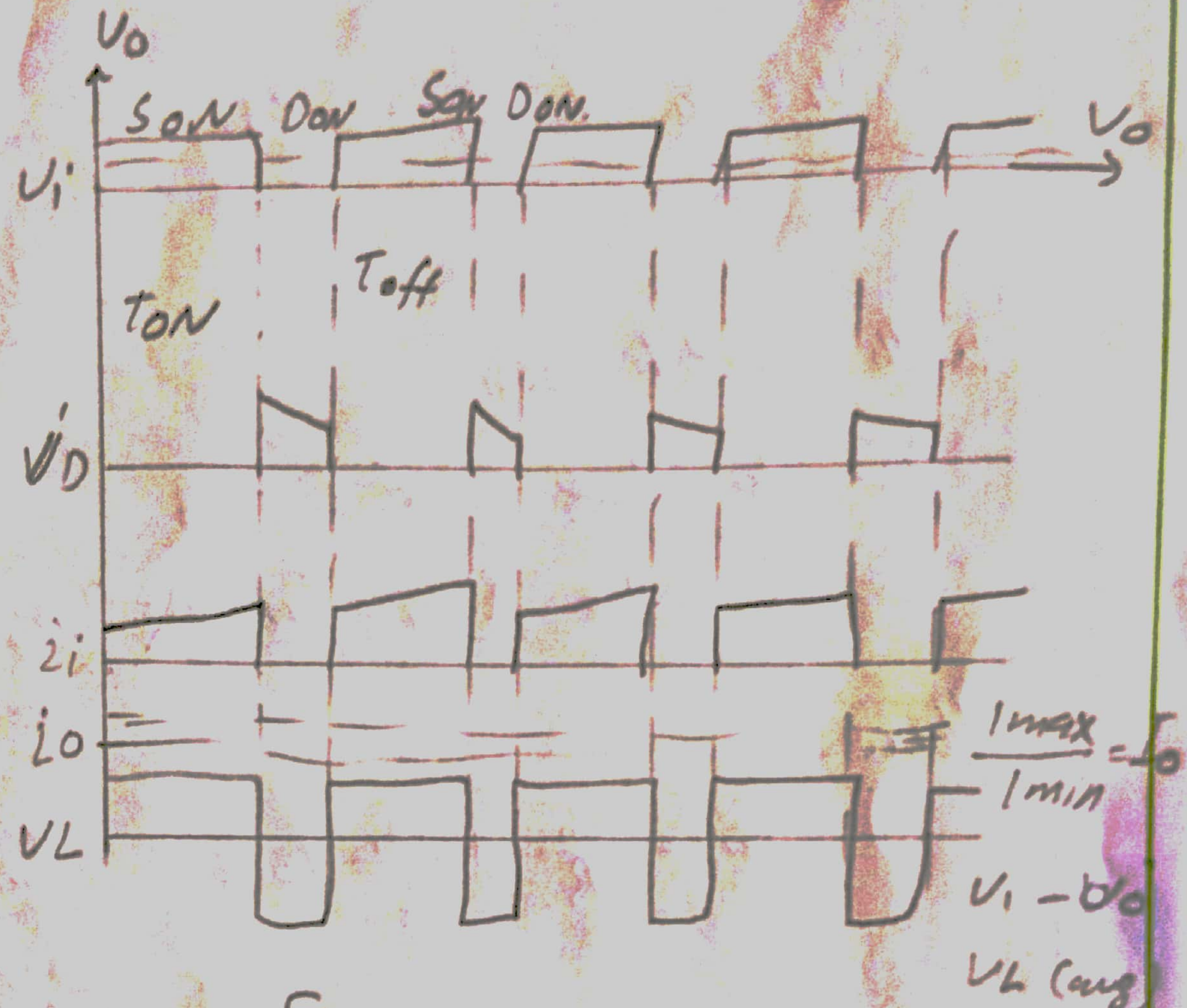

Fig

Discontinuous Current:-

① This mode is undesirable and is avoided by proper selection of chopping and L.

② The minimum value of L for continous current mode is

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ensured by setting $I_{min} = 0$.

$$I_{min} = 0 = \frac{V_0}{R} - \frac{V_0}{R} T_{off}$$

$$\frac{V_0}{R} = T_{off} \cdot \frac{V_0}{L}$$

$$L = T_{OFF} \cdot R$$

$$L = \frac{T_{off}}{2} R.$$

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Q4 The Boost chopper is a type of DC-DC converter Explain in detail the principle is and working of Boost converter when swith is open and closed

Ans (4) Set of (Boost) chopper:

⊗ with S closed again, D become reverse baised the capacitor energy supplies the load voltage and the cycle repets

$$V_0 = V_1 + V_L$$

⊗ Vo is always higher than VI as polarity of inductor voltage VL is same as VI.

⊗ if inductor L is very large, Source current II is ripple free and is considered constaint

$$W_{OFF} = (V_0 - V_1) * I * T_{OFF}$$

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(x) Since losses are neglected the energy transferred during T off by L must be equal energy gained during T on

$W_{ON} = W_{OFF} = V_1 I T_{ON} = (V_0 - V_i) * L * T_{OFF}$

$$V_0 = V_1 \left(1 + \frac{T_{ON}}{T_{OFF}}\right) = V_1 \left(\frac{T}{T - T_{ON}}\right) = V_1 \left(\frac{1}{1 - \frac{T_{ON}}{T}}\right)$$

$$= V_1 \left(\frac{1}{1-d}\right)$$

Thus Vo is always greater than VI.

Set up (Boost) chopper

(x) $P_1 = P_0 \rightarrow V_1 I_1 = \frac{V_0^2}{R}$ $I_1 = 0 * \frac{V_2}{V_1} 1/R$

(x) $I_0 = I_1 * \frac{T_{OFF}}{T} \Rightarrow I_0 = I_1 1(-d)$

(x) $P_0 = P_1 \Rightarrow V_1 I_1 = \frac{V_0^2}{R} = \frac{V_2}{(1-d)} * \frac{1}{R}$

(x) $T_1 = \frac{V_1}{1-d} *_2 \frac{}{R}$

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(3) (19)

(Boost) chopper ~~Sect~~ step up

(x) voltage across L is

(x) $V_L = V_I = L * \frac{di_I}{dt}$ or $\frac{di_I}{dt} = \frac{V_I}{L}$

(x) $\Delta I_1 = \frac{V_1}{?} T_{ON}$ or $I_{max} - I_{min} = \frac{V_1}{?} T_{ON}$

again $I_{max} + I_{min} = 2 * I_1$

Solving

$$I_{max} = V_1 \left[\frac{1}{R(1-d)^2} + \frac{T_{ON}}{2L} \right]$$

$$I_{min} = V_1 \left\{ \frac{1}{R(1-d)^2} - \frac{T_{ON}}{2L} \right)$$

(x) $I_{p-p} = I_{max} - I_{min} = \frac{V_1 T_{ON}}{L}$

(x) For continous current mode

$$I_{min} = 0 = V_1 \left\{ \frac{1}{R(1-d)^2} - \frac{T_{ON}}{3L} \right]$$

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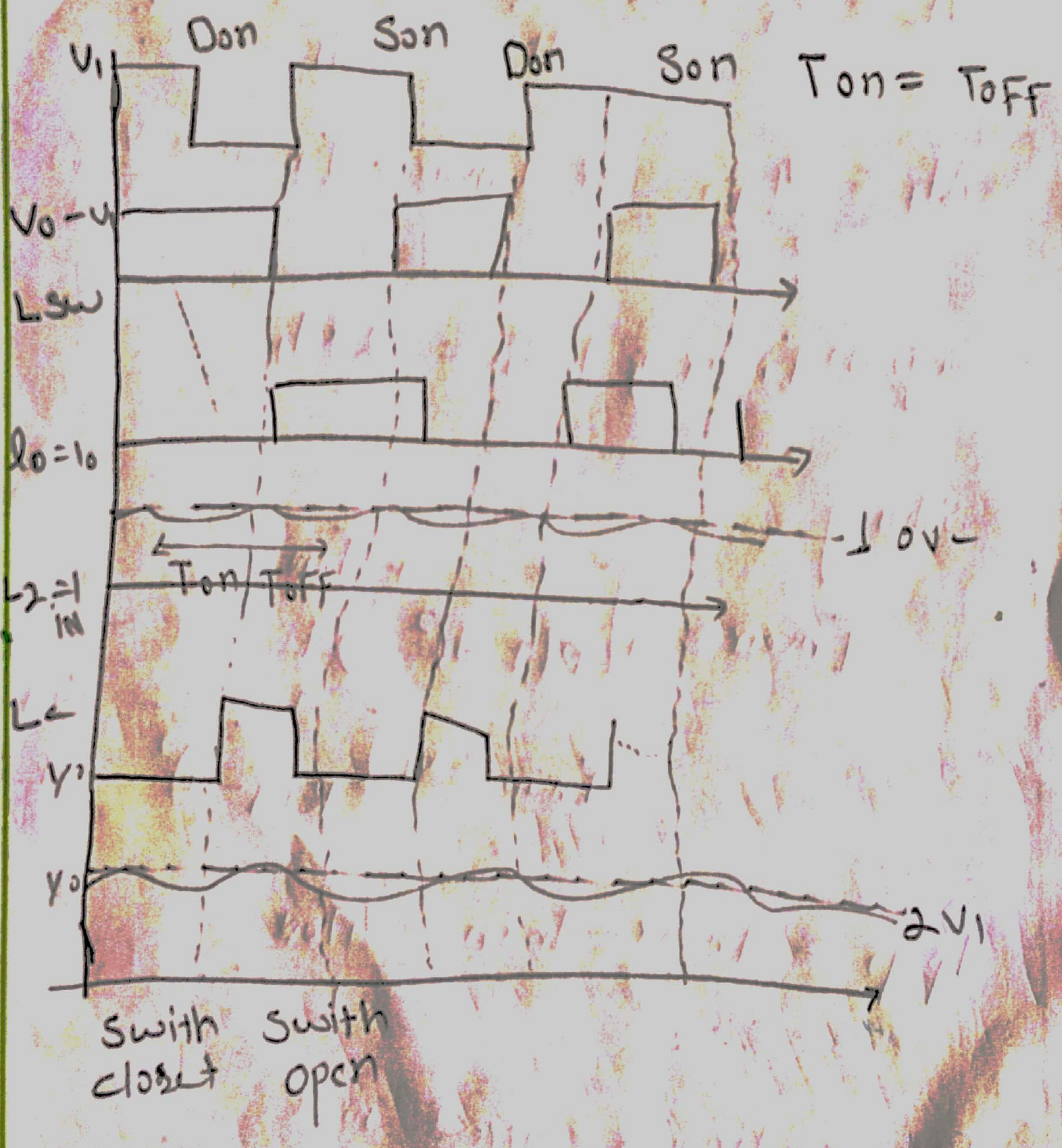
(x) $I_? = \frac{I_{max} + I_{min}}{2} = I_1$

(x) $I_{max} + I_{min} = 2 * I_1$



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$$\Rightarrow \frac{1}{R(1-d)^2} = \frac{T_{ON}}{2L}$$

$$\Rightarrow L = \frac{R T_{ON}}{2}(1-d)^2$$

Q#5

Ans(5)

Buck - Boost chopper :-

- it combines the concept of both the step-up and step-down choppers
- the switch is either an SCR or GTO and GBT
- when S is ON, D is reverse baised and I_D is zero
- The capcitor supplies energy to the output load
- with S off, the source is disconnected
- O/P voltage become equal to the inductor voltage

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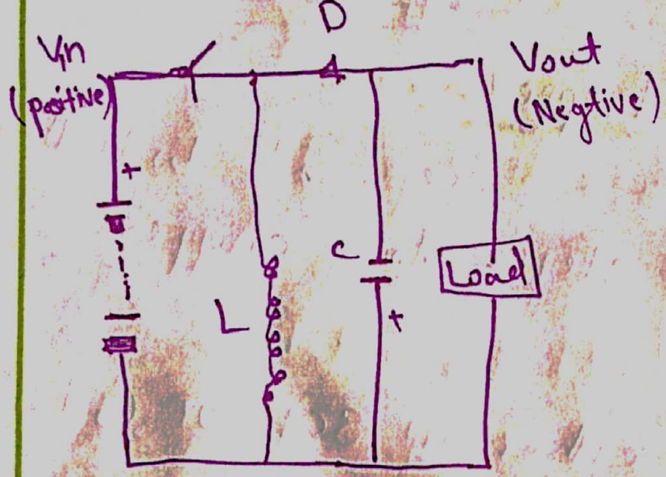
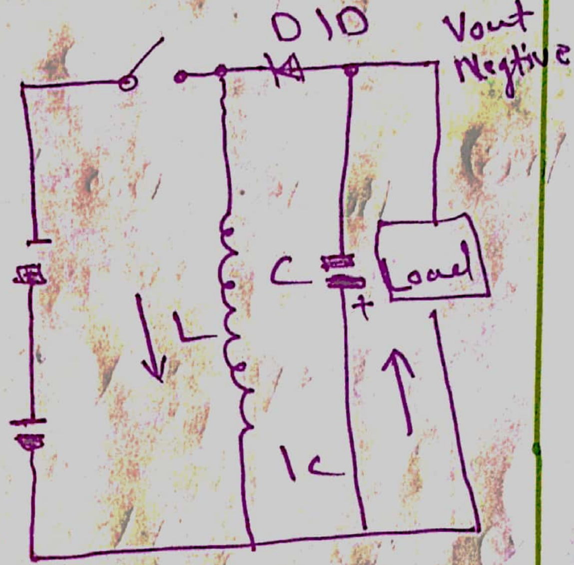
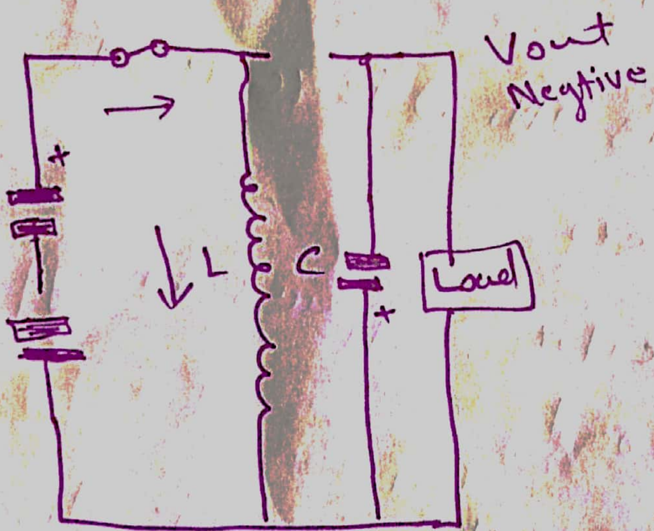
Buck - Boost chopper:

(x) with S = ON (TON); W ON = $V_1 * I_1 *$ on

with S = OFF (TOFF); W ON = $V_1 * I_1 *$ TOFF







(x) Ignoring Losses $W_{ON} = W_{OFF} \Rightarrow V_I * I_1 * T_{ON}$

$= V_1 * I_1 * T_{OFF}$

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$$V_0 = V_1 \left(\frac{d_1}{(1-d\,T)}\right) = V_1 \frac{d}{(1-d)}$$ (o/p voltage

is controlled by changing duty cycle d

$I_L \frac{I_{max} + I_{mix}}{2}$ $I = I_{Ld} = \left(\frac{I_{max} + I_{min}}{2}\right) d$

The average o/p power is given as

$P_1 = V_1 I = \left(\frac{I_{max} + I_{min}}{2}\right) a V_1 = P_0 = o \frac{V^2}{R}$

$I_{mix} + I_{min} = \frac{2V_1}{R(1-d^2)}$; $I_{max} - I_{min} = \frac{V_1 dT}{L}$

$I_{mix} = V_1 \left[\frac{1}{R(1+d)} + \frac{T}{2L}\right] d$ $I_{min} = V_1 \left[\frac{1}{R(1+d)} - \frac{T}{2L}\right] dt$

$I_{p-p} = \frac{V_1 T d}{L}$

For continous current condition

$I_{min} = 0 = V_1 \left[\frac{1}{R(I-d)^2} \frac{T}{2L}\right] \Rightarrow L = \frac{RTd}{2}$

$(1-d)^2$

The end.