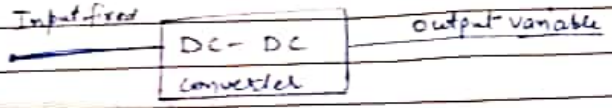
POWER ELECTRONICS NOTES FOR UP. SEM ECE students

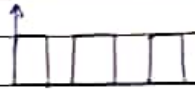
BY:- POOJA VERMA

UNIT CHOPPERS AND ITS TYPES

CHOPPERS are used in power control and signal applications

A chopper is a device that converts fixed DC input to a variable DC output voltage





Devices used in choppers → Low power application Power BJT, MOSFETs

→ High power application Thyristor or SCR.

TYPES OF CHOPPERS

DC choppers

A.C link choppers

classification of choppers according to their working in any of the four quadrants

Type A Type B Type C Type D E

for explaination of DC and A.C Link choppers Link is sent

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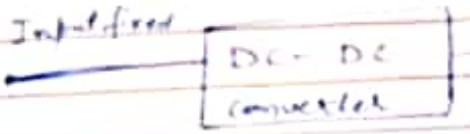
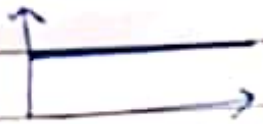
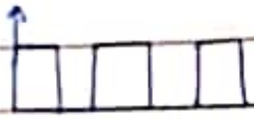



Fixed DC voltage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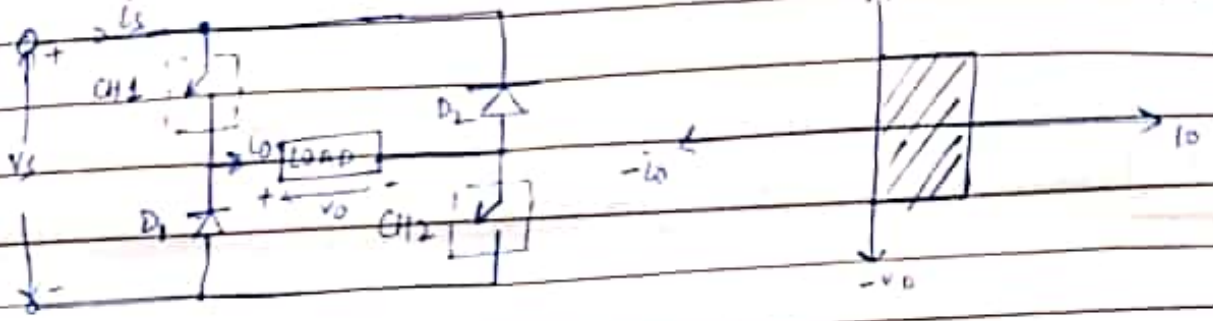
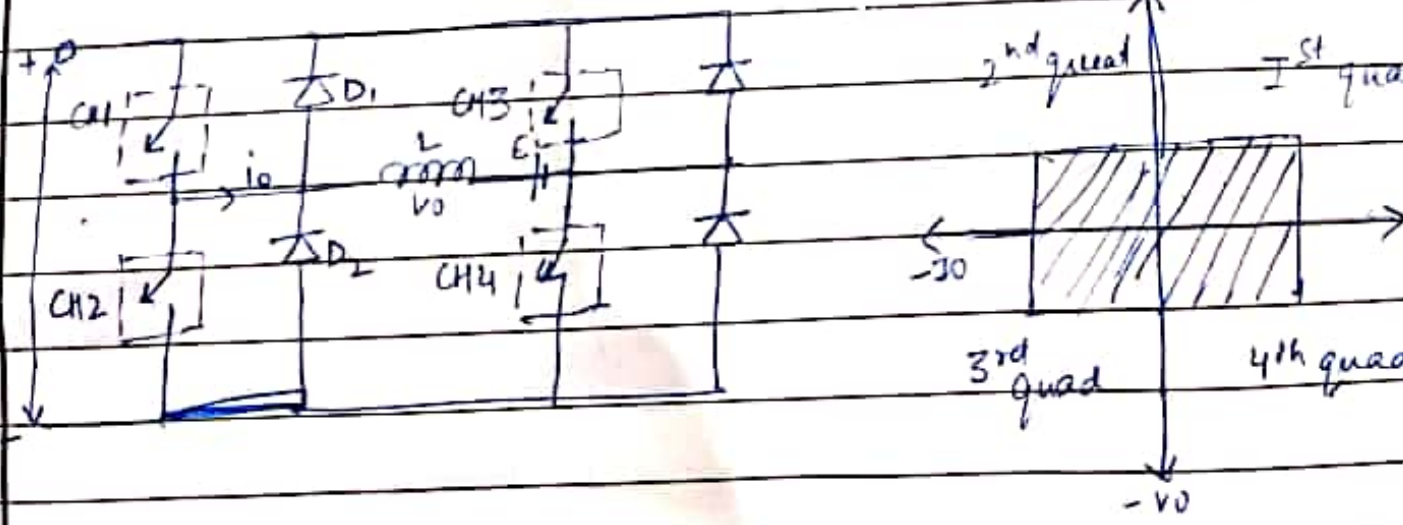
Type A | Type B | Type C | Type D

both the diodes D_1 and D_2 will start conducting. So the average output voltage will be positive when the chopper turn-on time T_{on} will be more than T_{off}. As diodes and choppers conduct current only in one direction, the direction of load current will be always positive.



5) Type E chopper or the fourth quadrant chopper.

This type of choppers consist of four semiconductor switches and 4 diodes arranged in antiparallel. The 4 choppers are numbered acc. to which quadrant they belong.

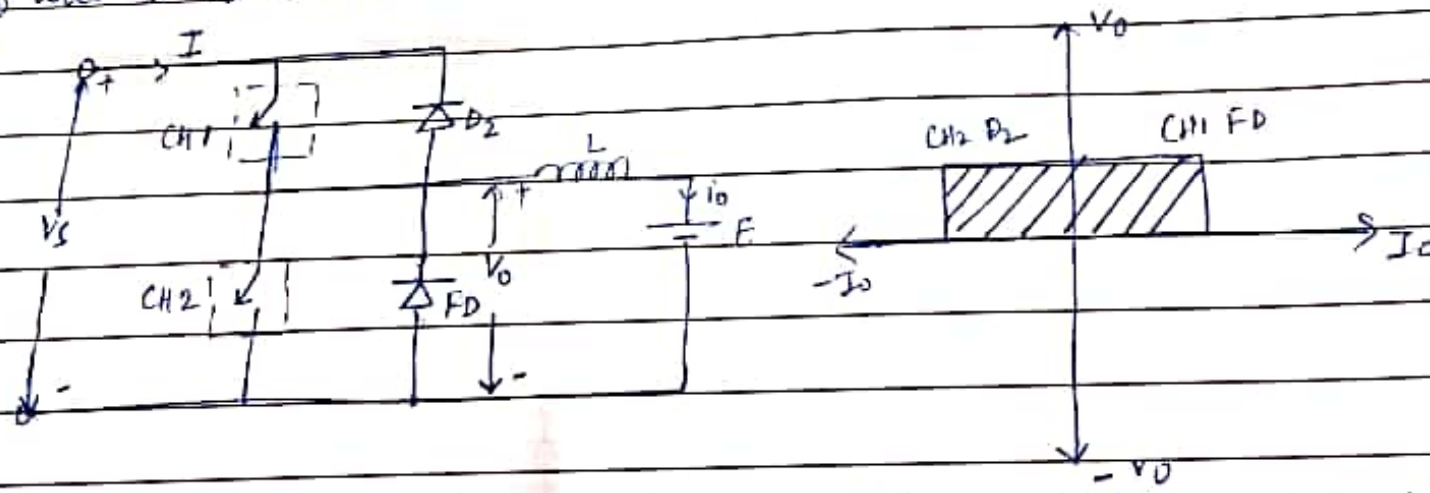


First Quadrant :- During Ist quadrant operation the chopper C will be on and chopper CH3 will be off and CH1 will be op As CH1 and CH4 is on the load voltage Vo will be equal to

(3) If out of the load and is treated negative. Since V_o is positive and the current I_o is negative the direction of power flow will be from load to source.

(2) Type C chopper or Two quadrant type A chopper.

orking Type C is obtained by connecting type A and type B choppers in parallel. We will always get a positive output voltage V_o as the free wheeling diode FD is present across the load. When the chopper is on the free wheeling diode starts conducting and the output voltage V_o will be equal to V_s. The direction of load curr i_o will be reversed.



The average voltage will be always positive but the average l current might be positive or negative. For regenerative bra and motoring these type of chopper configuration is used.

1) Type D chopper or Two-quadrant Type B chopper.

Working: When the two choppers are on the output voltage v be equal to V_s. When $V_o = -V_s$ the two choppers will be off

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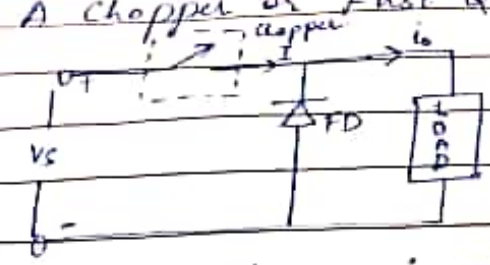
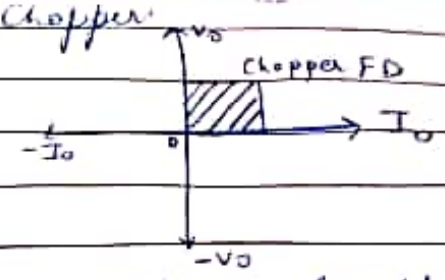
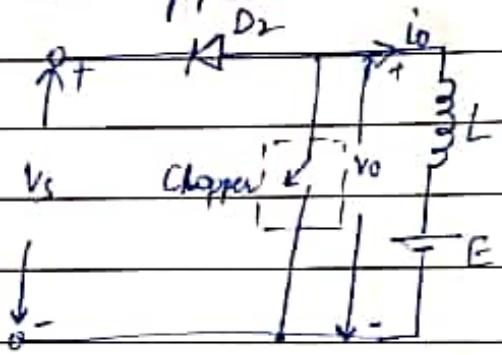
(2a) (1) TYPE A chopper or First Quadrant Chopper.

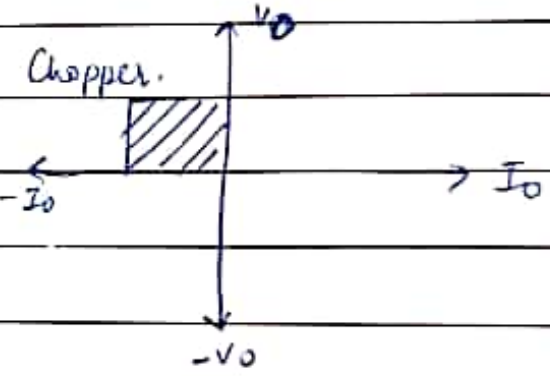




Working: When Chopper is on, $V_o = V_s$ and as a result current flows in the direction of the load. But when chopper is off V_o is zero but I_o continues to flow in same direction through free wheeling diode, thus average value of voltage and current say V_o and I_o will be always positive.

(2) TYPE B Chopper or Second - Quadrant chopper.





Working :- In type B or second-quadrant chopper the load always contain a dc source E. When chopper is on, V_o is zero the load voltage E drives the current through inductor L a chopper, L stores the energy during time T_{on} of the chopper When chopper is off, $V_o = (E + L \cdot di/dt)$ will be more than source voltage V_s. Because of this diode D_2 will be forward biased and begins conducting and hence the power starts f to the source. No matter chopper is on/off current I_o will be

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the source voltage V_s and the load current i_o will begin to flow i_o and i_o will be positive. As soon as CH3 is turned off, the positive current freewheels through CH4 and diode D_2. The type E chopper acts as step-down chopper.

Second Quadrant: In 2nd quad CH_2 will be operational and the other three are kept off. As CH2 is on negative current will start flowing through inductor L, CH_2, E and D_4. In second quadrant the chopper will act as a step-up chopper as the power is fed back from load to source.

Third Quadrant: In 3rd quad CH1 will be kept off, CH2 will be on and CH3 is operated. For this quadrant working the polarity of the load should be reversed. As the chopper CH3 is on, the load gets connected to the source V_s and V_o and i_o will be negative and third quad operation will takes place. This chopper acts as a step-down chopper.

Fourth Quadrant: CH4 will be operated and CH1, CH2 and CH3 will be off. When the chopper CH4 is turned on positive current starts to flow through CH4, D_2, E and L (inductor) will store energy. As CH_4 is turned off the current is feedback to the source through diodes D_2 and D_3. The operation will be in fourth quadrant as load voltage is negative but load current is positive. In this quad the chopper acts like a step up chopper.

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