3. Class C Chopper

- **Class C Chopper** is a combination of **Class A** and **Class B Choppers**.
- For first quadrant operation, **CH1** is ON or **D2** conducts.
- For second quadrant operation, **CH2** is ON or **D1** conducts.
- When **CH1** is ON, the load current is positive.
- The output voltage is equal to ‘V’ & the load receives power from the source.
- When **CH1** is turned OFF, energy stored in inductance **L** forces current to flow through the diode **D2** and the output voltage is zero.
- Current continues to flow in positive direction.
- When **CH2** is triggered, the voltage **E** forces current to flow in opposite direction through **L** and **CH2**.
- The output voltage is zero.
- On turning OFF **CH2**, the energy stored in the inductance drives current through diode **D1** and the supply
- Output voltage is **V**, the input current becomes negative and power flows from load to source.
- Average output voltage is positive
- Average output current can take both positive and negative values.
- Choppers **CH1 & CH2** should not be turned ON simultaneously as it would result in short circuiting the supply.
- **Class C Chopper** can be used both for dc motor control and regenerative braking of dc motor.
- **Class C Chopper** can be used as a step-up or step-down chopper.
4. Class D Chopper

- Class D is a two quadrant chopper.
- When both \( CH1 \) and \( CH2 \) are triggered simultaneously, the output voltage \( vO = V \) and output current flows through the load.
- When \( CH1 \) and \( CH2 \) are turned OFF, the load current continues to flow in the same direction through load, \( D1 \) and \( D2 \), due to the energy stored in the inductor \( L \).
- Output voltage \( vO = -V \).
- Average load voltage is positive if chopper ON time is more than the OFF time.
- Average output voltage becomes negative if \( tON < tOFF \).
- Hence the direction of load current is always positive but load voltage can be positive or negative.
5. Class E Chopper
Class E is a four quadrant chopper

- When CH1 and CH4 are triggered, output current $i_o$ flows in positive direction through CH1 and CH4, and with output voltage $v_o = V$.
- This gives the first quadrant operation.
- When both CH1 and CH4 are OFF, the energy stored in the inductor L drives $i_o$ through D2 and D3 in the same direction, but output voltage $v_o = -V$.
- Therefore the chopper operates in the fourth quadrant.
- When CH2 and CH3 are triggered, the load current $i_o$ flows in opposite direction & output voltage $v_o = -V$.
- Since both $i_o$ and $v_o$ are negative, the chopper operates in third quadrant.
- When both CH2 and CH3 are OFF, the load current $i_o$ continues to flow in the same direction D1 and D4 and the output voltage $v_o = V$.
- Therefore the chopper operates in second quadrant as $v_o$ is positive but $i_o$ is negative.

Source: http://elearningatria.files.wordpress.com/2013/10/ece-vii-power-electronics-10ec73-notes.pdf