Government Polytechnic Collage Kasauli
Electrical Dept.
IIIrd - mid term test
Subject - Power Electronics AND DRIVES
Code - EE-301
Date - 16/1/2018
Max. MARKS - 15

Attempt any three out of following four questions.

1. Explain working of UJT as a relaxtion oscillator.
2. Explain the principle of chopper (Step-down)
3. What do you mean by chopper? Explain type B chopper.
4. What are the control stratagies for chopper? explain each

Ans. 1 UJT as a Relaxaion oscillator :-

The UJT is highly efficient switch it is used as a trigger devise for SCR, nonsinusoidal oscillator's, saw tooth generators, phase control and timing circuits. Since UJT shows negative Resistance charactoristics, it is mostly used as a relaxation oscillator. figure shows UJT as a relaxation oscillator. Initialy the voltage acrss capasitor is zero (i.e. $V_E = V_C = 0$) hense UJT is off. In this condition a small Reverse leakage current as a emitter current will be flowing. As shown fig. Capacitor C will begin to charge by V_{BB} through Resistor R.

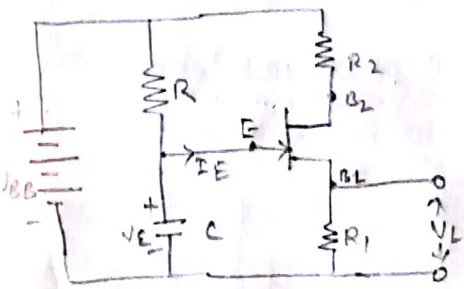

Fig (a)
Circuit diagram of UJT as a relaxation oscillator

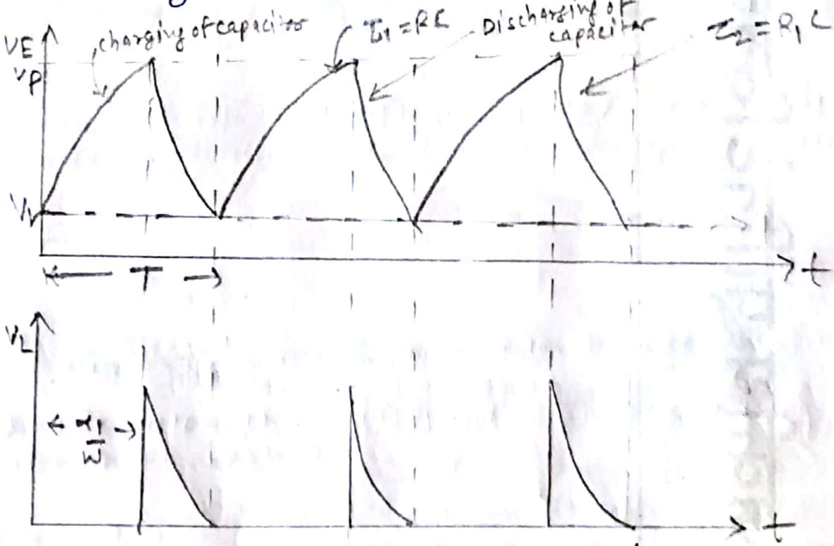

Fig (b) voltage waveforms and triggering pulse

The capacitor voltage increase with a time constant $\tau_1 = R_C$ and is given by $V_C = V_E = V_{BB}(1 - e^{-t/RC})$ — ①

it will continue to increase until the voltage at the emitter reaches at V_P whose value is given by $V_P = \eta V_{BB} + V_D$ — ②

Now UJT turns on and capacitor will discharge through the low Resis. R_1. The time constant of discharging is $\tau_2 = R_1 C$. But $\tau_2 < \tau$ because $R_1 < R$, when the emitter voltage is decreased to the valley point voltage V_V, Between two pulses at its a long relaxation time is observed. on This this basis, the circuit shown in figure (a) called UJT Relaxation oscillator.

from eq. ① $V_E = V_{BB}(1-e^{-t/RC}) = \eta V_{BB}$ - ③

Therefore $\eta = 1-e^{-t/RC}$

$e^{-t/RC} = (1-\eta)$

$t = RC \ln\left(\frac{1}{1-\eta}\right)$ - ④

where t time required for charging the capacitor from V_v to V_p through R.

Ans ② Principal of chopper operation : According to the output voltage, chopper may be divided into two type step up chopper and step down chopper. In this chopper, the output voltage will be less than input voltage. let Ton is the on period and Toff is the off period of chopper in Ton period load voltage will be equal to source voltage V_s. The waveforms are shown in fig.

It is cleared from the fig that average load voltage Vav is given by

$$V_{av} = \frac{T_{on}}{T_{on}+T_{off}} \cdot V_s = \frac{T_{on}}{T} V_s = \alpha V_s$$

where $\alpha = \frac{T_{on}}{T}$ = duty cycle

and $T = T_{on}+T_{off}$ = chopping period

from eq.

$$V_{av} = \frac{T_{on}}{T} V_s = F \cdot T_{on} \cdot V_s$$

where F = Chopping Frequency

Ans ③ Chopper is a Device which converts a fixed dc voltage to a variable dc voltage. Chopper provides smooth acceleration control, fast response, Regeneration and high efficiency. Choppers are used in subway cars, trolly, marine hoists, forklift trucks and mine haulers.

Choppers is a high speed on/off semiconductor switch which is represented by a switch sw with an arrow as shown in fig. No current will flow if the switch is off and when it is on, current will flow in the direction of arrow only.

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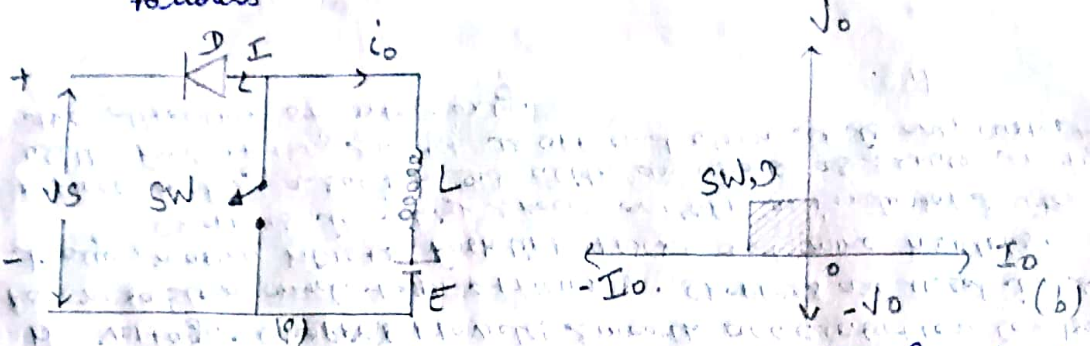
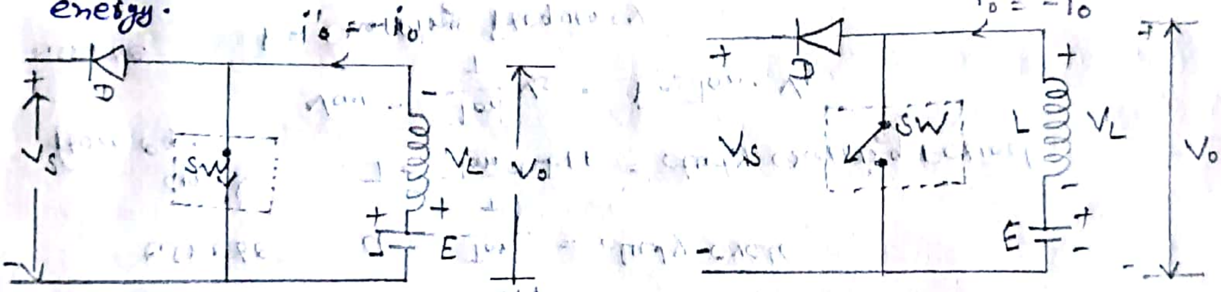
Second Quadrant of B chopper :- The operation of class B chopper as follows.



mode I :- when SW is on, $V_o = 0$ but current will be following through inductance L and chopper SW due to E as shown fig.. In this mode inductance L stores energy.

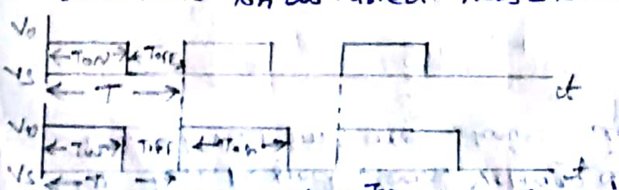


from this fig. that the voltage polarity is same as directed but the current is following in reverse Direction

mode II :- when SW is off, $V_o = \left(E + L \frac{di'_o}{dt} \right)$ exceeds the V_S therefore diode D. Again the load Voltage is Positive but current is in negative direction

Ans (4) Control strategies :-

(1) Constant frequency system :- In this system chopping Period T is kept constant but the ON-Time T_{on} is varied. This system is also referred to Pulse width (PWM) or (TRC) scheme



Since we have $V_{av} = \frac{T_{on}}{T} V_S$, by Increasing the on time T_{on}, output voltage V_o can be varied between and source voltage V_S.

(2) variable frequency system :- In this system, the chopping Period T will be varying but either T_{on} is kept constant or T_{off} is kept constant.