

LEVEL 2

30marks

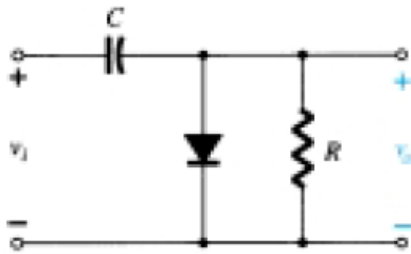
1. Raju, Farhan and Rancho working alone can complete a work in 6,8, and 10 hours respectively. All the three of them start working together. After 2 hours of working Raju has a fight with Rancho and he leaves the work and goes away. The remaining work is finished by Farhan and Rancho. Which of the following best represents the total time taken (T) to finish the work?

- a) $T < 1$
- b) $2.5 < T < 3$
- c) $3 < T < 3.5$
- d) $T > 3.5$

(2marks)

Ans:b)

2. For the given circuit, what is the minimum peak value of the output waveform if the input waveform is 10V square wave with switching time of 1 second? Assume that the input switches between +10V and -10V DC levels.

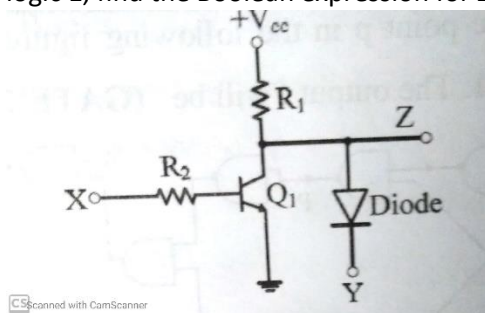


- a) 0 V
- b) -5 V
- c) -20 V
- d) -10 V

(2marks)

Ans: c)

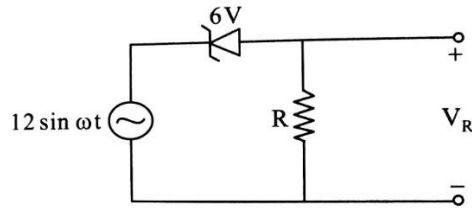
3. In the circuit shown below, if V_{cc} is +5V X & Y are digital signals with 0V as logic 0 and V_{cc} as logic 1, find the Boolean expression for Z in terms of X and Y. Elucidate the answer.



(3 marks)

Ans: X needs to be low so that the collector output is high and, Y needs to be high. If Y is low, then output Z will also become 0 as the diode gets forward biased. Hence function is: $Z = X'Y$.

4. For the circuit below, assuming that the zener is ideal with a breakdown voltage of 6V, draw the waveform across R. (Given, the input is a 24Vpp sine wave)



(4marks)

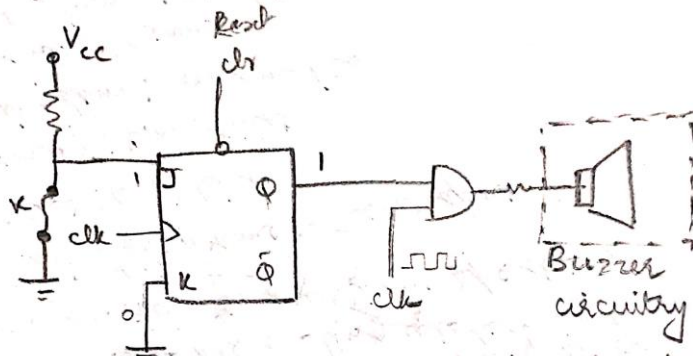
Ans:

Case (i):
 During negative half cycle, Zener diode works as normal diode as it is in forward bias. (i.e., when $V_{in} < 0$).
 $\therefore V_{in} - V_R = 0$
 $V_R = V_{in}$

Case (ii):
 During positive half cycle.
 When $0 < V_{in} < 6$ - D-OFF
 Hence, the circuit diagram is

Hence, $V_R = 0$
 When $V_{in} > 6$, Zener diode acts as a voltage circuit.

5. Design a burglar alarm system using JK flip-flop. When a burglar is sensed, the alarm should turn ON, and remain ON until the RESET button is pressed.
 (5 marks)



Initial state: $J=1, K=0$

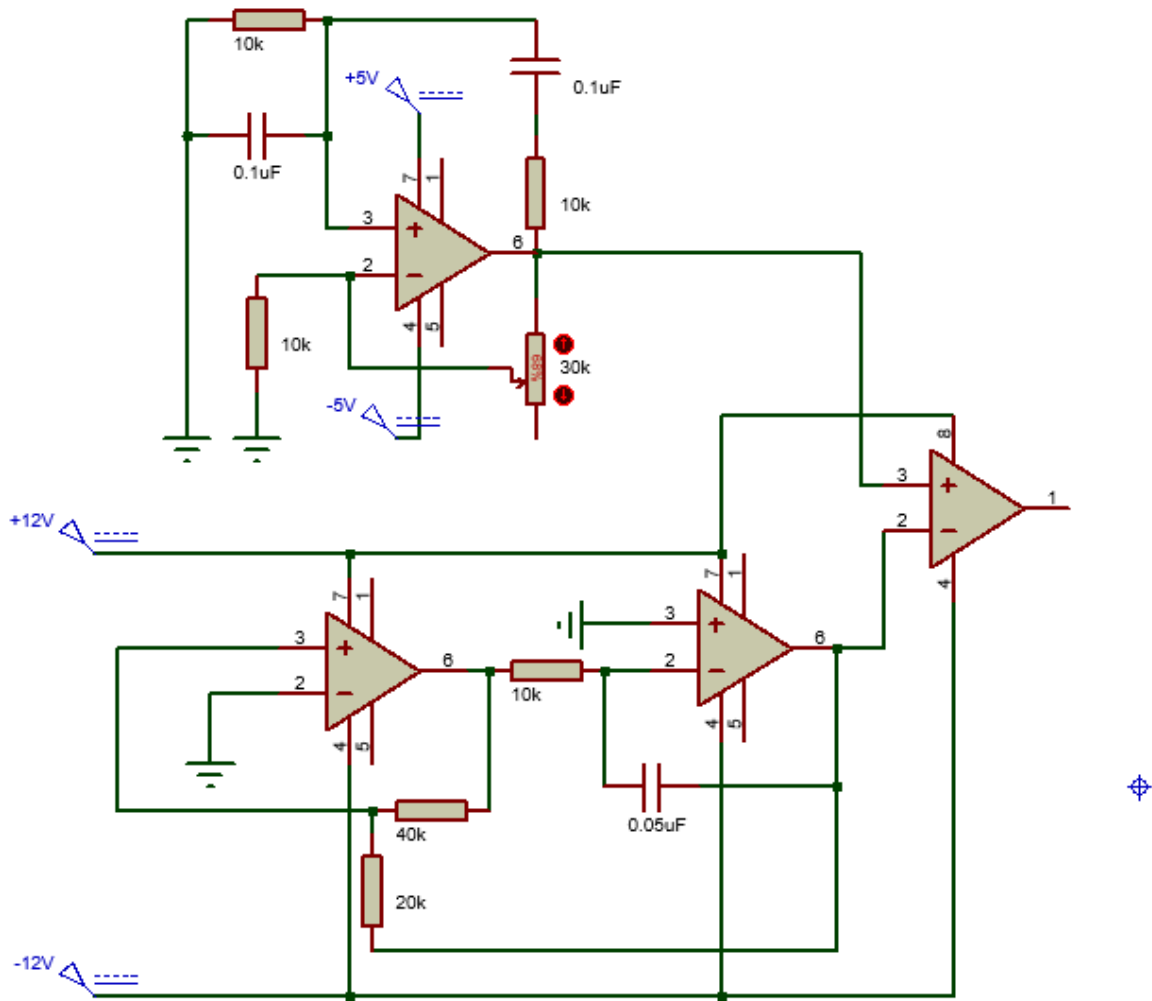
When Burglar is sensed, k gets open

$\therefore J=1, K=0$

\therefore sets o/p, $Q=1$; even if k is closed back, $J=0, K=0 \Rightarrow$ same state (latch) until next.

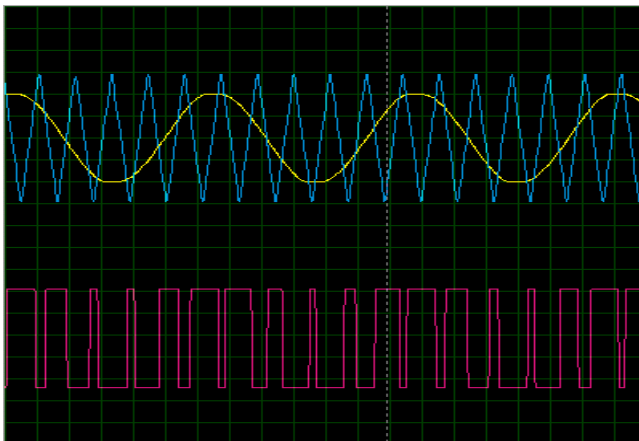
• Clock has to be given to Buzzer, since it needs an ac. for continuous functioning.

6. Find the output waveform of the circuit given. (Assume ideal conditions)



(5marks)

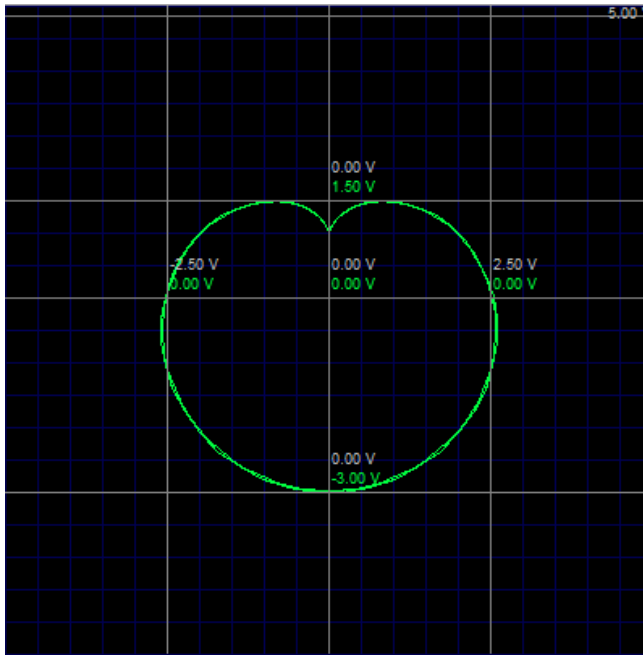
Ans:



Amp = 24Vpp SPWM signal , Sine wave $F = 160\text{Hz}$, Triangle wave = 1Khz

Freq = 1Khz

- Design suitable circuit for generating the given X-Y plot on the DSO. Assume ideal conditions. Also assume that you are given with the required sinusoidal signals of various frequencies.

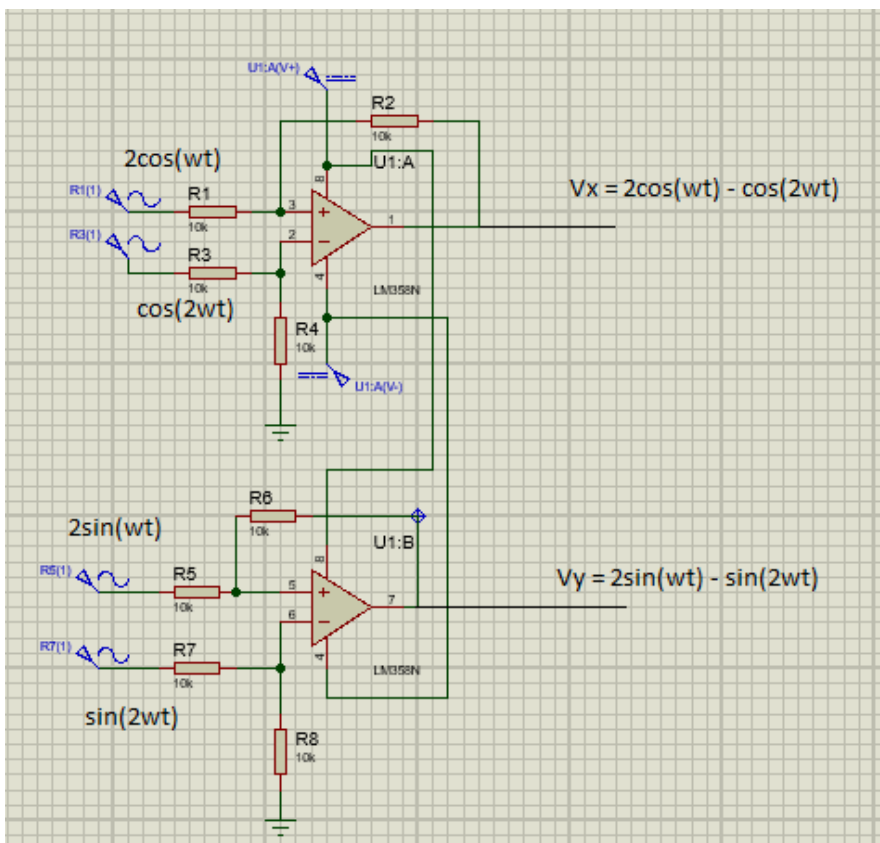


(5marks)

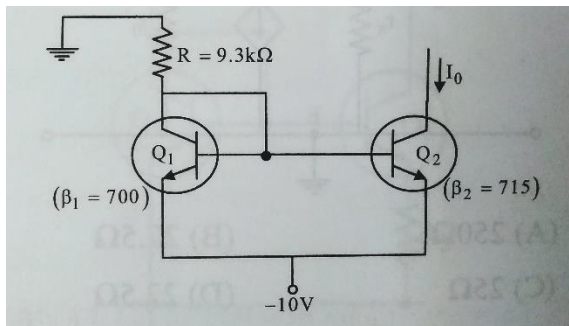
Ans: Parametric eqn for cardioid

$$X = 2\cos(\omega t) - \cos(2\omega t)$$

$$Y = 2\sin(\omega t) - \sin(2\omega t)$$



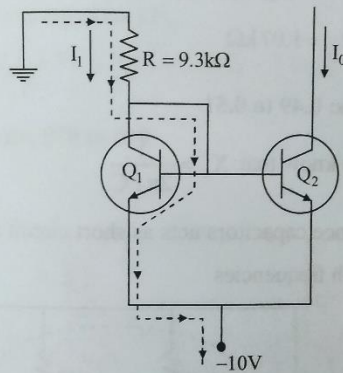
8. In the silicon BJT shown below, assume that the emitter area of transistor Q1 is half that of transistor Q2.



(4marks)

Ans:

Sol: The given circuit is a current mirror circuit in which the output current is a mirror image of the input current if both the transistors are identical.



Apply KVL around the loop

$$-RI_1 - V_{BE} - (-10) = 0$$

$$\therefore I_1 = 1 \text{ mA}$$

Since the emitter area of transistor Q₁ is half that of transistor Q₂,

$$\text{So, } I_1 = I_0 / 2$$

$$\text{Therefore, } I_0 = 2 \text{ mA}$$