BEC ASSIGNMENT -1 :-

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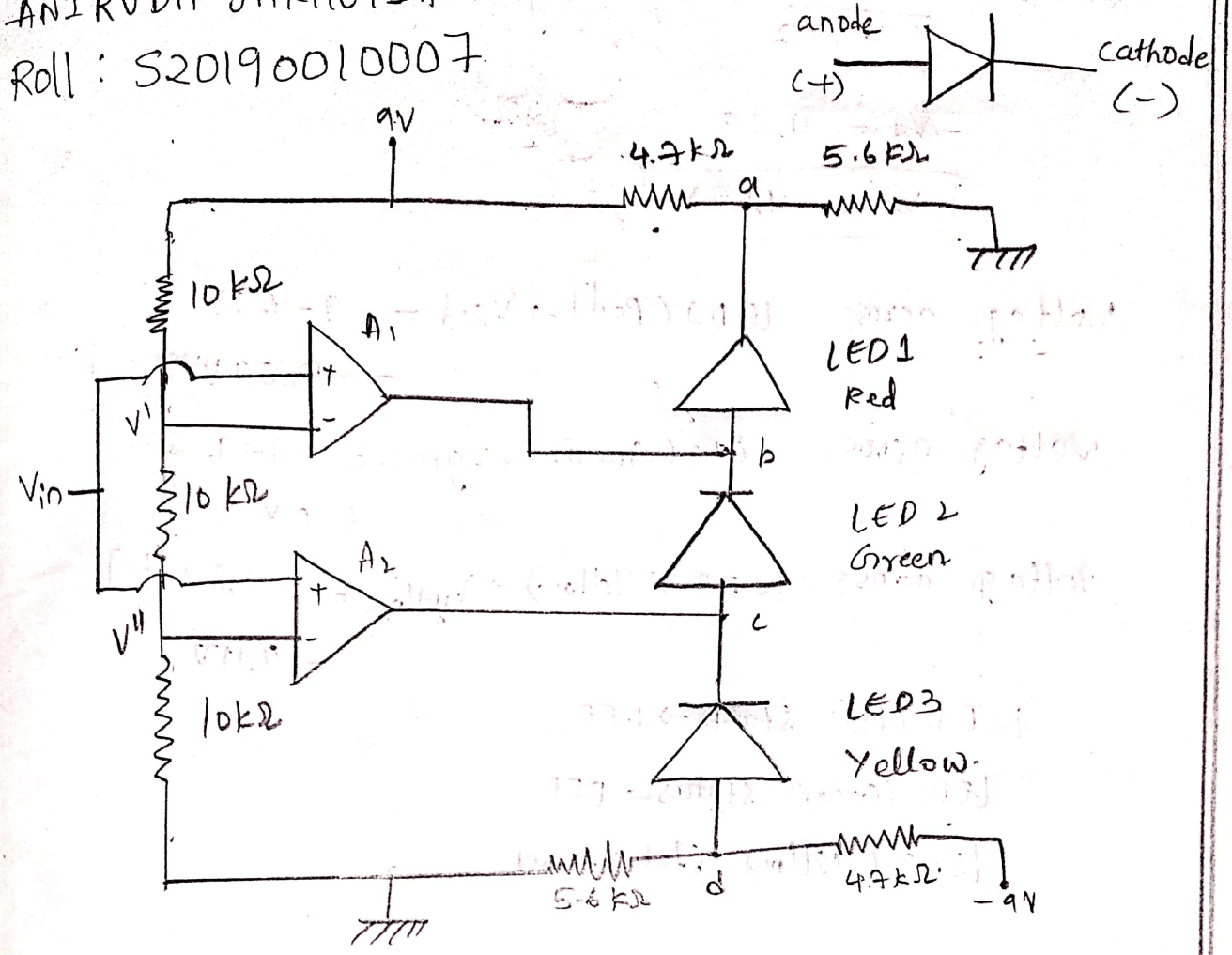


To find V' & V''

We use voltage divider circuit.

$V'' = \frac{9 \times 10\,k\Omega}{30\,k\Omega} = 3V$

$V' + V'' = 9V$

$V' = 9V - V'' = 9V - 3V = 6V.$

when $V_{in} = 1V$ A_1 output is $-V_{sat} = -9V$ } [$\because V_{in} < V_{ref}$

A_2 output is $-V_{sat} = -9V$ }

$V_b = -9V$, $V_c = -9V$

$V_a = \frac{9 \times 5.6\,k\Omega}{10.3\,k\Omega}$ [$\because$ by Voltage divider circuit]

$\boxed{V_a = 4.89V}$

$0 - V_d = \frac{(0+9)\ 5.6k\Omega}{10.3k\Omega}$ [∵ by voltage divider circuit]

$-V_d = 4.89$

$V_d = -4.89\,V$

Voltage across LED1 (Red) → $V_{red} = -9 - 4.89$
$= -13.89\,V$

Voltage across LED2 (Green) → $V_{green} = -9 + 9$
$= 0\,V$

Voltage across LED3 (Yellow) → $V_{yellow} = -4.89 + 9$
$= 4.11\,V$

LED1 (Red) status → OFF

LED2 (Green) status → OFF

LED3 (Yellow) status → ON

When $V_{in} = 5V$

A_1 output is $-V_{sat} = -9V = V_b$

A_2 output is $+V_{sat} = +9V = V_c$

$V_a = 4.89V$, $V_d = -4.89V$

$V_b = -9V$, $V_c = +9V$.

Voltage across LED1 (Red) $= V_{red} = V_b - V_a$
$= -9 - 4.89V$
$= -13.89V$

Voltage across LED 2 (Green) → V_{green} → $V_c - V_b$
$= 9 + 9 = 18V$

Voltage across LED3 (Yellow) → $V_{yellow} = V_d - V_c$
$= -4.89 - 9$
$= -13.89\,V$

LED1 (Red) Status → OFF

LED2 (green) status → ON

LED3 (yellow) status → OFF.

When $V_{in} = 7V$

A_1 Output PS $+V_{sat} = +9V = V_b$

A_2 Output is $+V_{sat} = +9V = V_c$

$V_a = 4.89V$, $V_d = -4.89V$

Voltage across LED1 (Red) $V_{red} = V_b - V_a$

$= 9 - 4.89$

$= 4.11\ V.$

Voltage across LED2 (green) $V_{green} = V_c - V_b$

$= 9 - 9 = 0V$

Voltage across LED3 (Yellow) $V_{yellow} = V_d - V_c$

$= -4.89 - 9$

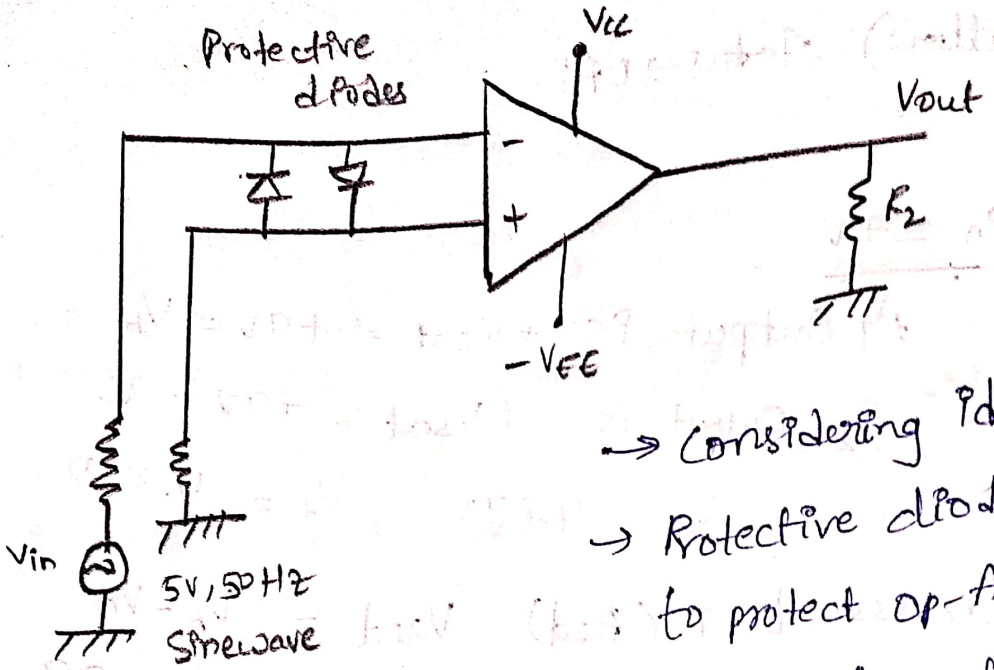
$= -13.89\ V$

LED1 (Red) Status → ON

LED2 (green) Status → OFF

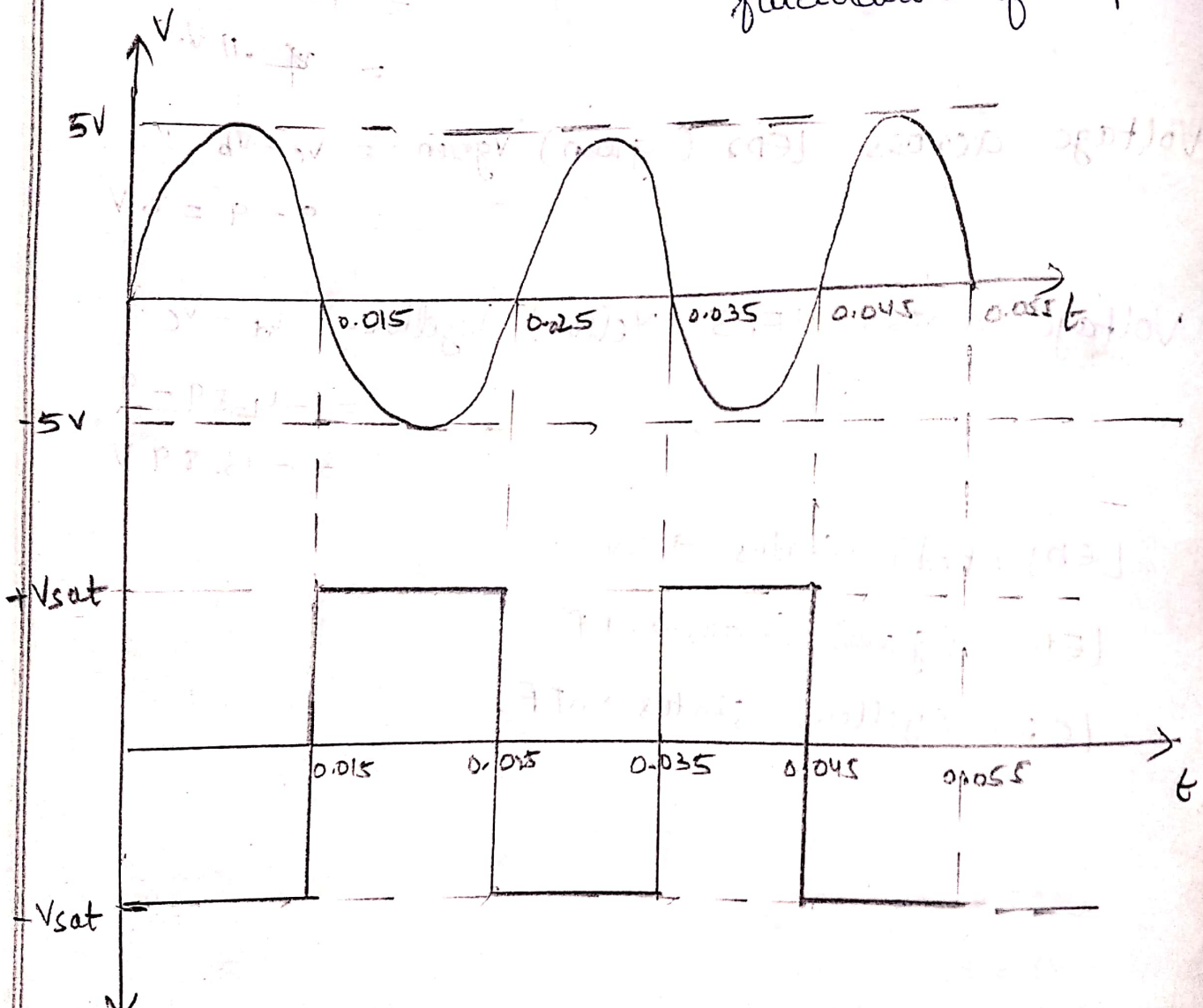
LED3 (yellow) Status → OFF.

(2) Zero crossing detector



→ Considering Ideal diodes:

→ Protective diodes are used to protect op-Amp from fluctuation of Input signal



For every 0.01sec it crosses Zero..