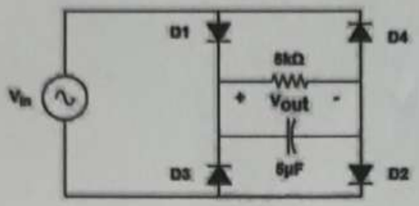
BRAC UNIVERSITY
Dept. of Computer Science and Engineering

Quiz 3

CSE251:Electronic Devices and Circuits
Total Marks: 25
Time: 25 minutes

Student ID:		**Section:**	
Name:			

[CO2] [8+4+3+3+7]



Here, $V_{in} = 10\sqrt{2}\sin 500\pi t$

[All diodes make with silicon having forward voltage drop $V_{D0} = 0.6V$]

1. **Show** the input and output waveform in separate planes considering there is no capacitor connected parallel to the load resistor in the diagram. [You need to label the peak voltage and time period appropriately for both waveforms].

2. **Justify** all 4 diodes of a Full Wave rectifier can not be ON at the same time.

3. **Calculate** peak to peak ripple voltage of the output.

4. **Calculate** the DC or Average value of the output.

5. Consider the new peak to peak ripple voltage is 50% of the previous value of it found in question 3 and the new ripple frequency is 300 HZ. Now keeping the load resistor and capacitor value same as mentioned in the diagram, **find** the new equation of the input waveform of this Full Wave rectifier.

③ $V_{r(p-p)} = \frac{V_p}{f_r * RC}$

$= 1.0352V$ (Ans)

$V_p = V_m - 2V_{D0}$
$= 12.94$

$f_r = 250*2$
$= 500$

$R = 5*10^3 \Omega$
$C = 5*10^{-6} F$

④ $V_{DC} = V_p - \frac{V_{r(p-p)}}{2}$

$= 12.94 - 0.5176 = 12.4224V$ (Ans)

(5)

$$V_r'(p-p) = \frac{50}{100} * V_r(p-p)$$

$$= 0.5 * 1.0352 = 0.5176 \text{ V}$$

$$f_r' = 300 \text{ Hz}$$

$$\therefore V_r'(p-p) = \frac{V_p'}{f_r' RC}$$

$$\Rightarrow V_p' = 3.882 \text{ V}$$

now $V_p' = V_m' - 2V_D$.

$$\therefore V_m' = 5.082 \text{ V}$$

$$\because V_{in} = V_m' \sin \omega t$$

$$= V_m' \sin 2\pi f$$

$$= 5.082 \sin 300\pi t$$

Ans

$\omega = 2\pi f$

$f = \frac{1}{2} f_r'$

$= 150$

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Quiz 4

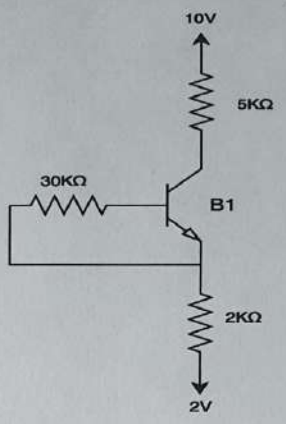
CSE251:Electronic Devices and Circuits

Total Marks: 25

Time: 25 minutes

Student ID:		**Section:**	
Name:			

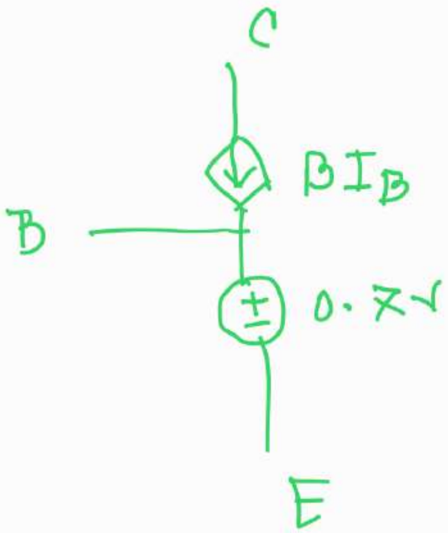
[CO2, CO3] [4+6+15+3]



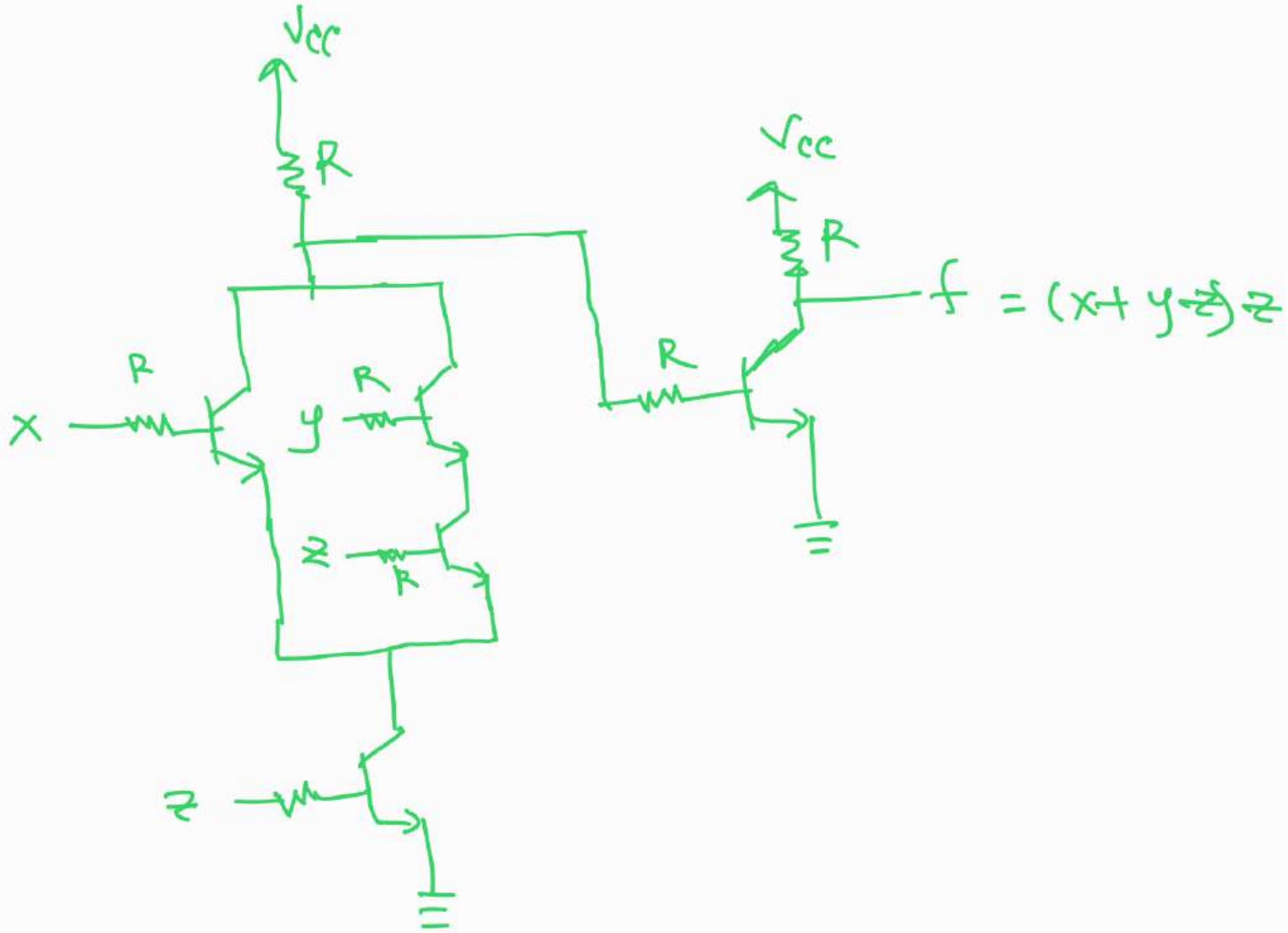
For the BJT, $\beta = 200$

1. Draw the **equivalent circuit** of a BJT when it is operating in **active** region.
2. Design the logic function **f = (x+yz) z** using BJTs. [Note that x, y, z are voltages]
3. Calculate the values of base, collector, emitter voltages and currents that is V_B, V_C, V_E and I_B, I_C, I_E for the BJT above. [You need to verify your assumption].
4. Make a **meme** about your current situation. [Bonus]

(1)



(2)

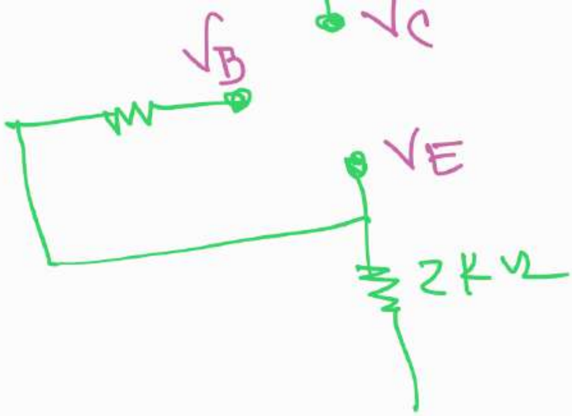


Hence $\beta = 200$

(3) Assumption 1, $B_1 \rightarrow$ cutoff

Since

$I_B = I_C = I_E = 0$



$\therefore V_C = 10V$

$V_E = 2V$

and $V_B = V_E = 2V$

$$\therefore V_{BE} = V_B - V_E$$
$$= 2 - 2 = 0V$$

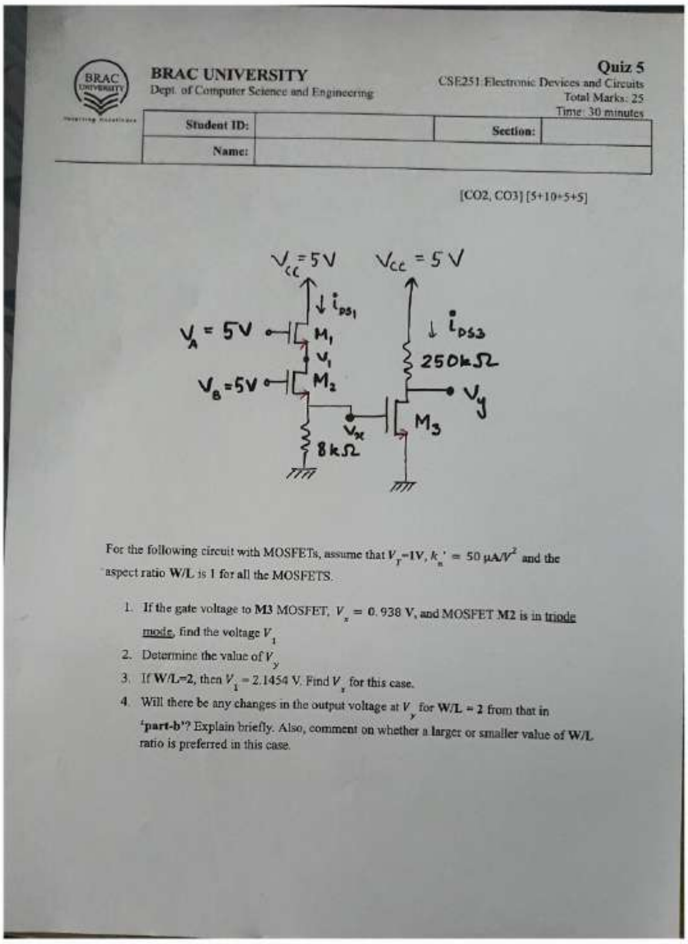
$$\therefore V_{BC} = V_B - V_C$$
$$= 2 - 10$$
$$= -8V$$

Verification

$$\because V_{BE} \leq 0.7V$$
$$V_{BC} \leq 0.6V$$

$$\therefore I_B = I_C = I_E = 0$$
$$V_C = 10V$$
$$V_B = V_E = 2V$$

Ans



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Quiz 5
CSE251 Electronic Devices and Circuits
Total Marks: 25
Time: 30 minutes

Student ID:		**Section:**	
Name:			

[CO2, CO3] [5+10+5+5]

For the following circuit with MOSFETs, assume that $V_T=1V$, $k_n' = 50\ \mu A/V^2$ and the aspect ratio **W/L** is 1 for all the MOSFETS.

1. If the gate voltage to **M3** MOSFET, $V_x = 0.938$ V, and MOSFET **M2** is in <u>triode mode</u>, find the voltage V_1
2. Determine the value of V_y
3. If **W/L=2**, then $V_1 = 2.1454$ V. Find V_x for this case.
4. Will there be any changes in the output voltage at V_y for **W/L = 2** from that in '**part-b**'? Explain briefly. Also, comment on whether a larger or smaller value of **W/L** ratio is preferred in this case.

$K'_n = 50\ \mu A$

$\frac{W}{L} = 1$

$\therefore K = 0.05\ mA/V^2$

① Given $M_2 \rightarrow$ Triode

Assuming $M_1 \rightarrow$ saturation

$\therefore \; i_{DS1} = i_{DS2}$

ohms law on $8k\Omega$

$$i_{DS1} = \frac{V_x - 0}{8} = \frac{V_x}{8} = \frac{0.938}{8} \quad \text{(1)}$$

From assumption (saturation) of M_1

$$V_{ov_1} = V_{GS1} - V_T$$
$$= 5 - V_{S1} - 1$$
$$= 4 - V_{S1}$$

$$V_{GS1} = 5 - V_{S1}$$

$$i_{DS1} = \frac{1}{2} k V_{ov_1}^2$$

$$\Rightarrow i_{DS1} = \frac{1}{2} * 0.05 * (4 - V_{S1})^2 \quad \text{(2)}$$

From (1) and (2)

$$\frac{0.938}{8} = \frac{0.05}{2} (4 - V_{S1})^2$$

$$\therefore \boxed{V_{S1} = 1.83435} \checkmark$$

or

$$V_{S1} = 6.1656$$

$\therefore$ verification

for M_1: $\quad V_{G1} = V_A = 5V$

$V_{D1} = V_{CC} = 5V$

$\therefore V_{DS1} = V_{D1} - V_{S1}$

$= 5 - 1.835$

$= 3.165$

$V_{OV1} = 4 - V_{S1} = 4 - 1.835$

$= 2.165$

$V_{DS1} > V_{OV1}$

and

$V_{GS1} = 5 - 1.835$

$= 3.165 > V_T = 1$

(correct)

For m_2:

$V_{D2} = V_{S1} = V_1 = 1.835$

$V_{S2} = V_X = 0.034$

$\therefore V_{DS2} = V_{D2} - V_{S2}$

$= 1.835 - 0.034$

$= 0.4007 \ V$

$V_{OV2} = V_{GS2} - V_T$

$= 5 - 0.038 - 1$

$= 3.962$

$\therefore V_{DS2} \geq V_{OV2}$

Triode $\Longrightarrow$ (correct)

$$\therefore \boxed{V_1 = 1.835\,V}$$

② For m_3

$$V_{G3} = V_x = 0.938\,V$$

$$V_{GS3} = V_{G3} - V_{S3}$$
$$= 0.938 - 0$$
$$= 0.983$$

$$\therefore V_{GS3} < V_T = 1\,V$$

$$\therefore \boxed{\text{cutoff.}} \quad \therefore i_{DS3} = 0$$

$$\therefore V_y = V_{cc} = 5\,V$$

③ $\frac{W}{2} = 2$

$$i_{DS1} = \frac{V_x}{8} = \frac{0.05}{2}\left(\frac{W}{2}\right)(5 - 2.145 - 1)^2$$

$$\therefore V_x = 1.377\,V$$

④ No changes since m_3 in cutoff.