Sir Syed University of Engineering & Technology (SSUET)

Computer Engineering Department

Course Name: Basic Electronics

Semester: Spring 2011, 3rd

Batch: 2010(Sections: A,B)

Assignments # 2

Course Responsible

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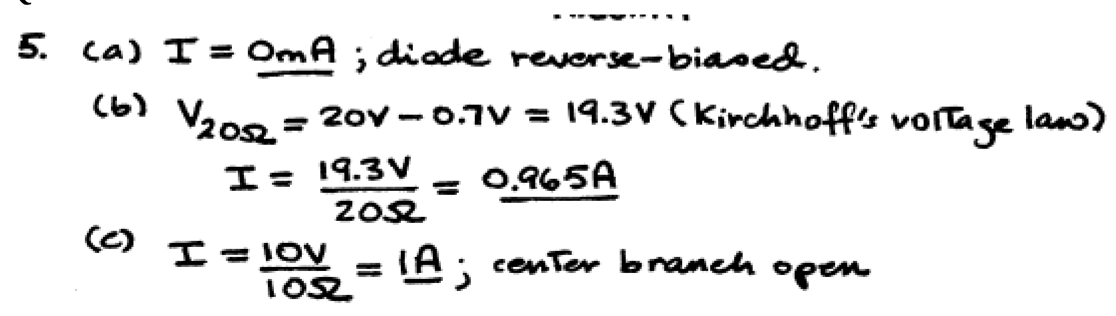
SIR SYED UNIVERSITY OF ENGINEERING AND TECHNOLOGY
COMPUTER ENGINEERING DEPARTMENT
BASIC ELECTRONICS
2010 BATCH (Sections: A, B)
Last Submission Date: Announce in Class

Assignment #2

1. Series Diode Configuration with DC Inputs: Q5 – to – Q9
2. Parallel and Series Parallel Configuration: Q10 – to – Q13
3. Half Wave Rectification: Q22 – to – Q27
4. Full Wave Rectification: Q28 – to – Q31

Q5.



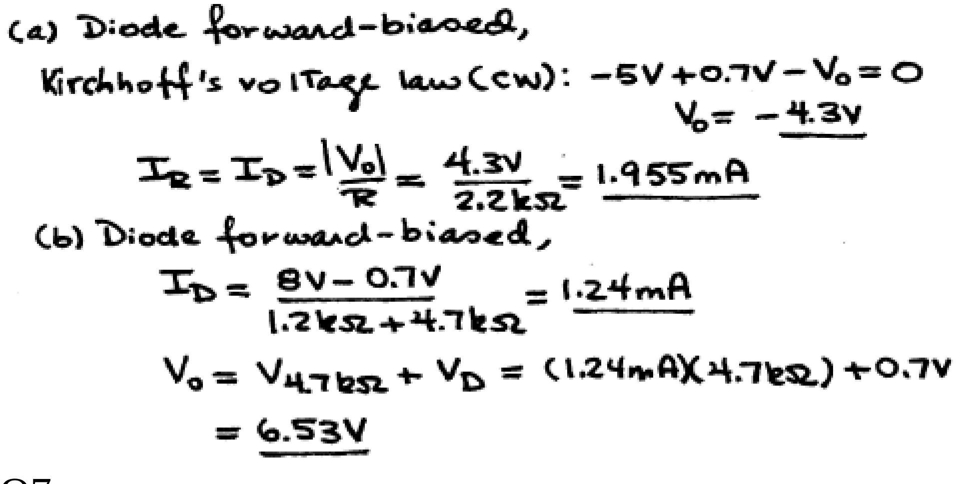
5. (a) $I = \underline{0\,\text{mA}}$; diode reverse-biased.

(b) $V_{20\Omega} = 20\text{V} - 0.7\text{V} = 19.3\text{V}$ (Kirchhoff's voltage law)

$$I = \frac{19.3\text{V}}{20\Omega} = \underline{0.965\text{A}}$$

(c) $I = \dfrac{10\text{V}}{10\Omega} = \underline{1\text{A}}$; center branch open

Q6.



(a) Diode forward-biased,

Kirchhoff's voltage law (CW): $-5\text{V} + 0.7\text{V} - V_o = 0$

$$V_o = \underline{-4.3\text{V}}$$

$$I_R = I_D = \frac{|V_o|}{R} = \frac{4.3\text{V}}{2.2\text{k}\Omega} = \underline{1.955\text{mA}}$$

(b) Diode forward-biased,

$$I_D = \frac{8\text{V} - 0.7\text{V}}{1.2\text{k}\Omega + 4.7\text{k}\Omega} = \underline{1.24\text{mA}}$$

$$V_o = V_{4.7\text{k}\Omega} + V_D = (1.24\text{mA})(4.7\text{k}\Omega) + 0.7\text{V}$$

$$= \underline{6.53\text{V}}$$

Q7.

7. (a) $V_o = \dfrac{2\,k\Omega\,(20\,V - 0.7\,V - 0.3\,V)}{2\,k\Omega + 2\,k\Omega}$

$= \frac{1}{2}(20\,V - 1\,V) = \frac{1}{2}(19\,V) = \underline{9.5\,V}$

(b) $I = \dfrac{10\,V + 2\,V - 0.7\,V}{1.2\,k\Omega + 4.7\,k\Omega} = \dfrac{11.3\,V}{5.9\,k\Omega} = 1.915\,mA$

$V' = IR = (1.915\,mA)(4.7\,k\Omega) = 9\,V$

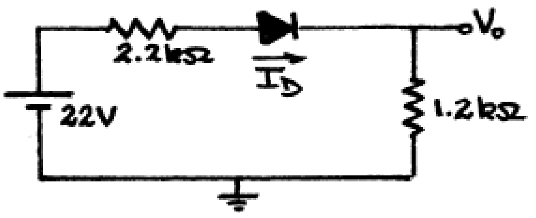
$V_o = V' - 2\,V = 9\,V - 2\,V = \underline{7\,V}$

Q8.

8. (a) Determine the Thevenin equivalent circuit for the 10mA source and 2.2kΩ resistor.

$E_{Th} = IR = (10\,mA)(2.2\,k\Omega) = 22\,V$

$R_{Th} = 2.2\,k\Omega$



Diode forward-biased

$I_D = \dfrac{22\,V - 0.7\,V}{2.2\,k\Omega + 1.2\,k\Omega} = \underline{6.26\,mA}$

$V_o = I_D(1.2\,k\Omega)$

$= (6.26\,mA)(1.2\,k\Omega)$

$= \underline{7.51\,V}$

(b) Diode forward-biased

$I_D = \dfrac{20\,V + 5\,V - 0.7\,V}{6.8\,k\Omega} = \underline{2.65\,mA}$

Kirchhoff's voltage law: (CW)

$+V_o - 0.7\,V + 5\,V = 0$

$V_o = \underline{-4.3\,V}$

Q9.

(a) $V_{o_1} = 12\,V - 0.7\,V = \underline{11.3\,V}$

$V_{o_2} = \underline{0.3\,V}$

(b) $V_{o_1} = -10\,V + 0.3\,V + 0.7\,V = \underline{-9\,V}$

$I = \dfrac{10\,V - 0.7\,V - 0.3\,V}{1.2\,k\Omega + 3.3\,k\Omega} = \dfrac{9\,V}{4.5\,k\Omega} = 2\,mA$, $V_{o_2} = -(2\,mA)(3.3\,k\Omega) = \underline{-6.6\,V}$

Q10.

(a) Both diodes forward-biased.

$$I_R = \frac{20V-0.7V}{4.7k\Omega} = 4.106mA$$

Assuming identical diodes:

$$I_D = \frac{I_R}{2} = \frac{4.106mA}{2} = \underline{2.05mA}$$

$$V_o = 20V - 0.7V = \underline{19.3V}$$

(b) Right diode forward-biased:

$$I_D = \frac{15V+5V-0.7V}{2.2k\Omega} = \underline{8.77mA}$$

$$V_o = 15V - 0.7V = \underline{14.3V}$$

Q11.

(a) Ge diode "on" preventing Si diode from turning "on".

$$I = \frac{10V-0.3V}{1k\Omega} = \frac{9.7V}{1k\Omega} = \underline{9.7mA}$$

$$V_o = 10V - 0.3V = \underline{9.7V}$$

(b) $$I = \frac{16V-0.7V-0.7V-12V}{4.7k\Omega} = \frac{2.6V}{4.7k\Omega} = \underline{0.553mA}$$

$$V_o = 12V + (0.553mA)(4.7k\Omega) = \underline{14.6V}$$

Q12.

Both diodes forward-biased,

$$V_{o_1} = \underline{0.7V}, \quad V_{o_2} = \underline{0.3V}$$

$$I_{1k\Omega} = \frac{20V-0.7V}{1k\Omega} = \frac{19.3V}{1k\Omega} = 19.3mA$$

$$I_{0.47k\Omega} = \frac{0.7V-0.3V}{0.47k\Omega} = 0.851mA$$

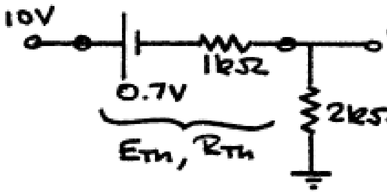
$$I(\text{Si diode}) = I_{1k\Omega} - I_{0.47k\Omega}$$

$$= 19.3mA - 0.851mA$$

$$= \underline{18.45mA}$$

Q13.

3. For the parallel Si − 2kΩ branches a Thevenin equivalent will result (for "on" diodes) in a single series branch of 0.7V and 1kΩ resistor as shown below:



$$V_o = \frac{2k\Omega\,(10V - 0.7V)}{1k\Omega + 2k\Omega} = \frac{2}{3}(9.3V)$$

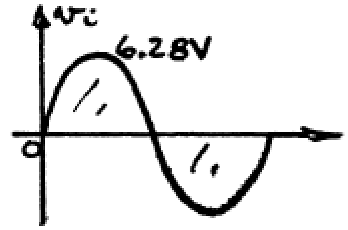
$$= \underline{6.2V}$$

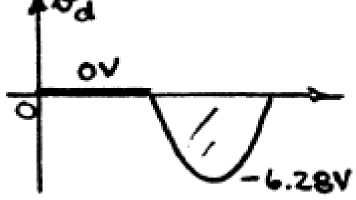
$$I_{2k\Omega} = \frac{6.2V}{2k\Omega} = 3.1mA$$

$$I_D = \frac{I_{2k\Omega}}{2} = \frac{3.1mA}{2} = \underline{1.55mA}$$

Q22.

$$V_{dc} = 0.318 V_m \Rightarrow V_m = \frac{V_{dc}}{0.318} = \frac{2V}{0.318} = 6.28V$$



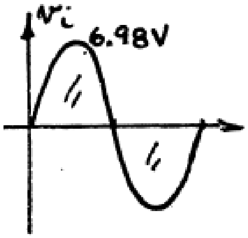


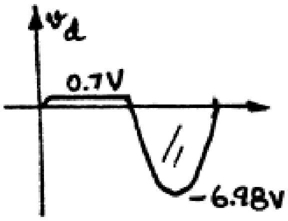
Q23.

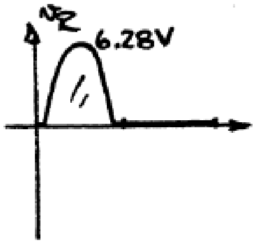
23. Using $V_{dc} \cong 0.318(V_m - V_T)$

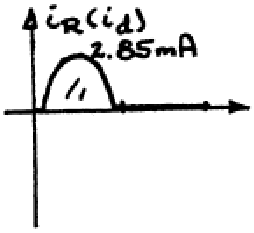
$2V = 0.318(V_m - 0.7V)$

Solving: $V_m = \underline{6.98V}$ $\cong$ 10:1 for $V_m : V_T$



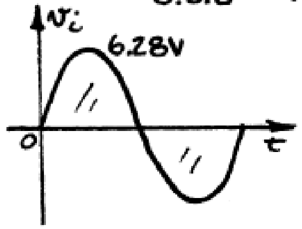


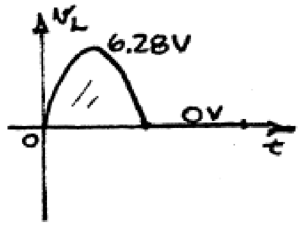




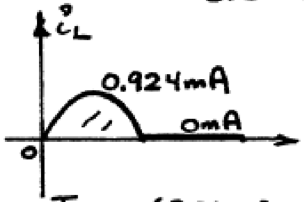
Q24.

24. $V_m = \frac{V_{dc}}{0.318} = \frac{2V}{0.318} = 6.28V$



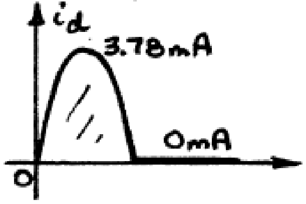


$I_{L_{max}} = \frac{6.28V}{6.8k\Omega} = 0.924mA$



$I_{max}(2.2k\Omega) = \frac{6.28V}{2.2k\Omega} = 2.855mA$

$I_{D_{max}} = I_{L_{max}} + I_{max}(2.2k\Omega) = 0.924mA + 2.855mA = 3.78mA$



Q25.

$V_m = \sqrt{2}\,110V = 155.56V$

$V_{dc} = 0.318V_m = 0.318(155.56V) = \underline{49.47V}$

Q26.

. Diode will conduct when $v_o = 0.7V$, That is,

$$v_o = 0.7V = \frac{10k\Omega(v_i)}{10k\Omega + 1k\Omega}$$

Solving: $v_i = 0.77V$

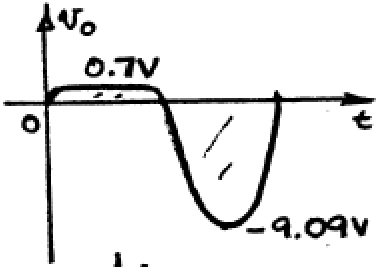
For $v_i \geq 0.77V$ Si diode is "on" and $v_o = 0.7V$

For $v_i < 0.77V$ Si diode open and level of v_o determined by voltage divider rule:

$$v_o = \frac{10k\Omega(v_i)}{10k\Omega + 1k\Omega} = 0.909v_i$$

For $v_i = -10V$:

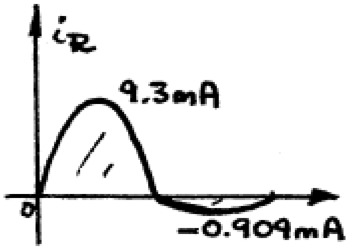
$$v_o = 0.909(-10V) = -9.09V$$



When $v_o = 0.7V$, $v_{R_{max}} = v_{i_{max}} - 0.7V = 10V - 0.7V = 9.3V$

$$I_{R_{max}} = \frac{9.3V}{1k\Omega} = 9.3mA$$

$$I_{max}(reverse) = \frac{10V}{1k\Omega + 10k\Omega} = 0.909mA$$



Q27.

(a) $P_{max} = 14mW = (0.7V)I_D$

$$I_D = \frac{14mW}{0.7V} = \underline{20mA}$$

(b) $4.7k\Omega \| 56k\Omega = 4.34k\Omega$

$V_R = 160V - 0.7V = 159.3V$

$$I_{max} = \frac{159.3V}{4.34k\Omega} = \underline{36.71mA}$$

(c) $$I_{diode} = \frac{I_{max}}{2} = \frac{36.71mA}{2} = \underline{18.36mA}$$

(d) yes $I_D = 20mA > 18.36mA$

(e) $I_{diode} = 36.71mA \gg I_{max} = 20mA$

Q28.

(a) $V_m = \sqrt{2}(120V) = 169.7V$

$V_{Lm} = V_{i_m} - 2V_D$

$= 169.7V - 2(0.7V) = 169.7V - 1.4V$

$= 168.3V$

$V_{dc} = 0.636(168.3V) = \underline{107.04V}$

(b) $PIV = V_m(\text{load}) + V_D = 168.3V + 0.7V = \underline{169V}$

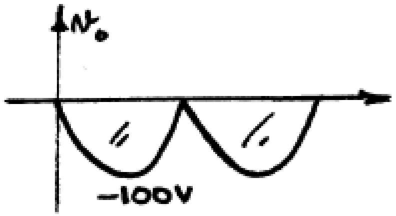
(c). $I_D(max) = \frac{V_{Lm}}{R_L} = \frac{168.3V}{1k\Omega} = \underline{168.3mA}$

(d) $P_{max} = V_D I_D = (0.7V) I_{max}$

$= (0.7V)(168.3mA)$

$= \underline{117.81mW}$

Q29.

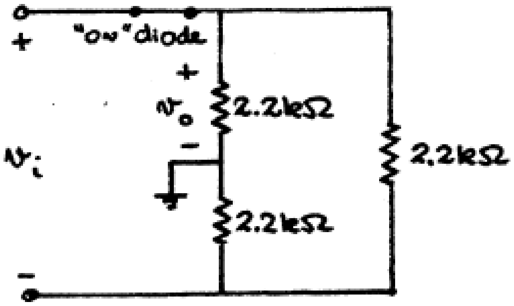


$PIV = \underline{100V}$

Q30.

Positive half-cycle of v_i:

Network redrawn:



Voltage-divider rule:

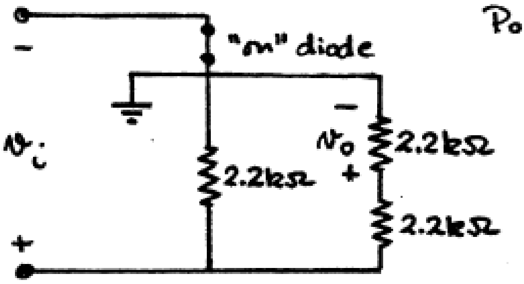
$$V_{o_{max}} = \frac{2.2k\Omega\,(V_{i_{max}})}{2.2k\Omega + 2.2k\Omega}$$

$$= \frac{1}{2}(V_{i_{max}})$$

$$= \frac{1}{2}(100V)$$

$$= \underline{50V}$$

Negative half-cycle of v_i:



Polarity of v_o across the 2.2kΩ resistor acting as a load is the same.

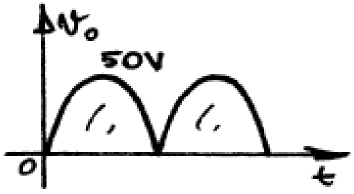
Voltage-divider rule:

$$V_{o_{max}} = \frac{2.2k\Omega\,(V_{i_{max}})}{2.2k\Omega + 2.2k\Omega}$$

$$= \frac{1}{2}(V_{i_{max}})$$

$$= \frac{1}{2}(100V)$$

$$= \underline{50V}$$



$$V_{dc} = 0.636\,V_m = 0.636(50V)$$

$$= \underline{31.8V}$$

Q31.

Positive pulse of v_i:

Top left diode "off", bottom left diode "on"

$2.2k\Omega \parallel 2.2k\Omega = 1.1k\Omega$

$$V_{o_{peak}} = \frac{1.1k\Omega\,(170V)}{1.1k\Omega + 2.2k\Omega} = 56.67V$$

Negative pulse of v_i:

Top left diode "on", bottom left diode "off"

$$V_{o_{peak}} = \frac{1.1k\Omega\,(170V)}{1.1k\Omega + 2.2k\Omega} = 56.67V$$

$$V_{dc} = 0.636(56.67V) = \underline{36.04V}$$