Final Answers Only

Ryerson University

Department of Electrical and Computer Engineering

ELE404 (Electronic Circuits I)

Makeup Midterm Examination (W2014)

March 2014

Duration: 100 minutes

Examiner: Prof. A. Yazdani

Name:.....

[Print Last Name] [Print First Name]

Student No:..... Section:....

NOTES

1. This is a closed-book examination. No aids other than basic calculators are permitted.

2. The examination paper is comprised of **FIVE QUESTIONS**, *each* question is worth as indicated in the following Table. The entire examination is worth *100* marks.

Question #	Maximum Mark	Mark Earned
1	**30**	
2	**15**	
3	**20**	
4	**15**	
5	**20**	
Total	**100**	

3. Answer all questions in the booklet, within the blank spaces provided under each question in this booklet. Use the reverse if needed.

4. ***No Questions to be asked during the examination***. *If in doubt about any question, clearly state your assumptions in answering the question.*

5. Part marks for an answer will only be given if the *correct methodology* is clearly shown.

6. **DO NOT DETACH** any pages from this booklet.

Q1: In the diode circuit of **Fig. 1**, D_1 is a regular diode whose forward voltage drop is assumed to be $0.7\ V$, whereas D_2 is an LED that starts to glow when its forward voltage drop reaches about $2.2\ V$. Further, $V_{CC} = 10\ V$, $R_1 = 1.0\ k\Omega$, $R_2 = 2.0\ k\Omega$, and $I_x = 4.0\ mA$. It is assumed that neither diode enters the breakdown region.

1a) If the voltage V_x is so negative that the LED is off, determine the conduction state ("on" or "off") of D_1, and calculate the voltages V_3 and V_4. Summarize your findings in **Table 1a**.

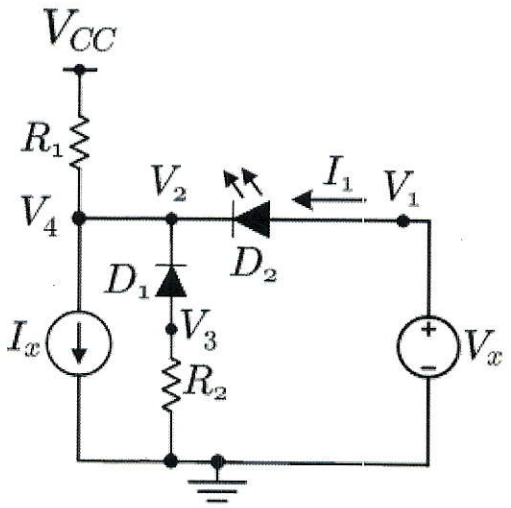

Fig. 1: Diode circuit of Q1.

Table 1a: Results of the diode circuit of Q1.

State of D_1	V_3 [V]	V_4 [V]
OFF	0	6

1b) V_x is then raised to 10.2 V and the LED glows. For this operating condition, calculate I_1, V_2, and V_3. Complete **Table 1b**.

Table 1b: voltage values corresponding to $V_x = 10.2\ V$.

$I_1\ [mA]$	$V_2\ [V]$	$V_3\ [V]$
2.0	8.0	0

Q2: In the circuit of **Fig. 2**, $V_{CC} = 15\ V$, $I = 1.5\ mA$, and $R = 3.3\ k\Omega$. If $V_O = 5.7\ V$ at a temperature of 20 °C, what will V_O be the 40 Celsius? At 0 Celsius? At 80 Celsius? Explain why and/or show the calculations. Summarize your results in **Table 2**. [***Hint:*** the voltage drop across the resistor is proportional to the current of the diode].

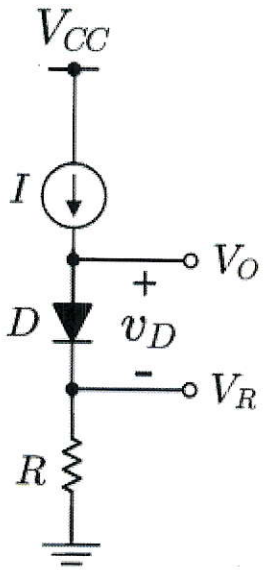

Fig. 2: Diode circuit of Q2.

Table 2: Results of the diode circuit of Q2.

T [°C]	20	40	0	80
$V_O[V]$	5.7	5.66	5.74	5.58

Q3: **Fig. 3** shows a full-wave rectifier with smoothing capacitor. A gross manufacturing error has resulted in the connection of a grounded load to the anode (as opposed to the cathode) of D_1. The source voltage v_I is a 5-Vrms sinusoid, $C = 680\ \mu F$, and $R_L = 1.2\ k\Omega$. The diodes may be assumed ideal.

Assuming that the circuit has reached a steady state, determine the reading of a dc voltmeter of the voltages v_O and v_L. Show all the work. **Box your answers.**

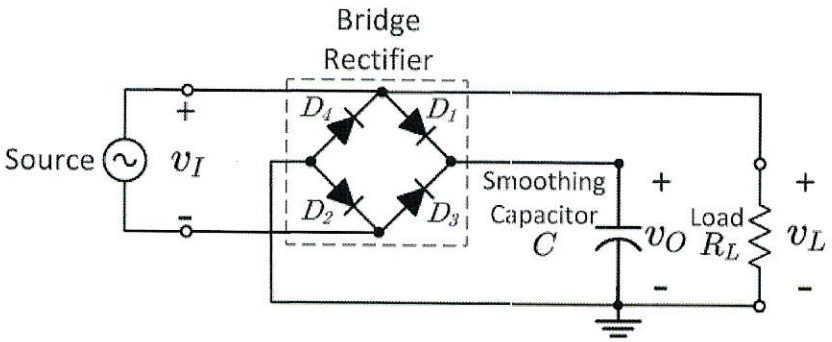

Fig. 3: Full-wave rectifier of Q3.

$\overline{v_O} = 7.0\,V$

$\overline{v_L} = 2.23\,V$

Q4: In the shunt voltage regulator of **Fig. 4**, $R = 330\ \Omega$, and the unregulated voltage v_{rec} is the output of a full-wave rectifier and, therefore, has an almost triangular waveform. According to the manufacturer, the Zener diode gives a voltage of $v_Z = V_{ZT} = 5.6\ V$ at a test current of $i_Z = I_{ZT} = 25\ mA$, and the diode can tolerate a maximum current of $I_{Zmax} = 100\ mA$. Further, $r_Z = 15\ \Omega$ and $I_{ZK} = 1.5\ mA$.

If the reading of a dc voltmeter of v_O is 5.9 V, and if v_O has a peak-to-peak ripple of 100 mV, determine the minimum and maximum values of v_{rec}.

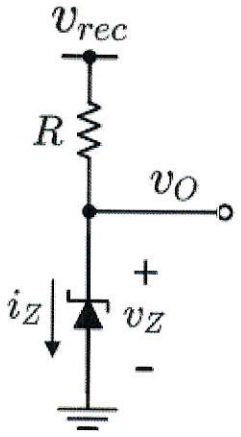

Fig. 4: Shunt regulator of Q4.

$v_{rec,min} = 19.6\ V$

$v_{rec,max} = 21.9\ V$

Q5: In the transistor circuit of **Fig. 5**, determine the mode of operation of the transistor and the node voltages, if $V_{EE} = 5\ V$, $-V_{CC} = -V_{BB} = -10\ V$, $R_1 = R_4 = 1.0\ k\Omega$, $R_2 = 3.3\ k\Omega$, and $R_3 = 1.5\ M\Omega$. Assume that $V_{EBon} = 0.7\ V$, $V_{ECsat} = 0.3\ V$, and $\beta = 100$.

Show all the work, and complete **Table 5**.

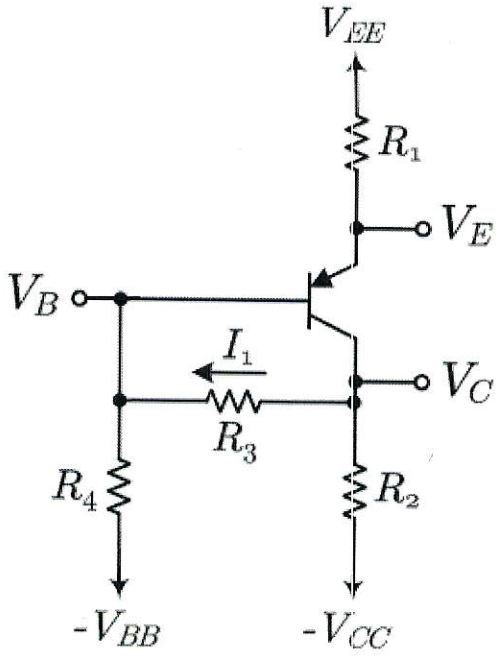

Fig. 5: Transistor circuit of Q5.

Table 5: transistor's mode of operation and the node voltages in the circuit of Q5.

Mode of Q1	$v_B[V]$	$v_C[V]$	$v_E[V]$
Saturation	−3.85	−3.45	−3.15