Final Answers Only

**Ryerson University**
Department of Electrical and Computer Engineering
**ELE404** (Electronic Circuits I)
**Midterm Examination (P2014)**
**May 2014**
**Duration: 120 minutes**
Examiner: Prof. A. Yazdani

Name:.....
[Print Last Name] [Print First Name]

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

**NOTES**

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

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

| Question # | Maximum Mark | Mark Earned |
|---|---|---|
| 1 | **25** | |
| 2 | **25** | |
| 3 | **25** | |
| 4 | **25** | |
| Total | **100** | |

3. Answer all questions in the booklet, within the blank spaces provided under each question in this booklet. **DO NOT USE THE REVERSE SIDE**.

4. *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**, $R_1 = 1.5\ k\Omega$, $R_2 = 2.2\ k\Omega$, $R_3 = 1.8\ k\Omega$, $V_{CC} = 10\ V$, $I_x = 5.1\ mA$, anid $V_x = -25\ V$. Further, the diodes exhibit a forward voltage drop of $0.7\ V$. The diodes are assumed to have a large reverse breakdown voltage and, therefore, do not enter their breakdown regions.

Determine the state of conduction of the diodes and calculate the voltages $V_1$ through $V_3$. Summarize your findings in **Table 1**. Show all the work.

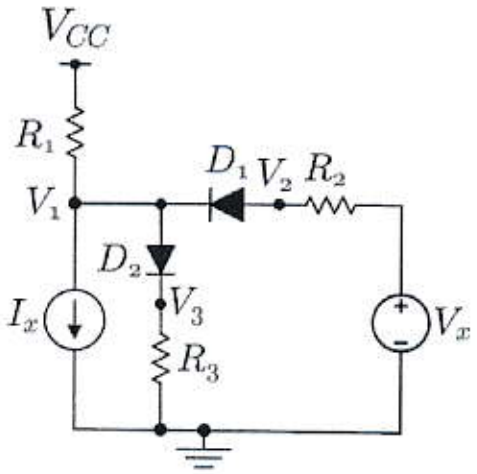


**Fig. 1**: Diode circuit of Q1.

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

| State of $D_1$ | State of $D_2$ | $V_1$ [V] | $V_2$ [V] | $V_3$ [V] |
|---|---|---|---|---|
| OFF | ON | 1.6 | -25 | 0.9 |

Q2: A 2.4-$V$ low-power electronic gadget is to be powered from a 12-$V$ car outlet. A proposal is to use the circuit of **Fig. 2** in which three series-connected identical diodes are forward-biased by the car outlet voltage through a resistor. Consulting the datasheet, one finds that each diode exhibits a forward voltage drop of 0.65 $V$ at 0.1 $mA$. Determine the resistance and power consumption of the resistor, $R$, such that $v_O = 2.4\ V$. Show all the work.

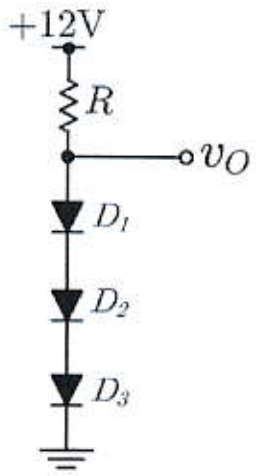


**Fig. 2:** Voltage regulator of Q2.

$R = 238\ \Omega$

$P_R = 387\ mW$

Q3: For the rectifier of **Fig. 3a**, $R_L = 80\ \Omega$ and each diode may be assumed to exhibits a forward voltage drop of about $0.6\ V$. In the lab, a student has recorded the oscilloscope screenshot of **Fig. 3b** (in which each vertical axis division represents one volt). Determine the ***reading of a DC voltmeter*** of the voltage $v_{rec}$, the capacitance $C$, and the voltage ratio of the step-down transformer. Show all the work or explain. Complete **Table 3.**

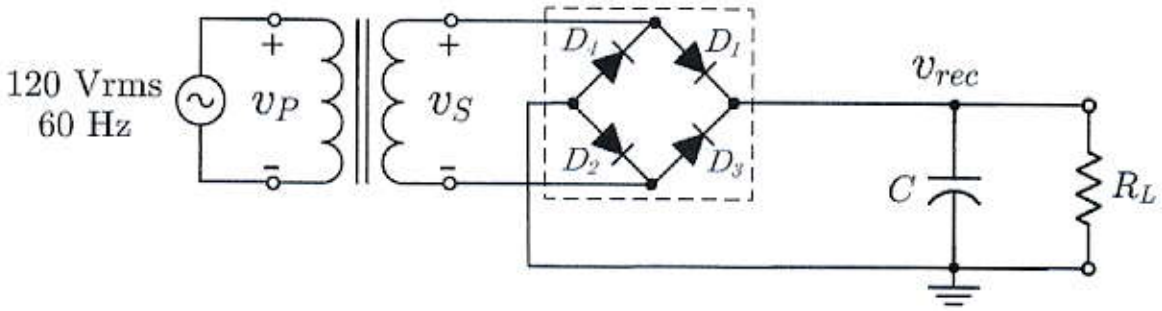


**Fig. 3a:** Rectifier of Q3.

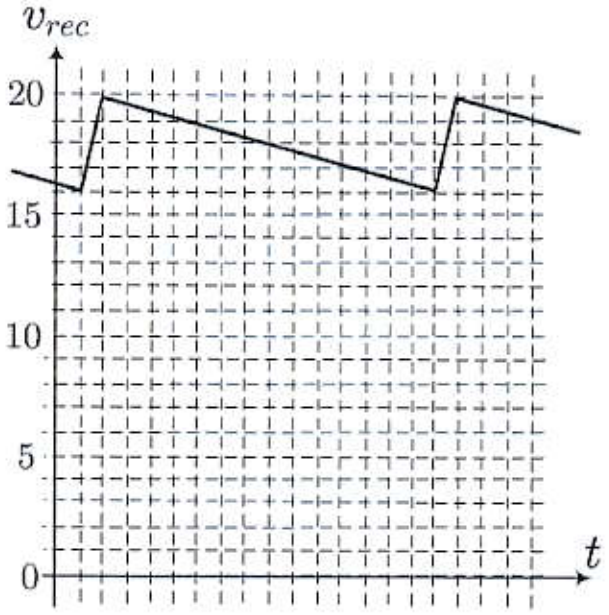


**Fig. 3b:** Rectifier's output voltage waveform.

**Table 3:** results of the rectifier of Q3.

| Reading of DC voltmeter $[V]$ | $C\ [\mu F]$ | Voltage ratio of transformer $[V_{rms}/V_{rms}]$ |
|---|---|---|
| 18 | 470 | 120/15 |

Q4: In the shunt voltage regulator of **Fig. 4**, $R_L = 1.0\ k\Omega$ and $R = 820\ \Omega$. According to the manufacturer, the Zener diode gives a voltage of $v_Z = V_{ZT} = 5.1\ V$ at a test current of $i_Z = I_{ZT} = 20\ mA$. Further, $r_Z = 10\ \Omega$ and $I_{ZK} = 1.5\ mA$.

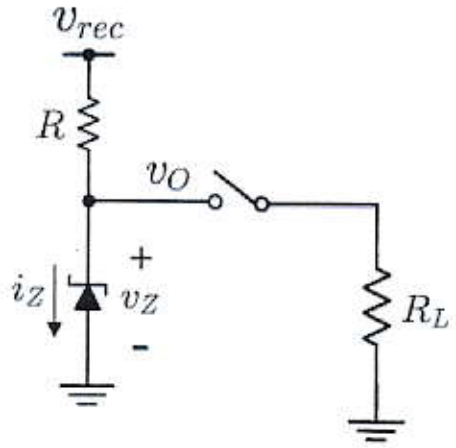


**Fig. 4:** Shunt regulator of Q4.

**(4a) [10 marks]** Assuming that the switch is open, determine the peak-to-peak ripple of the output voltage $v_o$ if the unregulated voltage $v_{rec}$ has a peak-to-peak ripple of 4.0 $V$. Show all the work.

48 mV

**(4b) [15 marks]** Assuming that the switch is closed, calculate the minimum permissible value of the unregulated voltage $v_{rec}$, in order for the Zener diode to retain its effectiveness. Show all the work.

10.17 V