American International University- Bangladesh (AIUB)
Faculty of Engineering

Course Name :	Electronic Devices	**Course Code:**	EEE 2103
Semester :	Summer 2020-21	**Section:**	
Faculty :	**Nowshin Alam**	Term	Mid

Assignment No :	1
CO Number	CO2
POI Number	P.b.1.C2

Student Name:	**Anonnya Sarkar**	**Student ID:**	**20-42600-1**

Submission Date:	**04/07/21**	**Due Date :**	**07/07/21**

Marking Rubrics (to be filled by Faculty):

Problems	Excellent [5]	Proficient [4]	Good [3]	Acceptable [2]	Unacceptable [1]	No Response [0]	Secured Marks
(i)	Detailed unique response explaining the concept properly and answer is correct with all works clearly shown.	Response with no apparent errors and the answer is correct, but explanation is not adequate/unique.	Response shows understanding of the problem, but the final answer may not be correct.	Partial problem is solved; response indicates part of the problem was not understood clearly.	Unable to clarify the understanding of the problem and method of the problem solving was not correct.	No Response	
(ii)	Detailed unique response explaining the concept properly and answer is correct with all works clearly shown.	Response with no apparent errors and the answer is correct, but explanation is not adequate/unique.	Response shows understanding of the problem, but the final answer may not be correct	Partial problem is solved; response indicates part of the problem was not understood clearly.	Unable to clarify the understanding of the problem and method of the problem solving was not correct	No Response	
Comments						Total marks (10)	

<u>INSTRUCTIONS:</u> When a question mentions "ID" as a value, you have to use the <u>last two digits of your ID</u> before the hyphen. For example, for 12-34567-8 it would be <u>67</u>. If the last 2 digits of your ID form a number less than 10, then add 10 with the number before using it to solve the problems. If the last 2 digits of your ID form a number greater than or equal to 10, you can use it as it is.

Note: Copied/identical submissions will be graded as 0 for all parties concerned.

Imagine a situation where your laptop is almost out of charge. To charge up your laptop, you have to use the wall socket, which provides a sinusoidal AC output of **(ID+100)** V (rms) and 50 Hz, but your laptop needs to receive a DC voltage of (**<u>ID</u>** ÷ 5) +15 V to be charged. However, the connection from the wall socket can be a bit unstable as sometimes it spikes to a much higher than the rated value.
To address the above issue, **illustrate** a diode-based circuit that can be placed between the wall socket and your laptop to charge your laptop successfully and safely.

<u>Design Criteria</u>:
1) The regular diodes (choose between Ge, Si, GaAs), zener diode, and resistors can be used to construct the circuit.
2) The PIV of the diode must exceed the peak value of the AC input.
3) An overcharge protection must be implemented to keep your laptop from being damaged from spikes in the voltage.

*Based on this criterion, **demonstrate** the following:*

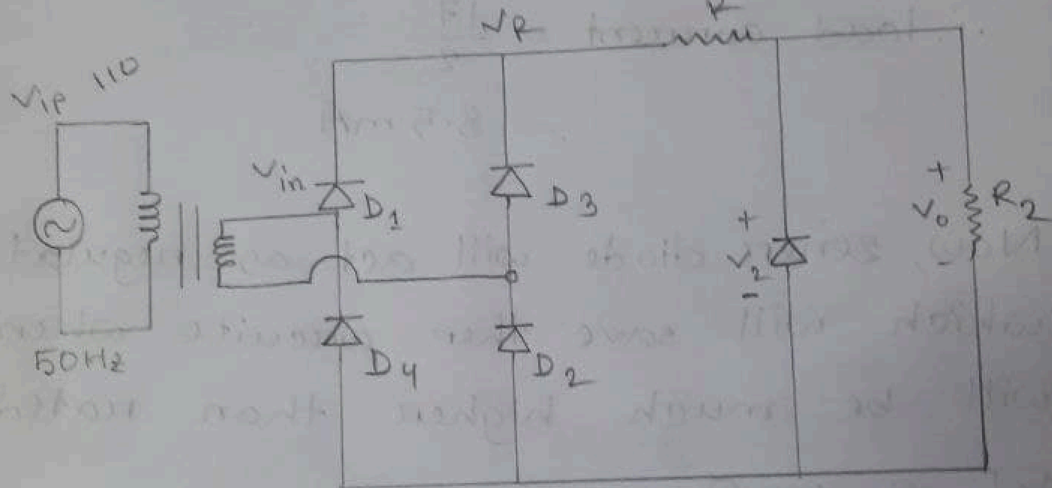
i) **Identify** the name of the circuit and **illustrate** the designed circuit with appropriate connections and adequate labeling. Also, **Explain** the operation of the designed circuit. **[5]**

ii) **Show** the appropriate label of the input and output voltage wave shapes of the designed circuit. **[5]**

My ID = 20-42600-1

as the last two digit of my id is 00 so I have to add 10 with it.

So, new id = 00+10
= 10



AC output, $v_1 = (ID + 100) = (10+100)$
$= 110\ v\ (rms)$

DC output, $v_2 = \{(ID \div 5) + 15\}\ v$
$= \{(10 \div 5) + 15\}\ v$
$= (2+15)\ v$
$= 17\ V$

Diodes considered can be normal Si diodes with $\cancel{23}$ 17 v forward voltage drop and specification for zener diode is considered as $V_Z = 17$ v, $I_{Z min} = 0A$, $I_{Z max} = 25$ mA

$R_L = 2 K\Omega$

$\therefore$ load current $= \frac{17}{2}$

$= 8.5$ mA

Now, zener diode will act as regulator which will save the circuite when i/p will be much higher than rated value.

let, $R = 100\Omega$

Rectifier O/P (min)

$= 17 + (8.5 \times 10^{-3} \times 100)$ v

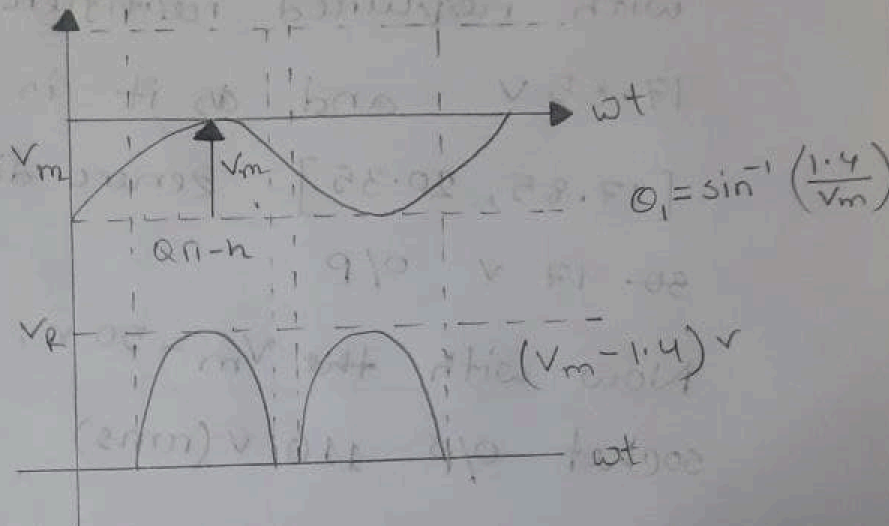
$= 17.85$ v

Rectifier O/P (max)

$17 + (8.5 + 25) \times 10^{-3} \times 100$

$= 20.35$ v

Now, considering 0.7 v forward voltage drop in Si diodes, the rectifier i/p and o/p waveforms will be



Now Avarage value of V_R will be

$$V_{Ravg} = \frac{1}{\pi}\int_{\theta_1}^{\pi-\theta_1} (V_m \sin \omega t - 1.4)\, d(\omega t)$$

$$= \frac{1}{\pi}\left[V_m\left[-\cos\omega t\right]_{\theta_1}^{\pi-\theta_1} - 1.4(\pi - 2\theta_1)\right]$$

$$\cancel{= \frac{1}{\pi}\left[2V_m \cos\theta_1 - 1.4(\pi - 2\theta_1)\right]}$$

$$= \frac{1}{\pi}\left[V_m \cos\theta_1 - \cos(\pi - \theta_1) - 1.4(\pi - 2\theta_1)\right]$$

$$= \frac{1}{\pi}\left[2V_m \cos\theta_1 - 1.4(\pi - 2\theta_1)\right]$$

$$\therefore V_{Ravg} = \frac{1}{\pi}\left[2\sqrt{V_m^2 - 1.4^2} - 1.4\pi + 2.8\sin^{-1}\left(\frac{1.4}{V_m}\right)\right]$$

Let's consider $V_m = 50$ v

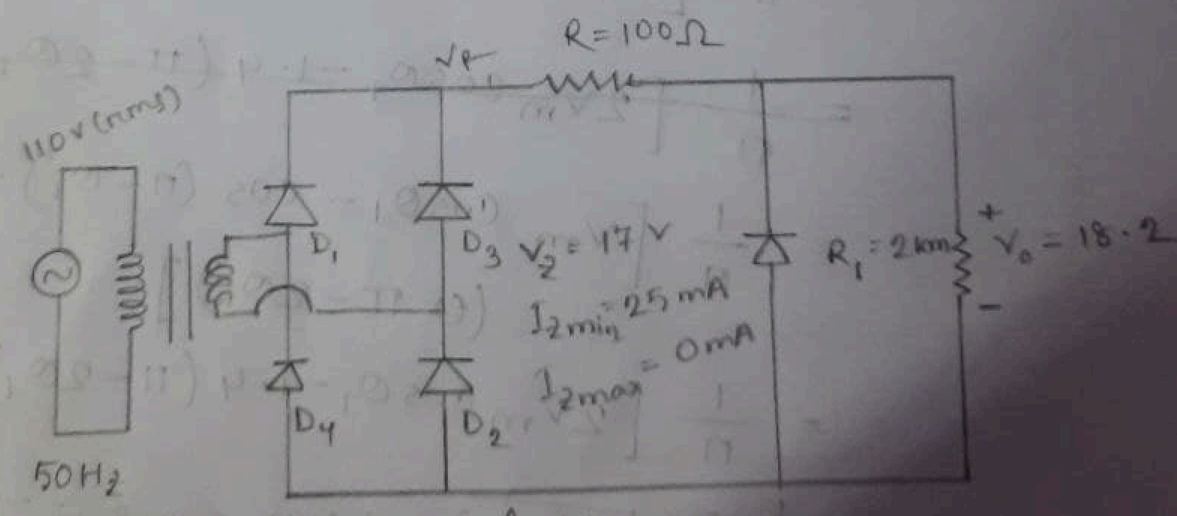
$\therefore V_{Ravg} = 31.84$ which is almost same with required rectifier o/p (min) i.e 17.85 V and as it is in range [17.85, 20.35], zener diode can maintain ~~so~~ 17 v o/p

Now with the $V_m = 50$ v, we have all socket o/p 110 v (rms)

i.e $(110\sqrt{2}) = 155.56$ v peak

Transformer turns ration $= \frac{155.56}{50} = 3.112$

Our final design will be.



Design of charger

Diode PIV will be $(2V_m) = (2 \times 50) = 100$ V

Waveforms for this current will be

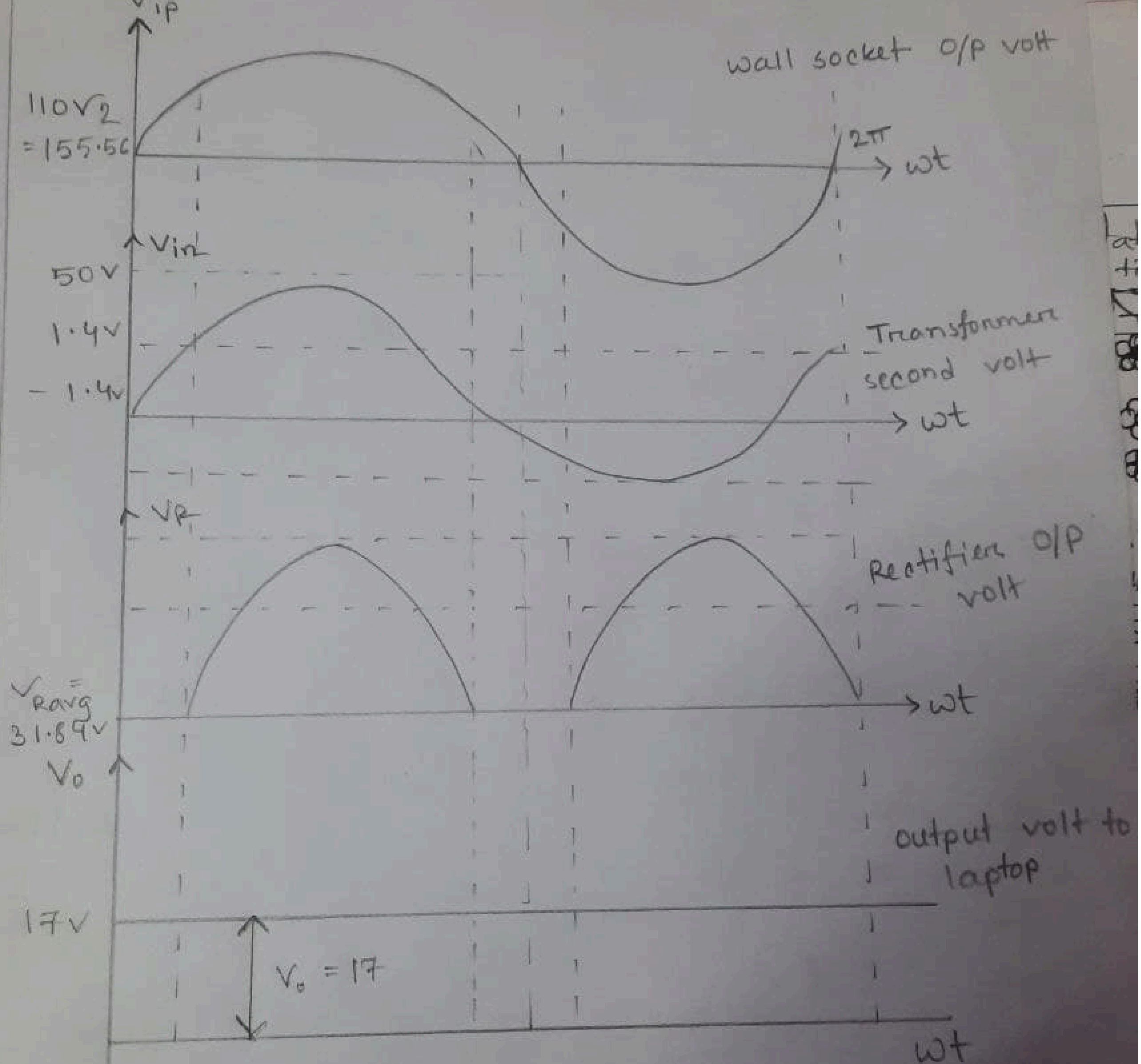


Fig: Wave shapes of designed circuit