Model Answer

Course name: Electronics I
Course Code: ECE201
Lecturer: Dr. Ahmed ElShafee

Exam number: Midterm - Fall 2017
Exam Date: Nov 2016
Time Allowed: 60 minutes

ID: .....

Name: .....

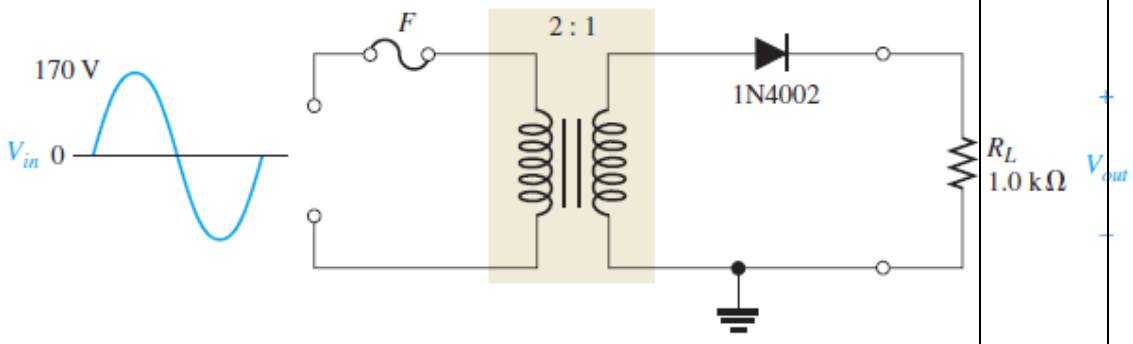
MCQ	Problems			Total
	Q1	Q2	Q3	
15	5	5	5	30

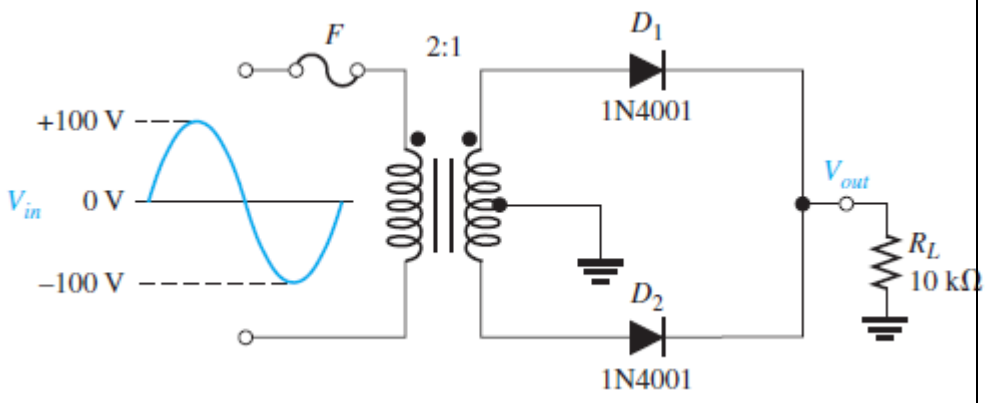
Part 1: MCQ

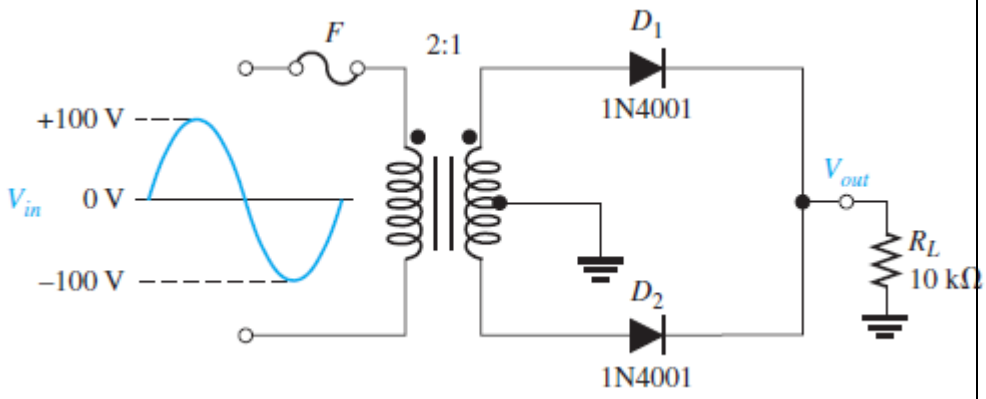
Highlight your answer in the following table (answer only 15 questions)

#	A	B	C	D	E	F	G	Answer
1					●			e
2	●							a
3			●					c
4	●							a
5			●					c
6	●							a
7	●							a
8				●				d
9			●					c
10		●						b
11				●				d
12			●					c
13		●						b
14		●						b
15			●					c
16			●					c
17	●							a
18		●						b
19		●						b
20	●							a

(answer only 15 questions)

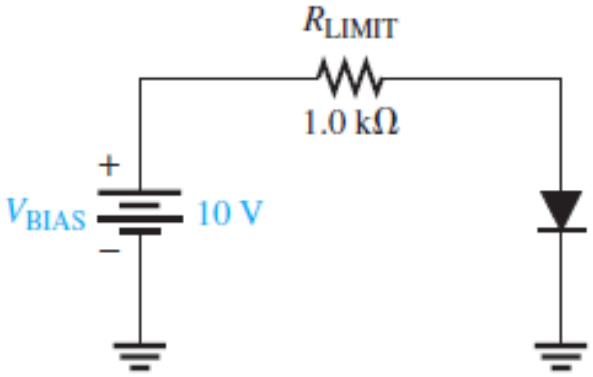
#	Question	Answer
1	In an intrinsic semiconductor, (a) there are no free electrons (b) the free electrons are thermally produced (c) there are only holes (d) there are as many electrons as there are holes (e) answers (b) and (d)	e
2	The process of adding an impurity to an intrinsic semiconductor is called (a) doping (b) recombination (c) atomic modification (d) ionization	a
3	The majority carriers in an *n*-type semiconductor are (a) holes (b) valence electrons (c) conduction electrons (d) protons	c
4	The minority carriers in an *n*-type semiconductor are (a) holes (b) valence electrons (c) conduction electrons (d) protons	a
5	A *pn* junction is formed by (a) the recombination of electrons and holes (b) ionization (c) the boundary of a *p*-type and an *n*-type material (d) the collision of a proton and a neutron	c
6	If the input voltage in Figure is increased, the peak inverse voltage across the diode will  (a) increase (b) decrease (c) not change	a

7	The average value of a half-wave rectified voltage with a peak value of 200 V is (a) 63.7 V (b) 127.2 V (c) 141 V (d) 0 V	a
8	The peak value of the input to a half-wave rectifier is 10 V. The approximate peak value of the output is (a) 10 V (b) 3.18 V (c) 10.7 V (d) 9.3 V	d
9	If the frequency of the input voltage in Figure is increased, the output voltage will  (a) increase (b) decrease (c) not change	c
10	The average value of a full-wave rectified voltage with a peak value of 75 V is (a) 53 V (b) 47.8 V (c) 37.5 V (d) 23.9 V	b
11	The total secondary voltage in a center-tapped full-wave rectifier is 125 V rms. Neglecting the diode drop, the rms output voltage is (a) 125 V (b) 177 V (c) 100 V (d) 62.5 V	d

12	If the PIV rating of the diodes in Figure is increased, the current through RL will  (a) increase (b) decrease (c) not change	c
13	Although current is blocked in reverse bias, (a) there is some current due to majority carriers (b) there is a very small current due to minority carriers (c) there is an avalanche current	b
14	The dynamic resistance can be important when a diode is (a) reverse-biased (b) forward-biased (c) in reverse breakdown (d) unbiased	b
15	Ideally, a diode can be represented by a (a) voltage source (b) resistance (c) switch (d) all of these	c
16	When a 60 Hz sinusoidal voltage is applied to the input of a half-wave rectifier, the output frequency is (a) 120 Hz (b) 30 Hz (c) 60 Hz (d) 0 Hz	c
17	When a 60 Hz sinusoidal voltage is applied to the input of a full-wave rectifier, the output frequency is (a) 120 Hz (b) 60 Hz (c) 240 Hz (d) 0 Hz	a

18	When the peak output voltage is 100 V, the PIV for each diode in a center-tapped full-wave rectifier is (neglecting the diode drop) (a) 100 V (b) 200 V (c) 141 V (d) 50 V	b
19	Each diode in a full-wave rectifier conducts for the entire input cycle. (a) True (b) False	b
20	The output frequency of a full-wave rectifier is twice the input frequency. (a) True (b) False	a

Part 2: problems:

Q1	Determine the forward voltage and forward current for the diode in Figure for each of the diode models (Ideal model, Ideal model: Practical model, Complete model). Also find the voltage across the limiting resistor in each case. Assume r'd = l0.0. at the determined value of forward current. 
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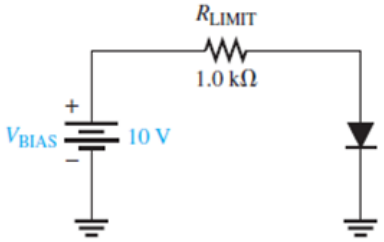
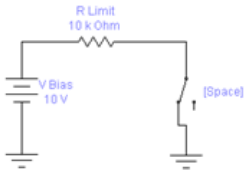


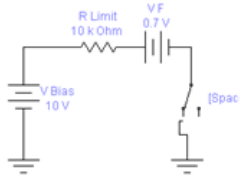
- Ideal model:

$$V_F = \mathbf{0\ V}$$
$$I_F = \frac{V_{BIAS}}{R_{LIMIT}} = \frac{10\ V}{1.0\ k\Omega} = \mathbf{10\ mA}$$
$$V_{R_{LIMIT}} = I_F R_{LIMIT} = (10\ mA)(1.0\ k\Omega) = \mathbf{10\ V}$$



- Practical model:

$$V_F = \mathbf{0.7\ V}$$
$$I_F = \frac{V_{BIAS} - V_F}{R_{LIMIT}} = \frac{10\ V - 0.7\ V}{1.0\ k\Omega} = \frac{9.3\ V}{1.0\ k\Omega} = \mathbf{9.3\ mA}$$
$$V_{R_{LIMIT}} = I_F R_{LIMIT} = (9.3\ mA)(1.0\ k\Omega) = \mathbf{9.3\ V}$$

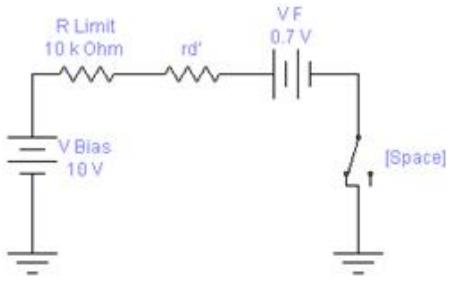


- Complete model

$$I_F = \frac{V_{BIAS} - 0.7\,V}{R_{LIMIT} + r'_d} = \frac{10\,V - 0.7\,V}{1.0\,k\Omega + 10\,\Omega} = \frac{9.3\,V}{1010\,\Omega} = \mathbf{9.21\,mA}$$

$$V_F = 0.7\,V + I_F r'_d = 0.7\,V + (9.21\,mA)(10\,\Omega) = \mathbf{792\,mV}$$

$$V_{R_{LIMIT}} = I_F R_{LIMIT} = (9.21\,mA)(1.0\,k\Omega) = \mathbf{9.21\,V}$$



Q2 Consider the circuit in Figure.

(a) What type of circuit is this?

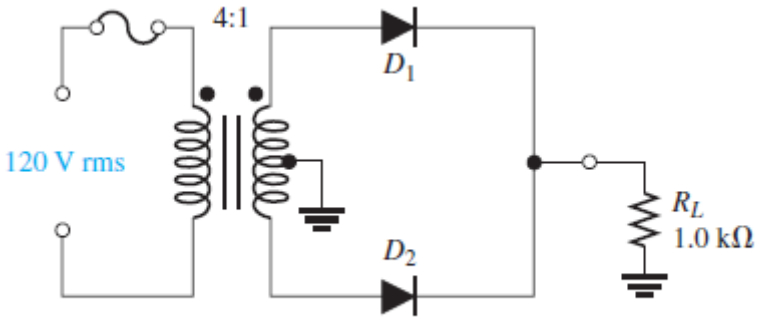
(b) What is the total peak secondary voltage?

(c) Find the peak voltage across each half of the secondary.

(d) Sketch the voltage waveform across RL.

(e) What is the peak current through each diode?

(f) What is the PIV for each diode?



(a) Center-tapped full-wave rectifier

(b) $V_{p(sec)} = (0.25)(1.414)110\ \text{V} = \mathbf{38.9\ V}$

(c) $\dfrac{V_{p(sec)}}{2} = \dfrac{38.9\ \text{V}}{2} = \mathbf{19.4\ V}$

(d) See Figure 2-2. $V_{RL} = 19.4\ \text{V} - 0.7\ \text{V} = 18.7\ \text{V}$

Figure 2-2

(e) $I_F = \dfrac{\dfrac{V_{p(sec)}}{2} - 0.7\ \text{V}}{R_L} = \dfrac{18.7\ \text{V}}{1.0\ \text{k}\Omega} = \mathbf{18.7\ mA}$

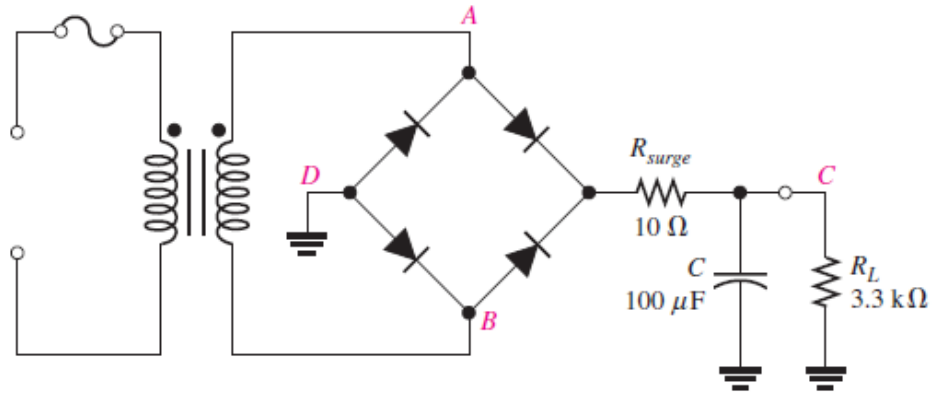
(f) PIV = 19.4 V + 18.7 V = **38.1 V**

Q3

in Figure the transformer has a 36 V rms secondary voltage rating, and the line voltage has a frequency of 60 Hz.

a) Determine the peak-to-peak ripple and dc output voltages

b) draw the following voltage waveforms in relationship to the input waveforms: V_{AB}, V_{AD}, and V_{CD}. another.



Consider that

$$V_{r(pp)} = \left(\frac{1}{fR_LC}\right)V_{p(rect)}$$

$$V_{DC} = \left(1 - \frac{1}{2fR_LC}\right)V_{p(rect)}$$

$V_{p(sec)} = (1.414)(36\text{ V}) = 50.9\text{ V}$

$V_{r(rect)} = V_{p(sec)} - 1.4\text{ V} = 50.9\text{ V} - 1.4\text{ V} = 49.5\text{ V}$

Neglecting R_{surge}, $V_{r(pp)} = \left(\frac{1}{fR_LC}\right)V_{p(rect)} = \left[\frac{1}{(120\text{ Hz})(3.3\text{ k}\Omega)(100\ \mu\text{F})}\right]49.5\text{ V} = \mathbf{1.25\text{ V}}$

$V_{DC} = \left(1 - \frac{1}{2fR_LC}\right)V_{p(rect)} = V_{p(rect)} - \frac{V_{r(pp)}}{2} = 49.5\text{ V} - 0.625\text{ V} = \mathbf{48.9\text{ V}}$

$V_{p(sec)} = 1.414(36\text{ V}) = 50.9\text{ V}$

See Figure 2-5.

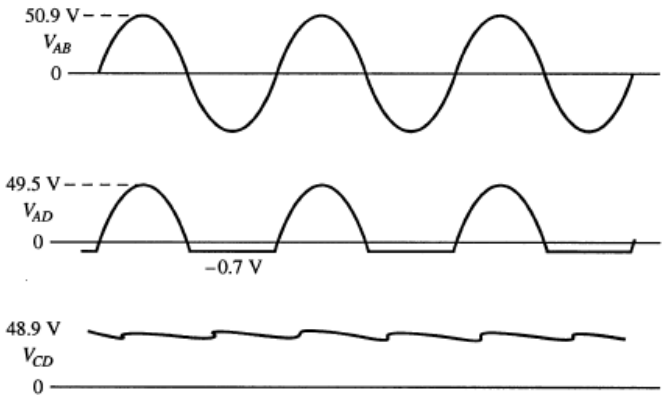


Figure 2-5