9th **September, 2017**   [**Total Marks: 20**]

1. **Attempt all the questions for 20 marks**

2. **Read the questions carefully before attempting**

3. **Don't rewrite the question while answering, only answers have to be written.**

Given: $n_i = 1.5 \times 10^{10}/cm^3$, $\epsilon_s = 10^{-12}F/cm$, $\dfrac{KT}{q} = 0.026V$, $q = 1.6 \times 10^{-19}$ C

1. For a Si uniformly doped PN junction, acceptor doping concentration $N_A = 10^{17}/cm^3$ and donor doping concentration $N_D = 10^{18}/cm^3$ at T=300K

   a) Calculate the built-in potential (V_{bi}) for the junction under zero-applied bias.   [**1**]

   b) Now calculate the depletion region width (W) and maximum E-field (E_m)   [**1**]
   for the junction.

   c) Draw energy band digram of a pn junction in reverse bias. In the diagram, show   [**1**]
   barrier potential energy, energy band-gap, space-charge width and applied reverse
   voltage.

   d) Consider the energy band diagram shown below in figure 1, and then answer the
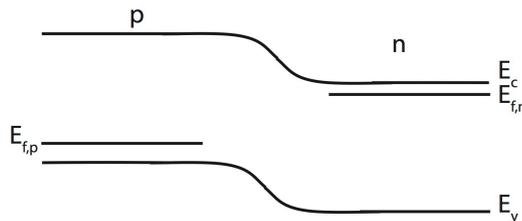   following questions:

Figure 1: Question 1 d)

   i) The given EBD is for forward bias or reverse bias?   [**0.5**]

   ii) What is the direction of electron diffusion and hole drift?   [**0.5**]

   e) Two students were performing zener regulator experiment. They got the readings
   for variations in the line regulation as follows:

	Student A	Student B
$V_{PS}(Volts)$	$V_L(volts)$	$V_L(volts)$
10	6.415	6.252
11	6.420	6.325
12	6.421	6.545
13	6.425	6.785
14	6.432	6.995

   Among the students A and student B, which regulator do you think is showing   [**1**]
   better results and why ?

2.   a) For the given clipper circuit in figure 2, draw the output waveforms for **[2]**
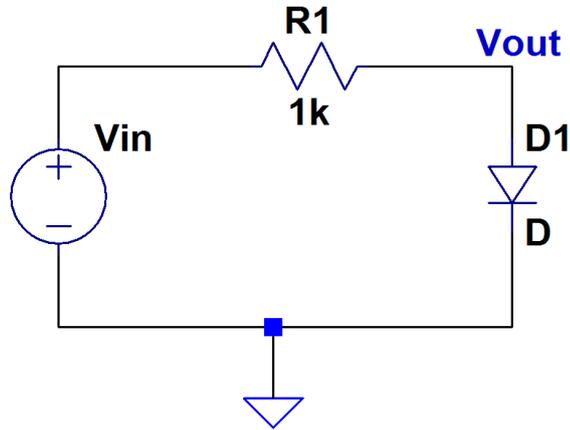   i) Ideal diode model ii) constant voltage model

Figure 2: Question 2a

b) For a N-channel JFET, starting from Shockley's equation, derive an expression **[1]**
   for transconductance (g_m)

c) For an N-channel JFET, find drain current I_D if $I_{DSS} = 8mA$, $V_{GS} = -1$V and **[1]**
   $V_P = -3V$

d) Draw transfer characteristics of Enhancement type and depletion type N-channel **[1]**
   MOSFET

3. Consider the circuit in figure 3

   ✠ Input ac voltage is 120V r.m.s, 60 Hz

   a) What type of circuit is this **[0.5]**

   b) What is the total peak secondary voltage (i.e V_m) **[0.5]**

   c) Sketch the rectified output waveforms **[1]**

   d) Sketch the filtered output waveforms **[1]**

   e) What is the peak current through each diode (i.e I_m) **[1]**

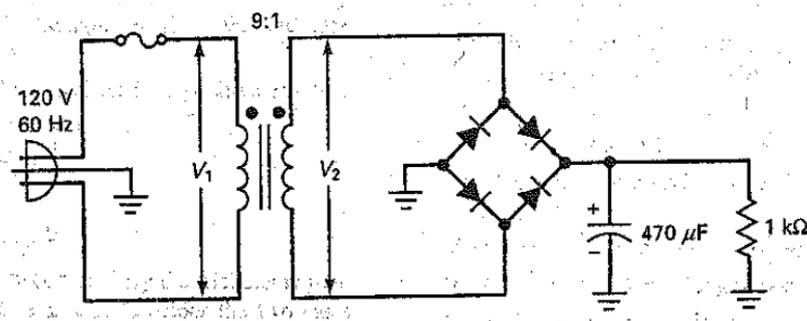   f) What is the PIV rating for each diode **[1]**

Figure 3: Question 3

2

4. Design a Full-wave center tapped rectifier employing an LC filter to meet the following   [5]
   specifications:

   i) Output dc voltage: 12V

   ii) Load current (max): 500mA

   iii) Ripple voltage < 60mV

   ✠ Specify ratings of the circuit components such as transformer, diode, choke,

   capacitors and resistors.

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