Department of ECE, Bennett University
CSET102: Introduction to Electrical and Electronics Engineering
Tutorial Sheet-8
Topics Covered: PN Junction diode and Diode circuits

If not mentioned, assume non-ideality factor (η) as 1.5, reverse saturation current I_0 as 5 nA.

1. A PN junction diode having reverse saturation current of 10^{-11} A is forward biased so that the current through the diode is 150 μA. Find the diode voltage.

2. At what reverse bias voltage does the reverse bias current in a PN Junction reaches 90% of its reverse saturation current?

3. What is the ratio of the current for a forward-bias voltage of 0.2 V to the current for a reverse-bias voltage of 0.2 V?

4. For the diode circuit shown in Fig. 1, V_S = 2 V. The silicon diode has a reverse saturation current of 1 nA at 300 K. Given that V = 0.7 V. Find
   i) R_2 when R_1 = 1 kΩ and ii) R_1 when R_2 = 1 kΩ

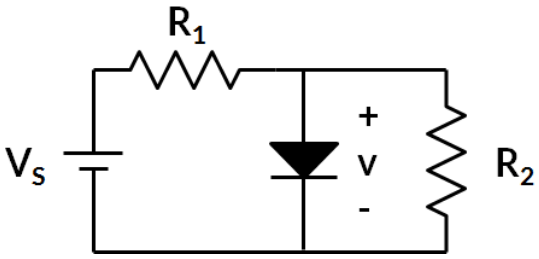

Fig. 1.

5. The diode circuit shown in Fig. 2, D_1 and D_2 are silicon diodes having saturation currents of 5 nA and 10 nA, respectively, at 300 K. Given that both the diodes are forward biased. Find the values of R for which the current is 15 mA.

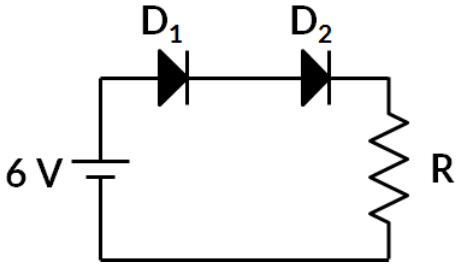

Fig. 2.

6. For the ideal diode circuit shown in Fig. 3, let R_f = 1kΩ and R = 9 kΩ. Find the output voltage V_0 when

   i) $V_1 = V_2 = 0$ V
   ii) $V_1 = 10$ V, $V_2 = 0$ V
   iii) $V_1 = V_2 = 10$ V

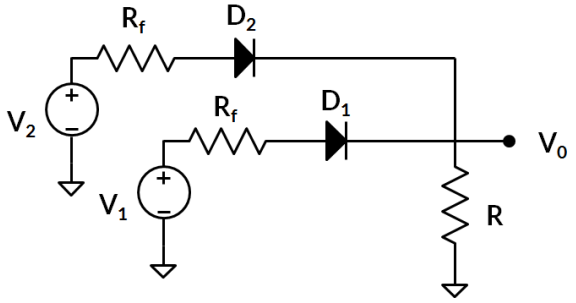

Fig. 3

7. Assume that each diode in the circuit shown in fig. 4 has a cut-in voltage of 0.65 V.

i) If the input voltage is V_I = 5V, determine the value of R_1 such that I_{D1} is one-half of I_{D2}. What are the values of I_{D1} and I_D2?

ii) If V_I = 8V and R_1 = 2 kΩ, determine I_{D1} and I_{D2}.

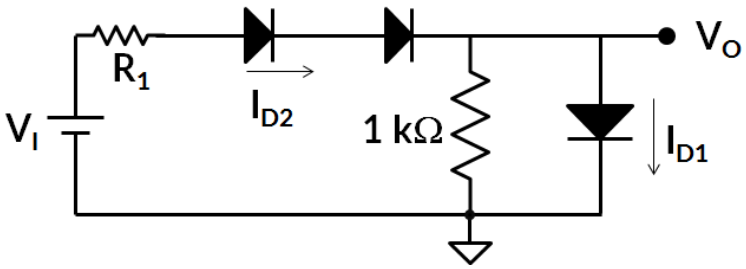

Fig. 4

8. In the circuit shown in fig. 5, find the diode voltage V_D and the supply voltage V such that the current I_D = 0.4 mA. Assume cut-in voltage is 0.7V. What is the power dissipated by the diode?

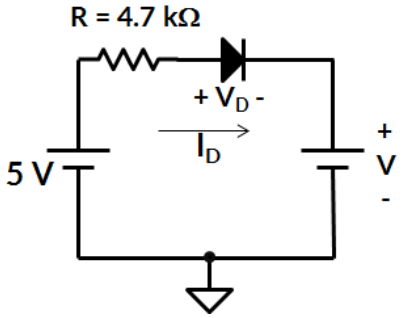

Fig. 5

Topics Covered: Applications of Diodes

If not mentioned, assume non-ideality factor (η) as 1.5, reverse saturation current I_0 as 5 nA, built-in the voltage of the diode is 0.6 V

Half wave rectification:

9. Assume a sinusoidal waveform with an amplitude of 10 V and 60 Hz is applied to the circuit shown in fig. 6. Draw the output waveform across the resistor and diode by assuming the diode is (i) ideal (ii) non-ideal.

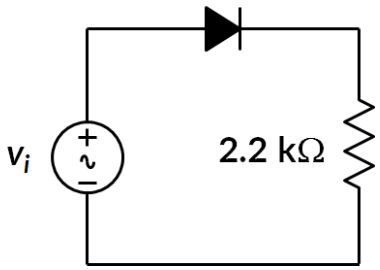

Fig. 6

Full wave rectification:

10. A full-wave bridge rectifier with a 120 V RMS sinusoidal input has a load resistance of 1 kΩ. Answer the following:

i) What is the voltage available across the load?

ii) What is the peak inverse voltage of each diode?

iii) When the diodes are conducting, what is the maximum current through each diode?

iv) What should be the minimum power rating of the diode?

11. A full-wave bridge rectifier with a 200 V peak-to-peak input has a load resistance of 3.3 kΩ. Draw the output voltage waveform as seen across the load.

---------- END OF QUESTIONS ----------

Answers:

1) 0.43 V
2) -0.06 V
3) 2193.4
4) i) R_2 = 538 Ω, ii) R_1 = 1.86 kΩ
5) R = 350 Ω
6) i) V_O = 0 V ii) V_O = 8.46 V iii) V_O = 8.91 V
7) i) I_{D1} = 0.65 mA, I_{D2} = 1.3 mA, R_1 = 2.35 kΩ ii) I_{D1} = 2.375 mA, I_{D2} = 3.025 mA
8) V = 2.42 V, P = 0.28 mW

10) (i) 168.8 V (ii) 84.4 V (iii) 168.8 mA (iv) 135.04 mW