American University of Beirut
Department of Electrical and Computer Engineering
EECE 310 – Electronics
Summer 2009
Midterm – July 20, 2009
Closed Book – 60 minutes

NAME:_____ ID Number: _____

ASSUME THAT AT ROOM TEMPERATURE, V_T = 25 mV

All questions are graded equally
The question sheet and scratch booklets will not be considered in grading

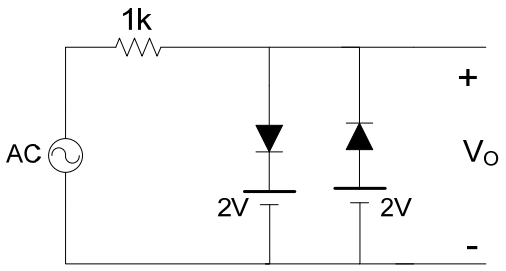
1. A half-wave diode rectifier with capacitor filter is connected to a 50 Hz sinusoidal supply with zero average and a peak value of 100 V. The capacitor value is 10 mF and the load value is 200 Ω. What is the value of the ripple voltage (in V)?

a) 2 b) 4 c) 0.5 d) **1** e) 0

2. Approximately, what would be the value of the ripple voltage (in V) in the previous question if we use a full-wave rectifier?

a) 0 b) **0.5** c) 1 d) 2 e) 4

3. In the following circuit, the diodes have a constant voltage drop model of 0.7 V when conducting. The input source is a sine wave with zero average and a peak value of 5 V. What is the maximum value of the output voltage (in V)?

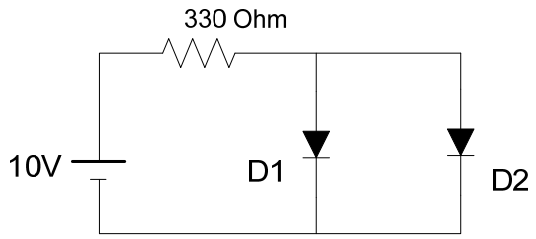


a) 0 b) 7 c) 6.3 d) 4.3 e) **2.7**

4. What is the minimum value of the output voltage (in V) in the previous problem?

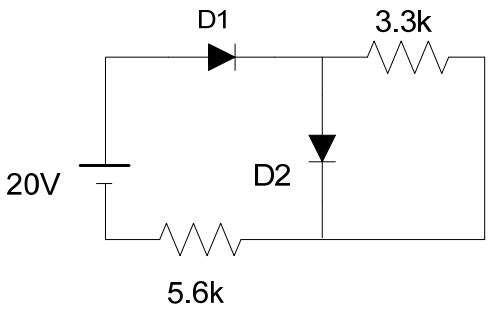
a) **1.3** b) -7 c) 0 d) 2.7 e) -4.3

5. The two diodes in the following circuit have a constant voltage drop model of 0.7 V when conducting. Determine the current in diode D2 (in mA).



a) 28.2 b) **14.1** c) 7.05 d) 0 e) 18.2

6. In the following circuit, the two diodes have a constant voltage drop model of 0.7 V when conducting. What are the states of the two diodes?



a) **Both are ON** b) Both are OFF c) D1 ON, D2 OFF d) D1 OFF, D2 ON

7. Determine the current in diode D2 (in mA) in the previous problem.

a) 2.1 b) 3.4 c) **3.1** d) 2.8 e) 0

8. A full-wave bridge rectifier uses diodes with a constant voltage drop model of 0.7 V (when conducting). The input is a sine wave with zero average and a peak value of 20 V. What is the approximate DC value of the output voltage (in V)?

a) 1.8 b) 15.6 c) 9.3 d) **11.5** e) 0

9. A Zener diode, with V_{Z0} = 6.8 V and r_Z = 50 Ω, is connected in series with a 5 kΩ resistor and a 10 V DC voltage source, such that the diode is operating in the Zener region. Find the current in the Zener diode (in mA).

a) **0.63** b) 3.3 c) 2 d) 13.6 e) 6.4

10. A 50 kΩ resistor is now connected in parallel with the Zener diode in the circuit of the previous problem. Find the voltage across the Zener (in V).

a) 6.865 b) 6.8 c) **6.825** d) 6.712 e) 6.932

11. A diode at room temperature with $n = 1.5$ is connected in series with a current source (in the forward diode direction) that continuously varies from 8 mA to 12 mA, with an average value of 10 mA. Find the variation in diode voltage (in mV) around its average value. Hint: Use the small-signal model.

a) +/- 5 b) +/- 1.5 c) +/- 3.5 d) +/- 10.5 e) **+/- 7.5**

12. A diode connected in series with a 5 V DC voltage source and a 1 kΩ resistor, such that the diode is forward biased, conducts 4.4 mA. When the DC voltage of the source is increased to 35 V, the diode current increases to 34.3 mA. Find the value of n for this diode.

a) 1.15 b) **1.95** c) 1.35 d) 1.55 e) 1.75

13. Find the value of I_S (in nA) for the diode in the previous problem.

a) 0.02 b) 2 c) 200 d) 0.2 e) **20**

14. An amplifier operating from +/– 12 V power supplies has a linear transfer characteristic except for output saturation at +/– 10 V. The *peak-to-peak* value of the largest sinusoidal wave that can be applied at the amplifier input without output distortion is 0.1 V. Find the amplifier voltage gain (in V/V).

a) 240 b) 100 c) **200** d) 120 e) 50

15. What is the power gain of the amplifier (for an undistorted signal with maximum amplitude), in dB, if the input power is 10 mW, and the load is a 10 Ω resistor?

a) 21 b) 35 c) 43 d) **27** e) 52

16. A doped semiconductor has an acceptor concentration of 10^{18} cm^{-3}. The intrinsic density is 1.5×10^{10} cm^{-3}. The mobility of holes is 500 cm^2/Vs and that of free electrons is 1300 cm^2/Vs. The elementary charge q is 1.6×10^{-19} C. Find the density of holes (in cm^{-3}).

a) 1.5×10^{10} b) **10^{18}** c) 225 d) 10^{10} e) 10^{20}

17. Find the density of free electrons (in cm^{-3}) in Problem 16.

a) 10^{18} b) 1.5×10^{10} c) **225** d) 10^{10} e) 10^{20}

18. Calculate the conductivity of the semiconductor (in S/cm) in Problem 16.

a) **80** b) 50 c) 246 d) 12 e) 0.67