American University of Beirut
Department of Electrical and Computer Engineering

EECE 310 – Electronics I
Quiz 1 – November 3, 2006
Closed Book – No Programmable Calculators
90 minutes
Penalty is 5 to 1

Name: _____ ID number: _____

Consider an amplifier with the following transfer characteristic:

$$v_O = 30 - 4(v_I - 5)^2 \quad \text{for } 5\text{ V} \le v_I \le v_O + 6 \text{ and } v_O \text{ positive.}$$

The amplifier is biased to obtain a DC output voltage of 9 V.

1- Find the lower limit L^- of v_O (in V)

a) 30 b) 3.91 c) 1.66 d) 0
e) none of the above

2- Find the small-signal voltage gain at the bias point.

a) 7.29 b) 18.33 c) -7.29 d) -18.33
e) none of the above

An amplifier uses +10V and –10V power supplies. It provides a 2 V_{peak} sine wave to an 80 Ω load when its input is a 0.1 V_{peak} sine wave from which a 4.0 mA_{peak} sine wave current is drawn. The amplifier efficiency is 25%.

3- Find the power gain in dB.

a) 13.98 b) 20.97 c) 125 d) 41.9
e) none of the above

4- Find the current drawn from each of the two power supplies (in mA).

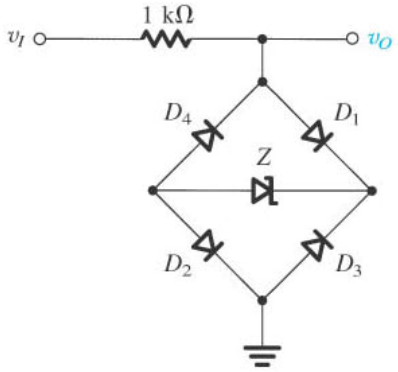
a) 17.7 b) 20.51 c) 5 d) 2.83
e) none of the above

5- Find the power dissipated in the amplifier (in mW).

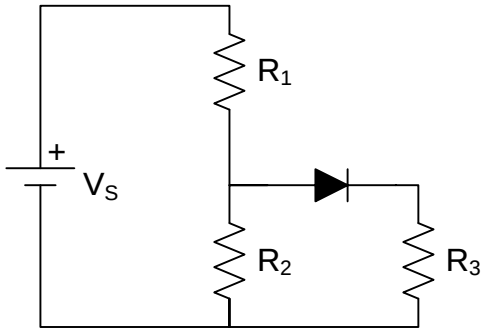
a) 25 b) 100 c) 75 d) 57
e) none of the above

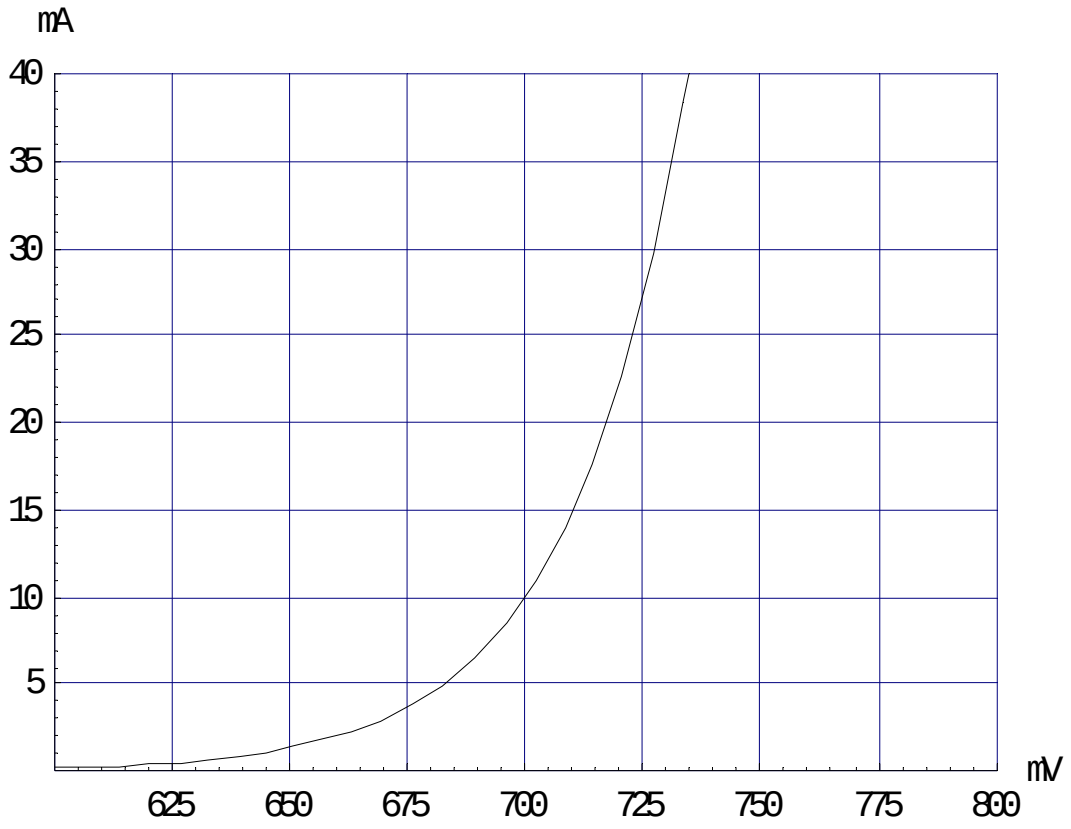
6- Consider the circuit shown below. The Zener diode has a test current and voltage of 10 mA and 9 V, respectively, and a Zener resistance of 20 Ω. The diodes have a V_{D0} = 0.65 V and r_D = 20 Ω. Use the piecewise linear model for all diodes. For v_I = 20 sin ωt V, find the peak value of v_O (in V).

a) 10.66 b) 10.1 c) 11.33 d) 12.66
e) none of the above



The diode in the circuit below has the I-V characteristic as shown. Assume $R_1 = R_2 = R_3 = 100\ \Omega$, $V_S = 9$ V. Construct the appropriate load line on the figure. *Hint*: Use two points at $V_D = 0.65$ V and $V_D = 0.75$ V.

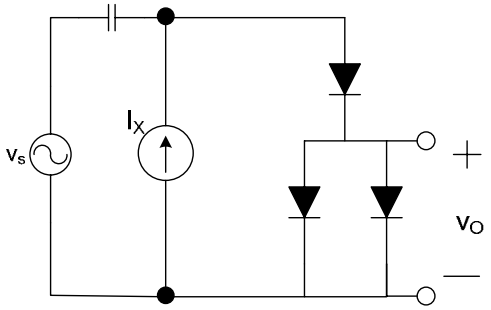




7- Find the diode current (in mA, to within ±1 mA)
a) 25 b) 27 c) 29 d) 31
e) none of the above

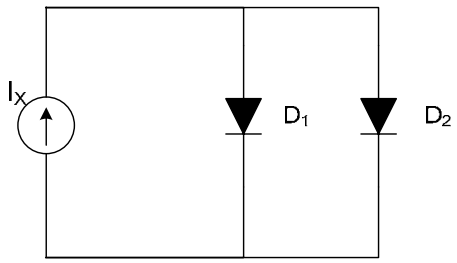
8- What is the slope of the load line (in mA/V)?
a) -6.7 b) -8.2 c) -10 d) -20
e) none of the above

In the circuit shown, I_X is a DC current, much larger than I_S for the diodes. Assume $v_s = 2\cos(\omega t)$ mV and $v_o \approx V_O + V_o \cos(\omega t)$ V. The capacitor in the circuit is large. It serves as an open-circuit for DC and as a short-circuit for AC signals.



9- What is the value of V_o (in mV)?
a) 0.5 b) 1 c) 2 d) 3
e) none of the above

In the circuit shown, $I_X = 22$ mA. D_1 conducts 1 mA @ 0.7 V voltage drop. D_2 conducts 10 mA @ 0.7 V voltage drop. Both diodes exhibit an increase in voltage drop of 0.1 V for a decade of current increase.



10- What is the voltage across the diodes (in V)?
a) 0.71 b) 0.73 c) 0.75 d) 0.76
e) none of the above

For a certain diode it is given that:
$v_D = 0.690$ V @ $i_D = 1$ mA
$v_D = 0.730$ V @ $i_D = 4$ mA

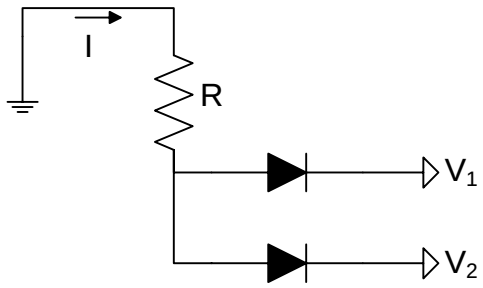
11- What is the value of *n* for this diode? Assume $V_T = 25$ mV.
a) 1.00 b) 1.15 c) 1.25 d) 1.40
e) none of the above

12- What is v_D @ i_D = 8 mA?

a) 0.740 V b) 0.745 V c) 0.750 V d) 0.755 V

e) none of the above

In the circuit shown below, assume that the diodes are ideal, and that R = 1 kΩ, V_1 = -5 V, V_2 = -10 V.



13- What is the value of I (in mA)?

a) 10 b) 5 c) 1 d) 0.5

e) none of the above

In the circuit of Figure 1, the diode drops 0.7 V when conducting. The source has a peak value of V_S = 4 V.

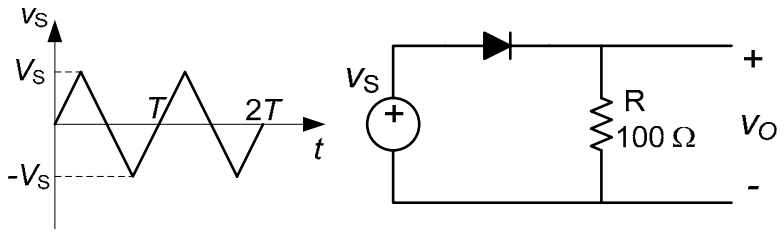


Figure 1

14- Find the maximum value of the diode current, in mA.

a) 38 b) 18 c) 23 d) 28 e) 33

15- Find the average value of the output voltage, in V.

a) 0.802 b) 0.441 c) 0.560 d) 0.681 e) 0.324

16- A capacitor is connected in parallel with the resistor. Find the minimum capacitance needed (in μF) to have a ripple voltage in the output of at most 0.1 V. Assume T = 1 msec, and that the capacitor discharges during the period $t \approx T/4$ to $t \approx 5T/4$, and so on.

a) 375 b) 175 c) 225 d) 275 e) 325

In the circuit of Figure 2, the diodes drop 0.6 V when conducting. The input voltage v_I is sinusoidal with a peak value of 11 V. Assume V_A = 2.5 V and V_B = 2 V.

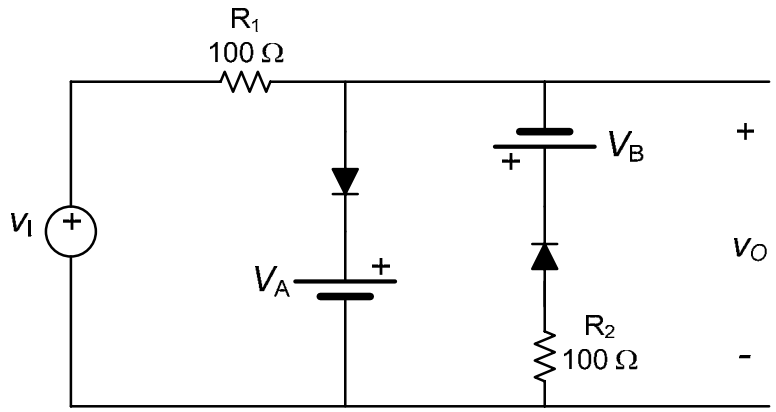


Figure 2

17- Find the maximum value of the output voltage v_O, in V.
a) 3.6 b) 4.6 c) 2.6 d) 3.1 e) 4.1

18- Find the minimum value of the output voltage v_O in V.
a) -7.3 b) -6.8 c) -5.3 d) -5.8 e) -6.3

The Zener regulator shown in Figure 3 uses a diode with the following parameters: V_{Z0} = 5.9 V, r_Z = 10 Ω, I_{ZK} = 1 mA, and I_{Zmax} = 250 mA. Assume that R = 330 Ω.

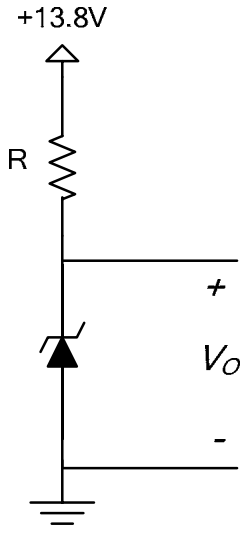


Figure 3

19- Find the output voltage V_O (in V) with no load.
a) 6.00 b) 6.13 c) 5.62 d) 5.74 e) 5.87

20- A load that draws a current I_L is connected from the output node to ground. Find the *change* in the output voltage V_O (in mV) when I_L increases from 1 mA to 21 mA.
a) -194.1 b) -165.8 c) -78.8 d) -108.1 e) -137.1

21- A resistor is now connected (as the only load) from the output node to ground. Find the minimum value of resistance (in Ω) that keeps the Zener diode in the breakdown region.

a) 258.0 b) 492.4 c) 411.7 d) 352.2 e) 298.1

22- The input v_I to the circuit shown in Figure 4 is a +/– 10 V symmetrical square wave. Find the average value of the output voltage (in V) if the Zener diodes drop 0.7 V in the forward direction, $V_{Z1} = 4.7$ V, and $V_{Z2} = 5.6$ V.

a) -0.55 b) 0.85 c) 0.45 d) -0.95 e) -0.25

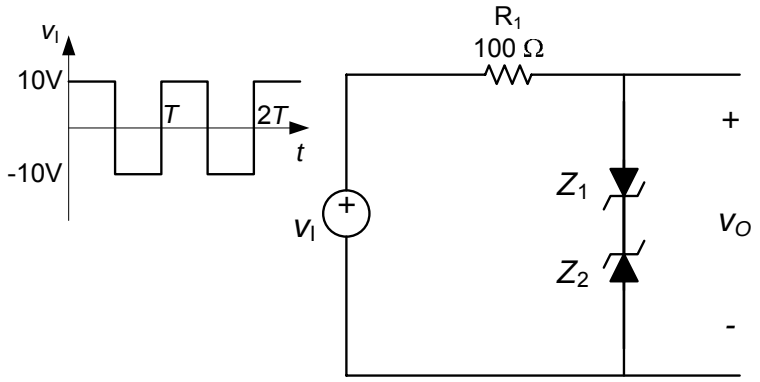


Figure 4

23- In the circuit of Figure 5, find the voltage V_X (in V) across R_2. Assume $V_1 = 7$ V, and $V_2 = 9$ V. The diodes are ideal.

a) 8 b) 9 c) 7.5 d) 7 e) 6

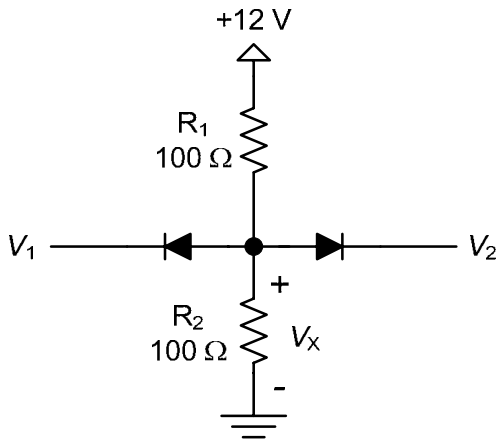


Figure 5

24- A full-wave rectifier uses a center-tap transformer with a primary winding of 100 turns, and two secondary windings of 10 turns each. The primary of the transformer is connected to a 220V RMS, 50 Hz source. Find the peak-inverse voltage (PIV), in V, of the diodes in the circuit, assuming that the diodes drop 0.8 V when conducting.

a) 86.3 b) 80.1 c) 61.4 d) 73.9 e) 67.6
