Electronics-1
Lecture #14

18/1/2018

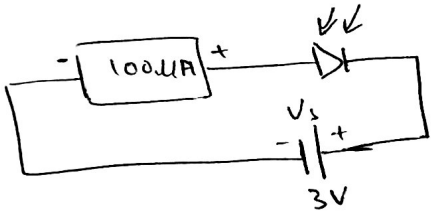
→ LED
→ PD
→ LASER
→ PIN
→ Schottky

→ Exercise Problems:-

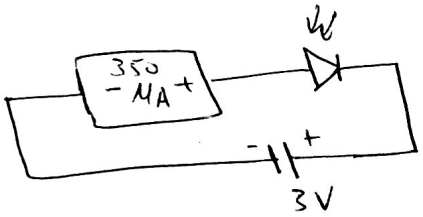
① , ③ , ④ , ⑤ , ⑥ , ⑦ , ⑧ , ⑨ , ⑩ , ⑱ , ⑰ , ⑳ , ㉔ , ㉕ , ㉗ , ㉘ , ㉙ .

P 25:- Find R of PD ?

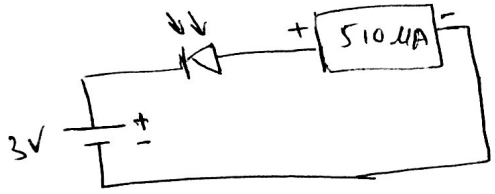
(a) $R = \frac{V_s}{I} = \frac{3V}{100.\mu A} = 30\,k\Omega$



(b) $R = \frac{V_s}{I} = \frac{3V}{350\mu A} = 8.57\,k\Omega$



(c) $R = \frac{V_s}{I} = \frac{3V}{510\mu A} = 5.88\,k\Omega$



P. 26: The reading of micrometer will increase

P. 27: Varactor diode current change: 0.25mA to 0.15mA
when volt. " : 125mV to 200mV.
Find resistance R=?

Sol: $R = \frac{\Delta V}{\Delta I} = \frac{125mV - 200mV}{0.25 - 0.15mA} = \frac{-75mV}{0.10mA} = -750\Omega$

3-10 From LED data sheet in Fig. 3-31 in Floyd 7th Ed. find?

(a) Radiant Intensity = I_e = ? at 900nm

Max. output of LED = 15 mW/sr

from relative spectral emission graph in fig. 3-31(c) the relative radiant intesity is approx. 0.75.

Therefore the I_e = 0.75 (15 mW/sr) = 11.3 mW/sr.

(b) Find forward voltge V_F drop = ? for I_F = 20mA

From graph in part (c) V_F = 1.23 V for I_F = 20mA

(c) Radiant Intensity, I_e = ? at I_F = 30mA

From graph in part (e) I_e = 5mW/sr for I_F = 30mA.

(d) max. Irradiance = H = ?

distance = d = 10cm.

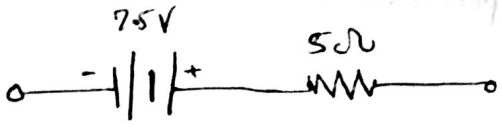
$$H = \frac{I_e}{d^2} = \frac{15\text{mW/sr}}{(10\text{cm})^2} = 0.15\ \text{mW/cm}^2$$

Exercise Problems

3-11

(1) Zener diode has V_Z = 7.5V, Z_Z = 5Ω] at certain current.

Draw equivalent circuit = ? of Zener diode



(3) ~~When reverse current is applied to~~ reverse current in Zener diode increases from 20mA to 30mA the voltage " " " changes " 5.6 V to 5.65 V.

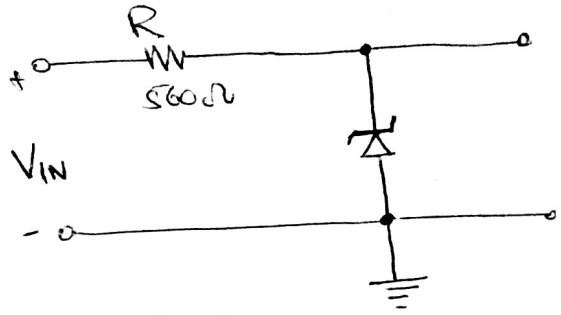
Find Impedence Z_Z = ?

$$Z_Z = \frac{\Delta V_Z}{\Delta I_Z} = \frac{5.65 - 5.6}{30 - 20} = \frac{0.05}{10} = 5\Omega.$$

(4) Given to students in Assignment #3.

(5) " " " " "

Determine the min. input voltage required for regulation to be established in fig.



Assume Ideal Zener diode

$I_{ZK} = 1.5mA$

$V_Z = 14V$

$$V_{IN(min)} = V_Z + I_{ZK}R$$

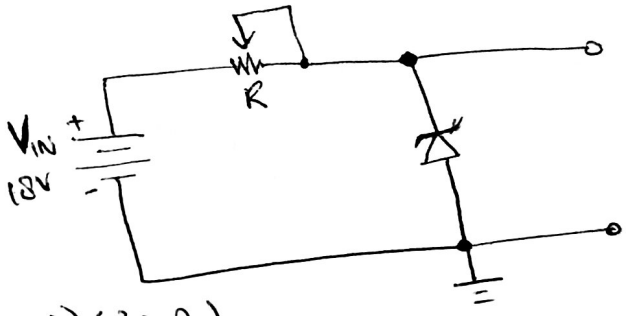
$$V_{IN(min)} = 14V + (1.5mA)(560\Omega)$$

$$V_{IN(min)} = 14.8V$$

(7) Assignment #3.

(8)* Find $R = ?$ at $I_Z = 40mA$

$V_Z = 12V$ at $30mA$, $Z_Z = 30\Omega$



First we find,

$$\Delta V_Z = I_Z Z_Z = (40mA - 30mA)(30\Omega)$$

$$\Delta V_Z = 0.3V$$

From ΔV_Z above and V_Z 12V we will find V_Z at 40mA as follows:

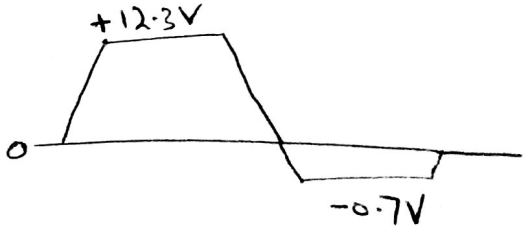
$$V_Z = 12V + \Delta V_Z = 12V + 0.3V = 12.3V$$

$$R = \frac{V_{IN} - V_Z}{40mA} = \frac{18V - 12.3V}{40mA} = 143\Omega$$

(9) Peak sinusoidal voltage is applied to above circuit. Draw output waveform of P(8)

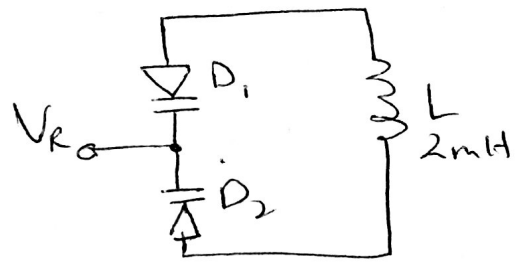
$$V_Z = 12V + 0.3V$$

$$V_Z = 12.3V$$



(10) Assignment #3

(18) Find capacitance value C=? to produce resonant freq. of 1MHz



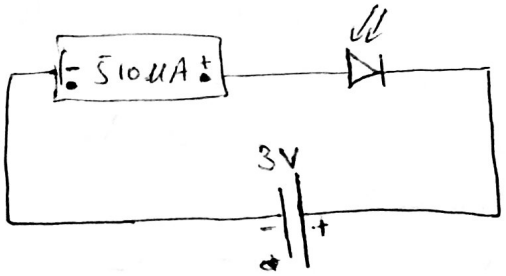
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$C = \frac{1}{4\pi^2 f^2 L}$$

$$= \frac{1}{4\pi^2 (2mH)(1MHz)^2} = 12.7\,pF$$

* Since both varactors are in series, so each should have a capacitance of $2C_T = 25.4\,pF$.

(25) What is resistance of each photodiod in below fig.



$$R = \frac{V_s}{I} = \frac{3V}{510\mu A}$$

$$R = 5.88K\Omega$$

(20) we assume $V_F = 1.2V$, Give $V_S = 24V$, $R = 680\Omega$, Find Radiant Power?

$$I_F = \frac{24V - 1.2V}{680\Omega} = 33.5mA$$

From the given graph in fig 3-73 (b) we see that Radiant power = 30mW.

(24) $V_R = 10V$, $R = 200K\Omega$

$$I_R = \frac{10V}{200K\Omega} = 50\mu A$$

Assignment # 3
Solution

Q-1: $Z_2 = 15\Omega$, At 50mA find terminal voltage $V_2 = ?$

At $I_2 = 25mA$ the voltage $V_2 = 6.8V$ ~~4.7V~~

$\Delta I_2 = 50mA - 25mA = 25mA$

$\Delta V_2 = \Delta I_2 Z_2 = (25mA)(15\Omega)$

$\Delta V_2 = 0.375V$

$V_2 = V_{ZT} + \Delta V_2 = 4.7V + 0.375V$

$V_2 = 5.075V$

Q.2: $V_2 = 6.8V$ at 25°C and $TC = +0.04\%/°C$

Find V_2 at 70°C = ?

$\Delta T = 70°C - 25°C = 45°C$

$\Delta V_2 = V_2 \times TC \times \Delta T$

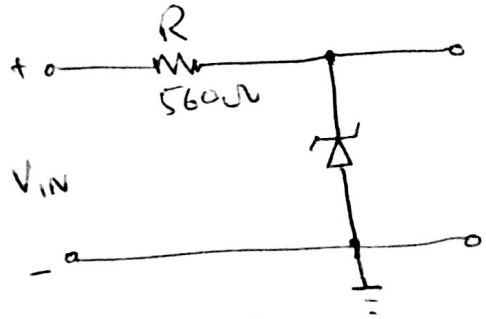
$= (6.8)(0.0004)(45)$

$\Delta V_2 = 0.1224 = 122mV$

The zener volt. at 70°C is

$V_2 + \Delta V_2 = 6.8V + 122mV = 6.922V$

Q 3: $V_{IN(min)} = ?$ $Z_2 = 20\Omega$, $V_2 = 14V$ at 30mA, $I_{ZK} = 1.5mA$



~~$\Delta V_2 = (I_{ZT} - I_{ZK}) Z_2$~~

~~$= 28.5mA$~~

~~$\Delta V_2 = \Delta I_2 Z_2$~~

~~$= (40mA - 30mA)(30\Omega)$~~

~~$\Delta V_2 = 0.3V$~~

$V_2 =$

$\Delta V_2 = (I_{ZT} - I_{ZK}) Z_2 = (28.5mA)$

$= (30 - 1.5)\,20\Omega = 28.5 \times 20 = 0.57V$

$V_{OUT} = V_{ZT} - \Delta V_2 = 14V - 0.57V = 13.43V$

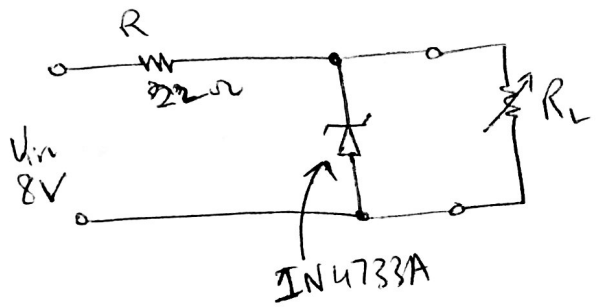
$V_{IN(min)} = I_{ZK} R + V_{OUT} = (1.5)(560) + 13.43$

$V_{IN(min)} = 14.3V$

Q.4 $V_Z = 5.1V$ at $I_Z = 49mA$, $I_{ZK} = 1mA$

$Z_Z = 7\Omega$, $I_{ZM} = 70mA$.

Find $I_{L(min)}$ & $I_{L(max)}$?



$$V_{Z(min)} = V_Z - \Delta I_Z Z_Z$$
$$= 5.1V - (49mA - 1mA)7\Omega$$
$$= 5.1V - (48mA)(7\Omega)$$
$$= 5.1V - 0.336 = 4.76V$$

$$V_R = 8V - 4.76V = 3.24V$$

$$I_T = \frac{V_R}{R} = \frac{3.24V}{22\Omega} = 147mA$$

$$I_{L(max)} = I_T - I_{ZK} = 147mA - 1mA$$

$$\boxed{I_{L(max)} = 146mA}$$

$$V_{Z(max)} = V_Z + (I_{ZM} - I_Z)(Z_Z)$$
$$= 5.1V + (70mA - 49mA)(7\Omega)$$
$$= 5.1V + 0.34V = 5.44V$$

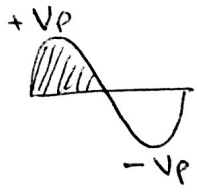
$$V_R = 8V - 5.44V = 2.56V$$

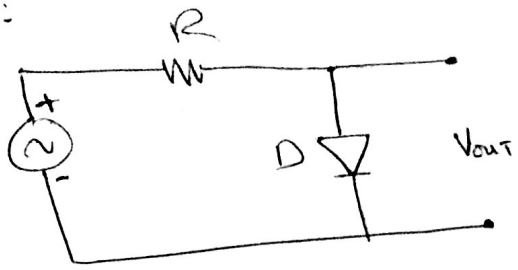
$$I_T = \frac{V_R}{R} = \frac{2.56V}{22\Omega} = 116mA$$

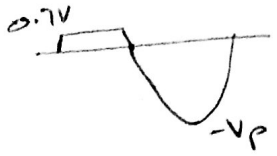
$$I_{L(min)} = I_T - I_{ZM} = 116mA - 70mA$$

$$\boxed{I_{L(min)} = 46mA.}$$

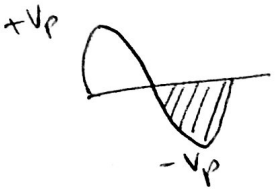
Diode Positive Clipping:

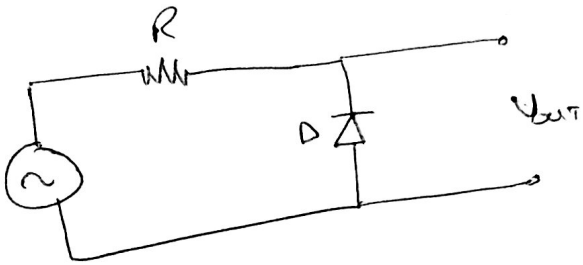




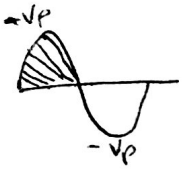


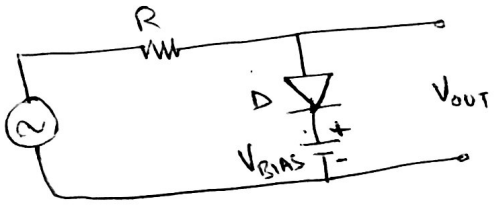
Diode Negative Clipping:

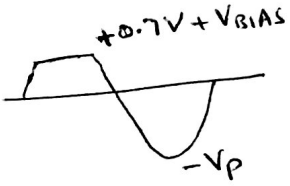




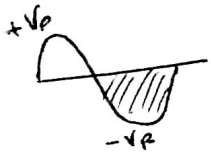
Positive Bias Diode Clipping:

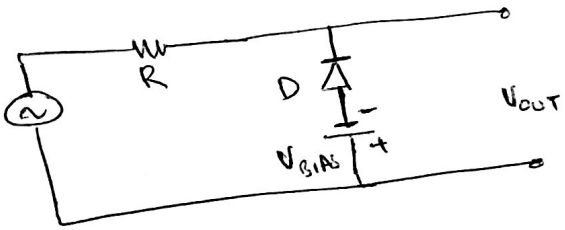


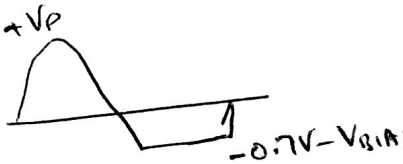




Negative Bias Diode Clipping:







Zener Limiter: