Scilab Manual for Optical Communication by Dr Lochan Jolly Electrical Engineering Thakur College of Engineering & Technology[1]

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Experiment: 1

To calculate the numerical aperture of the optical fiber.

Scilab code Solution 1.1 Numerical aperture

```
1 //Experiment no.1 To calculate the numerical
     aperture of the optical fiber.
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //n1=1.50
6 //n2=1.47
7 clear;
8 close;
9 clc;
10 n1=input("enter the value of core refractive index")
11 n2=input("enter the value of cladding refractive
     index")
12 delta=(n1^2-n2^2)/(2*n1^2)
13 NA=n1*sqrt(2*delta)
14 accept=asind(NA)
15 disp (NA,"numerical aperture=");
```

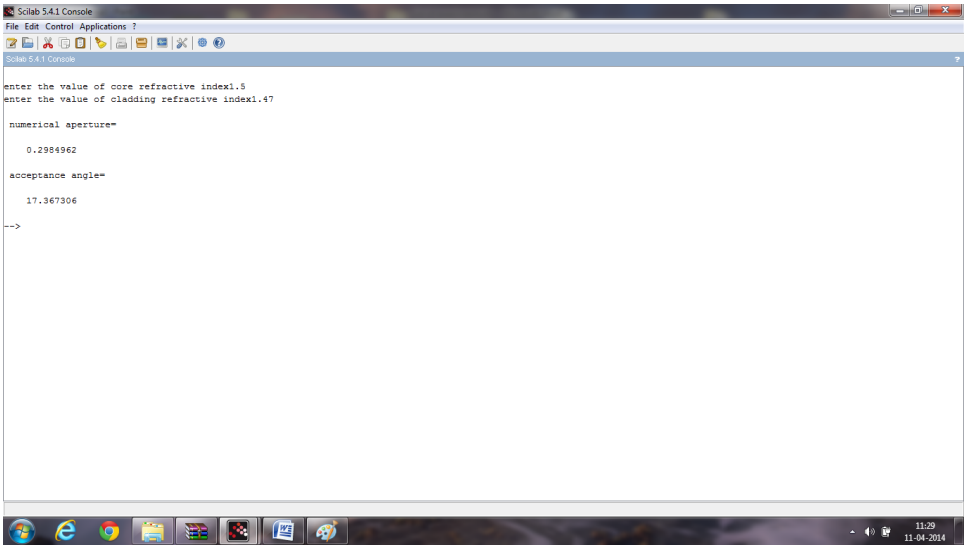

Figure 1.1: Numerical aperture

```
16 disp (accept,"acceptance angle=");
```

Experiment: 2

To calculate the Bending Loss in the optical fiber in the link.

Scilab code Solution 2.2 Bending Loss

```
1 //Experiment no.2 To calculate the Bending Loss in
     the optical fiber in the link.
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //n1=1.50
6 //n2=1.47
7 //R=1e-2
8 //lambda=0.82
9 clear;
10 close;
11 clc;
12 n1=input("enter the value of core refractive index="
     )
13 n2=input("enter the value of cladding refractive
     index=")
14 R=input("enter the value of radius of curvature of
```

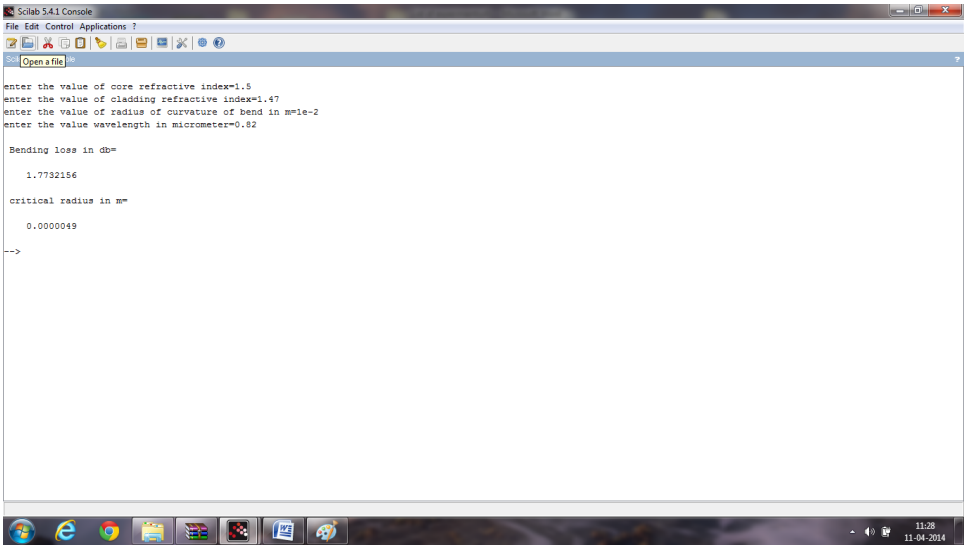

Figure 2.1: Bending Loss

```
    bend in m=")//curvature of bend
lambda=input("enter the value wavelength in
    micrometer=")
c1=1.2;//constant
c2=0.5//constant
delta=(n1^2-n2^2)/(2*n1^2);
Rc=(3*lambda*1e-6)/(4*3.14*2*delta);
alpha=c1*exp(-c2*R);
alphadb=10*log(alpha)
disp (alphadb,"Bending loss in db=");
disp (Rc,"critical radius in m=");
```

Experiment: 3

To plot the responsivity curve for the given detector material.

Scilab code Solution 3.3 Responsivity

```
1 //Experiment no.3 To plot the responsivity curve for
      the given detector material.
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //Eg=1.43
6 clear;
7 close;
8 clc;
9 Eg=input("Band gap of material selected in eV=")
10 e=1.6e-19;
11 eta=0.65//quantum efficiency
12 h=6.626e-34;//planks constant
13 c=3e8//velocity of light
14 lambdacf=h*c/(Eg*e*1e-6);//wavelength in micrometer
15 lambda=0:0.25:2//range of wavelength
16 for i=1:9
```

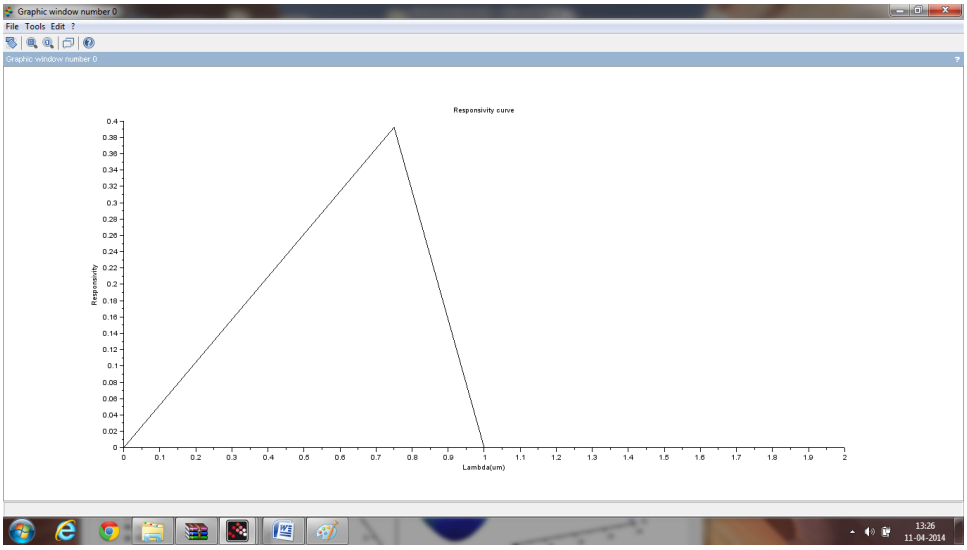

Figure 3.1: Responsivity

```
17      if(lambda(i)<lambdacf)
18      responsivity(i)=eta*e*1e-6*lambda(i)/(h*c);
19  else  responsivity(i)=0
20      end
21  end
22  plot2d(lambda,responsivity);
23  xtitle('Responsivity curve', 'Lambda(um)', '
      Responsivity');
```

Experiment: 4

To plot the characteristic curve for LED.

Scilab code Solution 4.4 LEDcharacteristics

```
1 //Experiment no.4 To plot the characteristic curve
     for LED. .
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 clear;
5 close;
6 clc;
7 h=6.626e-34;//planks constant
8 c=3e8;//velocity of light
9 e=1.6e-19;//charge of electron
10 lambda=0.87e-6//wavelength of light
11 tr=60e-9;//regenerative recombination
12 tnr=100e-9;//non regenerative recombination
13 t=tr*tnr/(tr+tnr);
14 Nint=t/tnr//internal quantum efficiency
15 for i= 1:40
16     L(i)=i;
```

```
17      pint(i)=Nint*i*h*c*1e-3/(e*lambda);//i is
            current in amperes
18  end
19
20  plot2d(L,pint);
21  xtitle('Characteristics of LED', 'Current(Amperes)',
        'Power(Watts)');
```

Experiment: 5

To calculate material dispersion at various wavelength of operation.

Scilab code Solution 5.5 Material dispersion

```
1 //Experiment no.5 To calculate material dispersion
     at various wavelength of operation.
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //L0=1.3 (zero dispersion wavelength psnm-2km-1)
6 //S0=0.095(Slope at zero dispersion wavelength in
     psnm-1km-1)
7
8 clear;
9 close;
10 clc;
11 L0=input("enter the value of zero dispersion
     wavelength in um")
12 S0=input("enter the value of Slope at zero
```

```
    dispersion wavelength")
13 lambda=0.7:0.1:1.7//wavelength of light
14 MD=(lambda.*S0/4).*(1-(L0./lambda).^4);//Material
    Dispersion
15 plot2d(lambda,MD);
16 xtitle('Material Dispersion at various wavelength',
    'wavelength(meters)', 'Material Dispersion(psnm-1
    km-1)');
```

Experiment: 6

To do power budgeting for the link for given parameters.

Scilab code Solution 6.6 Power Budgeting

```
1 //Experiment no.6 To do power budgeting for the link
      for given parameters
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //Ps=13 (input power in dBm)
6 //Pr=-31(sensitivity of receiver)
7 //L=80(Link length in Km)
8 //Loss=0.35(fiber loss in dB/Km)
9 //SL=0.1(Splice Lossin dB)
10 //CL=0.5(coupling loss in dB)
11 //EL=1.5(excess loss)
12
13 clear;
14 close;
15 clc;
16 Ps=input("Power from source in dBm=");
```

```
17 Pr=input("sensitivity of receiver in dBm=");
18 L=input("Link length in Km=");
19 Loss=input("fiber loss in dB/Km=");
20 SL=input("Splice Lossin dB/Km=");
21 CL=input("coupling loss in dB=");
22 EL=input("excess loss in dB=");
23 Pt=Ps-Pr;
24 SM=Pt-(2*CL+Loss*L+SL*L)
25 disp ("dB",SM,"system margin=");
```

Experiment: 7

To do time budgeting for the link for given parameters.

Scilab code Solution 7.7 Time Budgeting

```
1 //Experiment no.7 To do rise time budgeting for the
     link for given parameters
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //ts=10 (rise time of the led source in ns)
6 //IMD=6(intermodal dispersion in ns/Km)
7 //L=10(link length in Km)
8 //PB=2(pulse broadening in ns/Km)
9 //td=8(response time of detector in ns)
10 //F=1(1-RZ return to zero format, 2-NRZ-non return
     to zero format)
11
12
13 clear;
14 close;
15 clc;
```

```
16 ts=input("rise time of the led source in ns=");
17 IMD=input("intermodal dispersion in ns/Km=");
18 L=input("Link length in Km=");
19 PB=input("pulse broadening in ns/Km=");
20 td=input("response time of detector in ns=");
21 disp ("Directory                    1-RZ return to zero
       format, 2-NRZ-non return to zero format");
22 F=input("Format=");
23 Tsys=1.1*sqrt(ts^2+(L*IMD)^2+td^2+(L*PB)^2);
24 if F==1 then Bt=0.35*1e3/Tsys //since Tsys is in
      nano sec and Bt is expressed in Mbps)
25     else Bt=0.7*1e3/Tsys
26 end
27 disp ("Mbps",Bt,"Maximum bit rate for the link =");
```

Experiment: 8

To calculate fiber parameters (dimensions, refractive index difference) for single mode operation.

Scilab code Solution 8.8 Single Mode

```
1 //Experiment no.8  To calculate fiber parameters for
      single mode operation
2 //OS=Windows XP sp3
3 //Scilab version 5.4.0
4 //sample values
5 //lambda(1)=8e-6 (wavelength of transmission)
6 //ric=1.45(refractive index of core)
7 //V=2.405(V mumber)
8 //delta=0.003(refractive index difference)
9
10
11 clear;
12 close;
```

```
clc;
lambda=0.8e-6:0.1e-6:1.7e-6;
ric=input("refractive index of core=");
V=input("V mumber for singlr mode transmission=");
delta=input("refractive index difference=");
for i=1:10
    a(i)=V*lambda(i)/(2*3.14*ric*sqrt(2*delta))
end
plot2d(lambda,a);
xtitle('Core daimeter versus wavelength of
   transmission', 'Wavelength (Lambda)(m)', 'Core
   diameter(m)');
```