**ECE 474 / EXPERIMENT 4**

**MATLAB CODE**

% This program plots the variation of refractive index against lamda

% Taken from Malitson, JOSA 1965.

clear;clc;close all;

inc = 5e-3;lamarr = 0.5:inc:2;

n = sqrt(1 + lamarr.^2.\*(0.6961663./(lamarr.^2 - 0.0684043^2) + 0.4079426./(lamarr.^2 - 0.1162414^2) + 0.8974794./(lamarr.^2 - 9.896161^2)));

ng = n(1:end-1) - lamarr(1:end-1).\*diff(n)/inc;ng = [ng ng(end)];

ngstr = '\itn\rm\bf\_2\it\_g';n2str = '\itn\rm\bf\_2';

figure(1)

plot(lamarr,n,'-k ','LineWidth',2);hold on

plot(lamarr,ng,'--r ','LineWidth',2);hold off

set(gcf,'Color','w');set(gca,'FontSize',16);

ylabel('refractive index','FontSize',18,'FontWeight','bold');

xlabel('wavelength in \mum','FontSize',18,'FontWeight','bold')

text(min(lamarr)\*1.2,max(n)\*1,ngstr,'FontSize',22,'FontWeight','bold','Edgecolor','white','BackgroundColor','white');

text(min(lamarr)\*1.2,max(n)\*1,n2str,'FontSize',22,'FontWeight','bold','Edgecolor','white','BackgroundColor','white');

dng = diff(ng(1:end-1))/inc;

figure(2)

plot(lamarr(1:end-2),dng,'-k ','LineWidth',2);

set(gcf,'Color','w');set(gca,'FontSize',16);

ylabel('\itdn\rm\bf\_2\it\_g / d\lambda','FontSize',18,'FontWeight','bold');

xlabel('wavelength in \mum','FontSize',18,'FontWeight','bold')

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

incV = 0.01;V = 0:incV:3;

%%%% Numeric differentiation

bnV = 1 - (1 + sqrt(2))^2./(1 + (4 + V.^4).^0.25).^2;

dVbn = diff(V.\*bnV)/incV;

Vd2Vbn = V(1:end - 2).\*diff(diff(V.\*bnV))/incV^2;

figure(3)

plot(V(1:end - 2),bnV(1:end - 2),'-k ','LineWidth',2);hold on

plot(V(1:end - 2),dVbn(1:end - 1),'--r ','LineWidth',2);hold on

plot(V(1:end - 2),Vd2Vbn,'--g ','LineWidth',2);hold off

set(gcf,'Color','w');set(gca,'FontSize',16);

ylabel('\itb\_n, d\rm( \itVb\_n\rm )/\itdV','FontSize',18,'FontWeight','bold');

xlabel('\itV','FontSize',18,'FontWeight','bold')

axis([min(V) max(V) 0 max(Vd2Vbn)\*1.05])

%%%% Analytic differentiation

syms V

bnV = 1 - (1 + sqrt(2))^2./(1 + (4 + V.^4).^0.25).^2;

dVbn = diff(V.\*bnV, V);

Vd2Vbn = V.\*diff(dVbn, V);

V = 0:incV:3;bnV = eval(bnV);dVbn = eval(dVbn);Vd2Vbn = eval(Vd2Vbn);

figure(4)

plot(V,bnV,'-k ','LineWidth',2);hold on

plot(V,dVbn,'--r ','LineWidth',2);hold on

plot(V,Vd2Vbn,'--g ','LineWidth',2);hold off

set(gcf,'Color','w');set(gca,'FontSize',16);

ylabel('\itb\_n, d \rm\bf( \itV b\_n\rm\bf ) / \itdV','FontSize',18,'FontWeight','bold');

xlabel('\itV','FontSize',18,'FontWeight','bold')

axis([min(V) max(V) 0 max(Vd2Vbn)\*1.05])