**ECE 474 / EXPERIMENT 1**

**MATLAB CODE**

% Experiment of Finding Beta

% This prog is based on CEs given in (3.17) and (3.22) of lecture notes, entitled

% "Notes on Fibre Propagation\_Jan\_2013\_HTE" available on

% ece474.cankaya.edu.tr course webpage

close all;clear;clc;clf reset

unset = 0.1:0.01:2.5;wnset = 0.1:0.01:2.5;

%wnset = sqrt(V^2 - unset.^2);

n1 = 1.49;n2 = 1.4825;v = 1;%n1 = 1.47028; n2 = 1.45709;

lamda = 1.4246e-6;k1 = 2\*pi\*n1/lamda;k2 = 2\*pi\*n2/lamda;k = 2\*pi / lamda;

[un,wn]=meshgrid(unset,wnset);

vstr = [' , \itv \rm\bf= ' num2str(v)];vstrTETM = [' , \itv \rm\bf= ' num2str(0)];

% Case of HE and EH Modes

% CE\_HEEH\_322 = (besselj(v+1,un)./(un.\*besselj(v,un)) + besselk(v+1,wn)./(wn.\*besselk(v,wn))).\* ....

% (n1^2\*besselj(v-1,un)./(un.\*besselj(v,un)) - n2^2\*besselk(v-1,wn)./(wn.\*besselk(v,wn)))+ ....

% (besselj(v-1,un)./(un.\*besselj(v,un)) - besselk(v-1,wn)./(wn.\*besselk(v,wn))).\* ....

% (n1^2\*besselj(v+1,un)./(un.\*besselj(v,un)) + n2^2\*besselk(v+1,wn)./(wn.\*besselk(v,wn)));

CE\_HEEH\_322 = (besselj(v+1,un)./un + besselj(v,un).\*besselk(v+1,wn)./(wn.\*besselk(v,wn))).\* ....

(n1^2\*besselj(v-1,un)./un - n2^2\*besselj(v,un).\*besselk(v-1,wn)./(wn.\*besselk(v,wn)))+ ....

(besselj(v-1,un)./un - besselj(v,un).\*besselk(v-1,wn)./(wn.\*besselk(v,wn))).\* ....

(n1^2\*besselj(v+1,un)./un + n2^2\*besselj(v,un).\*besselk(v+1,wn)./(wn.\*besselk(v,wn)));

% Case of TE Modes

% CE\_TE\_317 = besselj(1,un)./(un.\*besselj(0,un)) + besselk(1,wn)./(wn.\*besselk(0,wn));% Actual equation, singular

CE\_TE\_320 = besselj(1,un)./un + besselj(0,un).\*besselk(1,wn)./(wn.\*besselk(0,wn));

% Case of TM Modes

% First two are actual equations, but they create singularities

% CE\_TM\_317 = (2\*pi\*n1/lamda)^2\*besselj(1,un)./(un\*besselj(0,un)) + (2\*pi\*n2/lamda)^2\*besselk(1,wn)./(wn\*besselk(0,wn));

% CE\_TM\_317 = n1^2\*besselj(1,un)./(un.\*besselj(0,un)) + n2^2\*besselk(1,wn)./(wn.\*besselk(0,wn));

CE\_TM\_320 = n1^2\*besselj(1,un)./un + n2^2\*besselj(0,un).\*besselk(1,wn)./(wn.\*besselk(0,wn));

%CE = CE\_HEEH\_322;CE = CE\_TE\_320;CE = CE\_TM\_320;

%CE = CE / max(max(abs(CE)));

figure(1)

set(gcf,'Renderer','Zbuffer');set(gcf,'Color',[1 1 1]);

meshc(un,wn,CE\_TM\_320);set(gca,'FontSize',16);colormap colorcube;%view([-21.5 60.0])

title('3D Plot of Characteristic Equation (CE) for TM\_0\_m modes','FontSize',14,'FontWeight','bold');

xlabel('\itu\_n','FontSize',14,'FontWeight','bold');

ylabel('\itw\_n','FontSize',14,'FontWeight','bold');

figure(2)

[C,h] = contour(un,wn,CE\_TM\_320,'--k');axis square;grid on

set(h,'LineWidth',2);H = clabel(C,h,[0]);set(H,'FontSize',10,'LineWidth',2);

set(gca,'FontSize',13);set(gcf,'Color',[1 1 1]);hold on

V2 = un.^2 + wn.^2;V = sqrt(V2);[C,h] = contour(un,wn,V,'-k');set(h,'LineWidth',2);

H = clabel(C,h);set(H,'FontSize',12,'LineWidth',3);set(H,'LineWidth',2,'BackgroundColor','white','Edgecolor',[.1 .8 .1]);

legtitle = ['Contour plot of TM\_0\_m modes and different \itV \rm\bfcircles' vstrTETM];

title(legtitle,'FontSize',16,'FontWeight','bold');

xlabel('\itu\_n','FontSize',14,'FontWeight','bold');

ylabel('\itw\_n','FontSize',14,'FontWeight','bold');

figure(3)

[C,h] = contour(un,wn,CE\_TE\_320,'--k');axis square;grid on

set(h,'LineWidth',2);H = clabel(C,h,[0]);set(H,'FontSize',10,'LineWidth',2);

set(gca,'FontSize',13);set(gcf,'Color',[1 1 1]);hold on

V2 = un.^2 + wn.^2;V = sqrt(V2);[C,h] = contour(un,wn,V,'-k');set(h,'LineWidth',2);

H = clabel(C,h);set(H,'FontSize',12,'LineWidth',3);set(H,'LineWidth',2,'BackgroundColor','white','Edgecolor',[.1 .8 .1]);

legtitle = ['Contour plot of TE\_0\_m modes and different \itV \rm\bfcircles' vstrTETM];

title(legtitle,'FontSize',16,'FontWeight','bold');

xlabel('\itu\_n','FontSize',14,'FontWeight','bold');

ylabel('\itw\_n','FontSize',14,'FontWeight','bold');

figure(4)

[C,h] = contour(un,wn,CE\_HEEH\_322,'--k');axis square;grid on

set(h,'LineWidth',2);H = clabel(C,h,[0]);set(H,'FontSize',10,'LineWidth',2);

set(gca,'FontSize',13);set(gcf,'Color',[1 1 1]);hold on

V2 = un.^2 + wn.^2;V = sqrt(V2);[C,h] = contour(un,wn,V,'-k');set(h,'LineWidth',2);

H = clabel(C,h);set(H,'FontSize',12,'LineWidth',3);set(H,'LineWidth',2,'BackgroundColor','white','Edgecolor',[.1 .8 .1]);

legtitle = ['Contour plot of HE and EH modes and different \itV \rm\bfcircles' vstr];

title(legtitle,'FontSize',16,'FontWeight','bold');

xlabel('\itu\_n','FontSize',14,'FontWeight','bold');

ylabel('\itw\_n','FontSize',14,'FontWeight','bold')