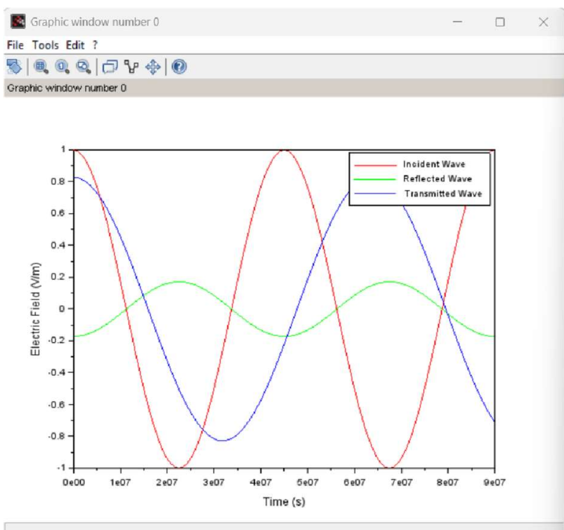
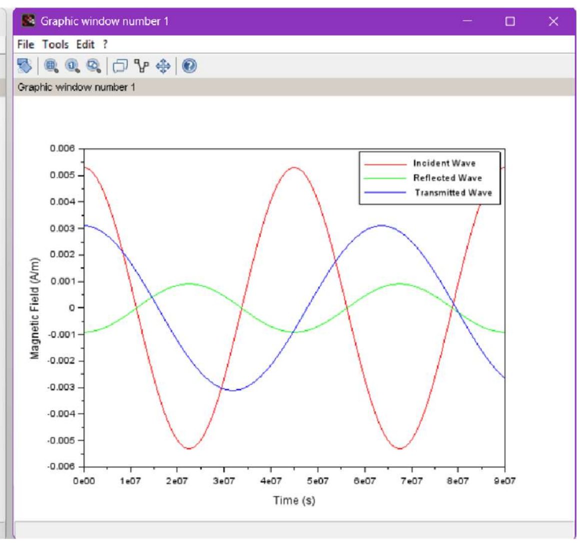
PRACTICAL -3

```
// Program to find the electric and magnetic fields of reflected and
transmitted WAVE
//Mayank Barman
//8562 //22025558001
f = 1e9;  // Frequency of the wave (1 GHz)
c = 3e8;  // Speed of light in vacuum (m/s)
epsilon0 = 8.854e-12;  // Permittivity of free space (F/m)
mu0 = 4 * %pi * 1e-7;  // Permeability of free space (H/m)

// Media properties
epsilon1 = 4 * epsilon0;  // Permittivity of medium 1 (F/m)
mu1 = mu0;  // Permeability of medium 1 (H/m)
epsilon2 = 2 * epsilon0;  // Permittivity of medium 2 (F/m)
mu2 = mu0;  // Permeability of medium 2 (H/m)

// Impedances of the media
Z1 = sqrt(mu1 / epsilon1);  // Impedance of medium 1 (Ohm)
Z2 = sqrt(mu2 / epsilon2);  // Impedance of medium 2 (Ohm)

// Incident angle
theta_i = 30;  // Incident angle in degrees
theta_i = theta_i * %pi / 180;  // Convert to radians

// Reflection and Transmission Coefficients
R = (Z2 - Z1) / (Z2 + Z1);  // Reflection coefficient
T = 2 * Z1 / (Z2 + Z1);  // Transmission coefficient

// Wave vectors
k0 = 2 * %pi * f / c;  // Wave number in free space (rad/m)
k1 = k0 * sqrt(epsilon1 * mu1);  // Wave number in medium 1
k2 = k0 * sqrt(epsilon2 * mu2);  // Wave number in medium 2
disp(k0,k1,k2)

// Electric and Magnetic Field of the incident wave
E0 = 1;  // Amplitude of the incident electric field
H0 = E0 / Z1;  // Amplitude of the incident magnetic field
// Electric and Magnetic Fields of Reflected Wave
Er = R * E0;  // Reflected electric field
Hr = Er / Z1;  // Reflected magnetic field

// Electric and Magnetic Fields of Transmitted Wave
Et = T * E0;  // Transmitted electric field
Ht = Et / Z2;  // Transmitted magnetic field
disp(R,T)

// Time variable for plotting
t = 0:(0.04*%pi)/k1:(4*%pi)/k1;  // Time vector (1 nanosecond interval)
// Electric fields as a function of time
E_incident = E0*cos(k1 * t);  // Incident electric field
E_reflected = Er * cos(k1 * t + %pi);
// Reflected electric field (phase shift by pi)
E_transmitted = Et * cos(k2 * t);  // Transmitted electric field
// Plot the fields
```

```
scf(0);
plot(t, E_incident, 'r', t, E_reflected, 'g', t, E_transmitted, 'b');
xlabel('Time (s)');
ylabel('Electric Field (V/m)');
legend("Incident Wave", "Reflected Wave", "Transmitted Wave");
// Magnetic fields as a function of time
H_incident = H0 * cos(k1 * t);  // Incident magnetic field
H_reflected = Hr * cos(k1 * t + %pi);  // Reflected magnetic field
H_transmitted = Ht * cos(k2 * t);  // Transmitted magnetic field
// Plot the magnetic fields scf(1);
plot(t, H_incident, 'r', t, H_reflected, 'g', t, H_transmitted, 'b');
xlabel('Time (s)');
ylabel('Magnetic Field (A/m)');
legend("Incident Wave", "Reflected Wave", "Transmitted Wave");
```

OUTPUT:





PRACTICAL 3

AIM:An electromagnetic wave propagating with the speed of light in free space is incident normally on a perfectly dielectric medium for which relative permittivity is 5.0.

Write a program to determine,

Magnitude of reflected electric field vector (Er/Ei)

Magnitude of transmitted electric field vector (Et/Ei)

Magnitude of reflected magnetic field vector (Hr/Hi)

Magnitude of transmitted magnetic field vector (Ht/Hi)

```
//Mayank Barman
//8562
//22025558001
// Scilab code to calculate reflected and transmitted field vectors
er = 5; // Relative permittivity
etal = 120 * %pi; // Intrinsic impedance of free space
eta2 = etal / sqrt(er); // Intrinsic impedance of  dielectric medium
erei = (eta2 - etal) / (etal + eta2); // Er/Ei
etei = (2 * eta2) / (etal + eta2);    // Et/Ei
hrhi = (etal - eta2) / (etal + eta2); // Hr/Hi
hthi = (2 * etal) / (etal + eta2);    // Ht/Hi
// Display the results (formatted to 2 decimal places)
mprintf("Er/Ei = %.2f\n", erei);
mprintf("Et/Ei = %.2f\n", etei);
mprintf("Hr/Hi = %.2f\n", hrhi);
mprintf("Ht/Hi = %.2f\n", hthi);
```

OUTPUT:

```
Er/Ei = -0.38
Et/Ei = 0.62
Hr/Hi = 0.38
Ht/Hi = 1.38
```

AIM: An electromagnetic wave having its electric field vector polarized parallel to the plane of incidence is incident at an angle theta_i. Refractive index of the first medium is 1 and the second medium is 1.33. Plot as a function of theta_i, variation of reflection factor, reflection coefficient, transmission factor, transmission coefficient.

```
//Mayank Barman
//8562
//22025558001
n1 = 1;
n2 = 1.33;
theta_i = linspace(0, %pi/2, 20); // 0 to 90 degrees in radians
alpha = sqrt(1 - ((n1 * sin(theta_i) ./ n2).^2)) ./ cos(theta_i);
beta = n2 / n1;
R = (alpha - beta) ./ (alpha + beta);
Rc = R.^2;
Tc = ((2 ./ (alpha + beta)).^2) .* alpha .* beta;
T = 2 ./ (alpha + beta);
// Convert theta_i to degrees for plotting
theta_deg = theta_i * 180 / %pi;
clf(); // clear the figure
plot(theta_deg, R, 'o');
plot(theta_deg, T, '*');
plot(theta_deg, Rc, 'rP-');
plot(theta_deg, Tc, 'gX-');
legend(["R", "T", "Rc", "Tc"]);
xtitle("Reflection and Transmission Coefficients vs Incident Angle", "Incident Angle (degrees)", "Coefficient Value");
xgrid();
```

OUTPUT: