Experiment :-06

Experiment No. 6 : Plots of Magnetic Flux density due to Current carrying wire.

① Determine the magnetic field intensity $\vec{H}$ due to a straight current-carrying conductor of an infinite length, carrying a current 200 nA. both using Ampere's Circuit law and from basic principles. Also write Matlab program to plot variations of $|\vec{H}|$ with due to this current-carrying conductor. [Hint: $\vec{H} = \frac{I}{2\pi\rho}\hat{a}_\phi$; Infinite length conductor is a special case of finite length Conductor].
Label the axes as 'Distance from Conductor ρ' and 'Magnetic Field Intensity H'. Take distances [-5 : 0.1 : 5]
Also Title it as 'Plots of Magnetic Field Intensity due to an Infinite line Current.'

2. For an infinitely long transmission line consisting of two concentric cylinders with inner conductor having radius 'a' and ~~outer~~ current I & Outer conductor has radius 'b' and thickness t with return current $-I$, determine $\vec{H}$ everywhere ~~Assume~~ that is in the following regions (i) $0 \le \rho \le a$ (ii) $a \le \rho \le b$ (iii) $b \le \rho \le b+t$ and iv) $\rho \ge b+t$. A
~~I = 200 nA~~ Also write a matlab Program to plot variations of $|\vec{H}|$ in different regions.
Given $I = 200\,nA$ $a = 5\,mm$ $b = 10\,mm$ $t = 1\,mm$
Label the axes and give the title appropriately.
[Hint: $\vec{H} = \begin{cases} \frac{I\rho}{2\pi a^2}\hat{a}_\phi, & 0 \le \rho \le a \\ \frac{I}{2\pi\rho}\hat{a}_\phi, & a \le \rho \le b \\ \frac{I}{2\pi\rho}\left[1 - \frac{\rho^2 - b^2}{t^2 + 2bt}\right]\hat{a}_\phi, & b \le \rho \le b+t \\ 0, & \rho \ge b+t \end{cases}$

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Commands used in the experiment-

1)plot- The plot function in Matlab is used to create a graphical representation of some data.

2)hold- The hold function determines whether new graphics objects are added to the graph or replace objects in the graph. hold on retains the current plot and certain axes properties so that subsequent graphing commands add to the existing graph. hold off resets axes properties to their defaults before drawing new plots.

3)grid()-grid on displays the major grid lines for the current axes returned by the gca command. Major grid lines extend from each tick mark. grid off removes all grid lines from the current axes or chart. grid toggles the visibility of the major grid lines.

Qno.01

```
% Determine the magnetic field intensity H due to a straight current
% carrying conductor of an infimite length carrying a current 200nA.
rho=[-5:0.1:5];
I=20;
L=I/(2*pi);
H=L./rho;
plot(rho,H);
xlabel('distance from conductor');
ylabel('magnetic field intensity (h)*10^-9');
grid();
title ('magnetic field intensity due to infinite line charge');
```

Output :-

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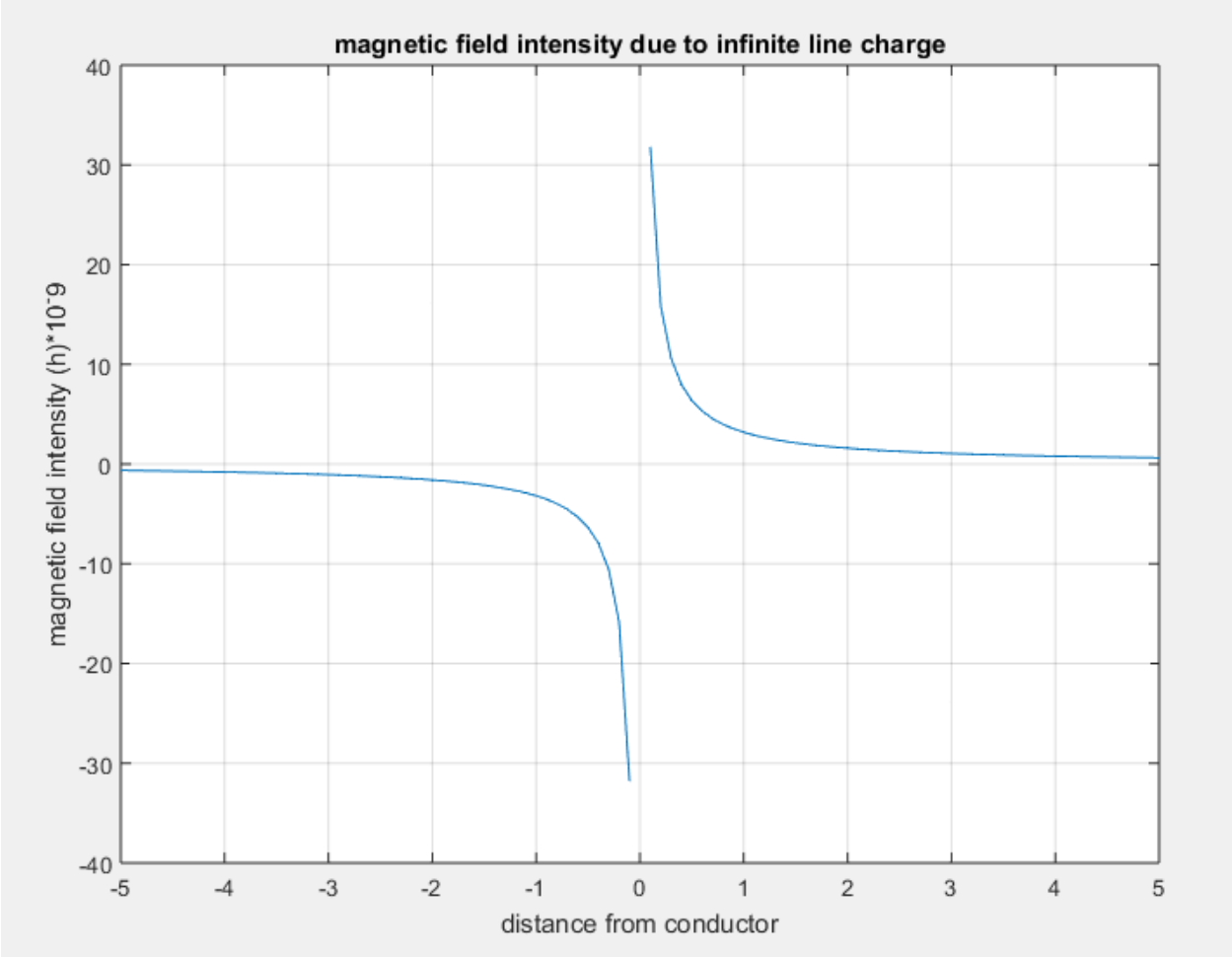

Qno.02

```
% plotting H for different values of rho using hold.

a=5;
b=10;
t=1;
rho1=[0:0.1:a];
rho2=[a:0.1:b];
rho3=[b:0.1:b+t];
I=200e-9;
H1=(I*rho1)/(2*pi*a*a);
H2=I./(2*pi*rho2);
H3=(I./(2*pi*rho3)).*(1-(rho3.*rho3-b.*b)/(t.*t+2.*b.*t));
plot(rho1,H1)
grid()
xlabel('rho')
ylabel('magnetic field intensity')
title('0<=rho>=b+t')
hold('on')
plot(rho2,H2)
grid()
hold('on')
```

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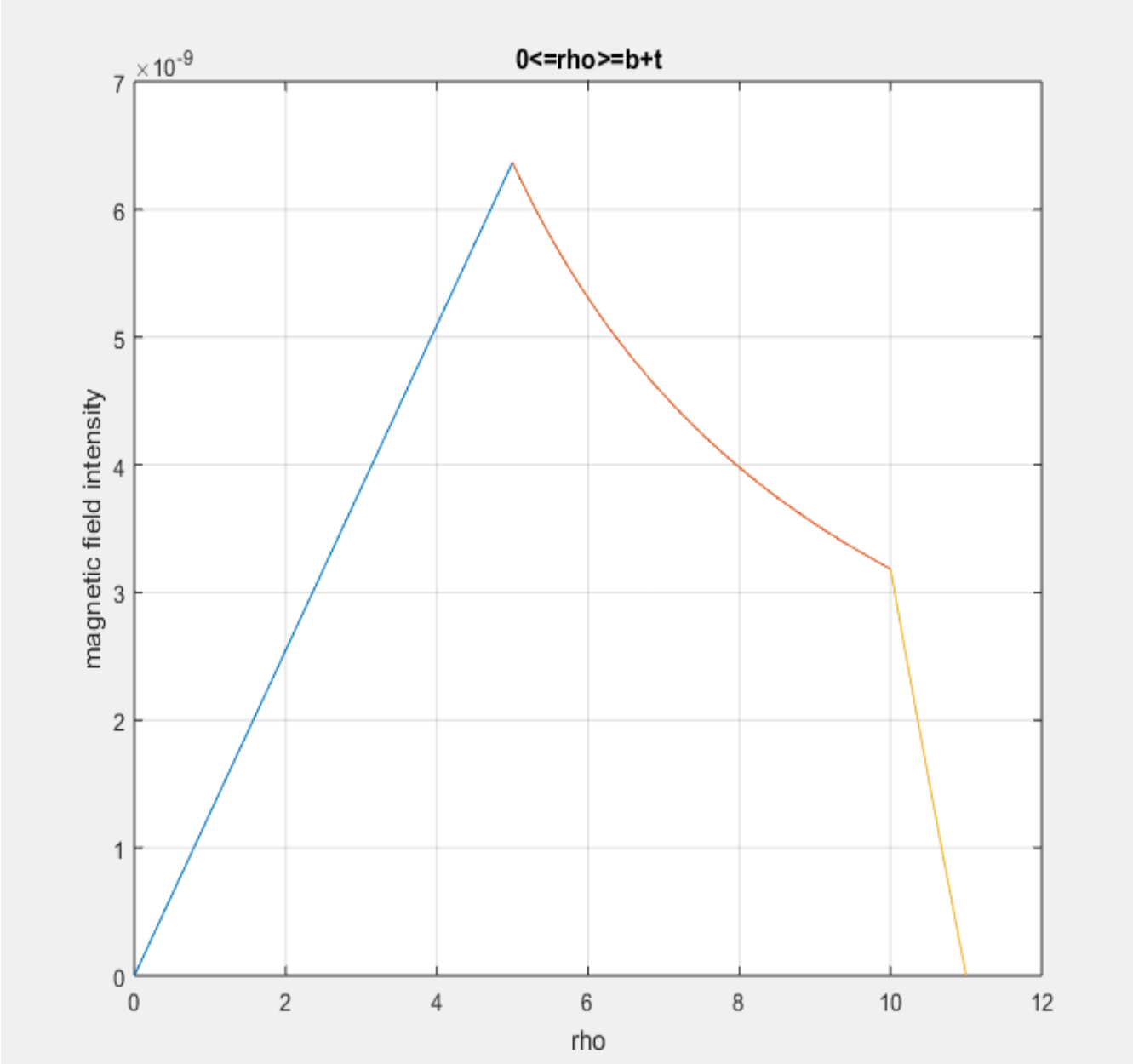
```
plot(rho3,H3)
hold('on')
grid()
```

Output :-



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Using subplot:-

```
a=5;
b=10;
t=1;
rho1=[0:0.1:a];
rho2=[a:0.1:b];
rho3=[b:0.1:b+t];
I=200e-9;
H1=(I*rho1)/(2*pi*a*a);
H2=I./(2*pi*rho2);
H3=(I./(2*pi*rho3)).*(1-(rho3.*rho3-b.*b)/(t.*t+2.*b.*t));
subplot(2,2,1);
plot(rho1,H1)
grid()
xlabel('rho')
ylabel('magnetic field intensity')
title('0<=rho>=a')
subplot(2,2,2);
plot(rho2,H2)
grid()
xlabel('rho3');
title('a<=rho>=b');
subplot(2,2,3);
plot(rho3,H3);
xlabel('rho3');
ylabel('magnetic field intensity');
title('b<=rho>=b+t');
grid()
```

Output:-

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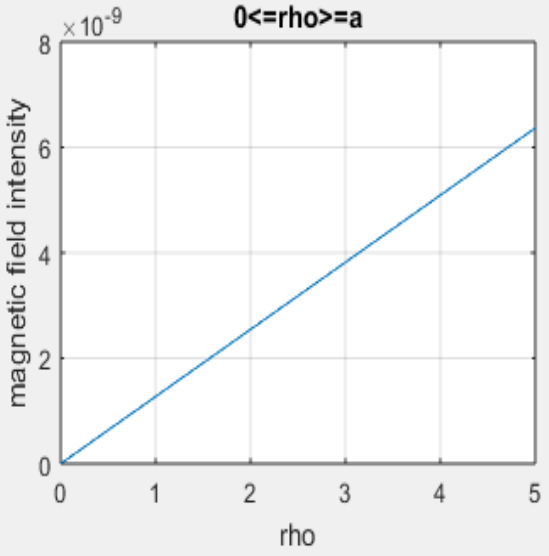

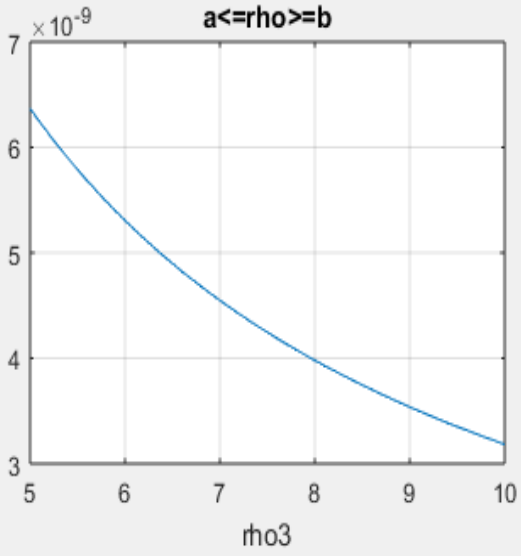

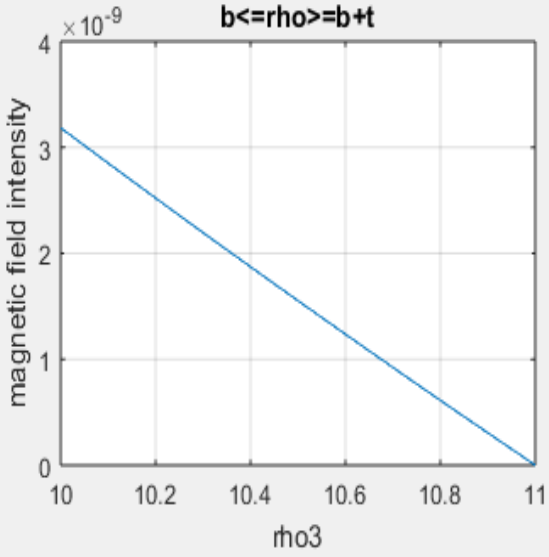

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