**Birla Institute of Technology & Science, Pilani, Rajasthan**

**First Semester 2021-2022**

**Comprehensive Exam: Lab Test (05-12-2021)**

**Solution**

**Q1 (a): Ts=1**

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**Q1(b): Ts=1/4**

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**Q1(c): Ts=1/2**

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Q1(d): Q1 is based on Nyquist criteria. When Ts=1, we are transmitting at a lower rate; When Ts=1/4, we are transmitting at a faster rate and thus ISI; When Ts=1/2, optimal rate.

clear all

B=1;

Ts=1; %%%for (a) Ts=1; for (b) Ts=1/4; for (c) Ts=1/2 optimal

fs=10;

ts=1/fs;

t=-10:ts:10;

xt= 2\*sinc(2\*t);

ht=2\*sinc(2\*t);

yt=conv(xt,ht,'same');

figure(1)

hold all

plot(t, yt)

fs=10;

ts=1/fs;

t=-10:ts:10;

xt= -2\*sinc(2\*t-Ts);

ht=2\*sinc(2\*B\*t);

yt=conv(xt,ht,'same');

figure(1)

hold all

plot(t, yt)

fs=10;

ts=1/fs;

t=-10:ts:10;

xt= 2\*sinc(2\*t-2\*Ts);

ht=2\*sinc(2\*t);

yt=conv(xt,ht,'same');

figure(1)

hold all

plot(t, yt)

**Q2 (a) Q2(b):**

****

close all

clear all

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%%%%%System parameters %%%%%%%%%%%%%

noise\_power\_watt= 2;

transmit\_power\_p\_min= 100;

transmit\_power\_p\_max= 1000;

simulation\_avg= [];

theoretical\_direct\_formula= [];

for p= transmit\_power\_p\_min:10:transmit\_power\_p\_max %%% this will increase the transmitted power of symbols.

symbol\_err=0; %%%%%%%initialization

num\_iter=10^5;

for iter=1:1:num\_iter

const=[1 -1];

m= const(randi(2));

x= sqrt(p)\*m;

n= sqrt(noise\_power\_watt)\*randn(1);

g=10^0.5;

lambda=10;

d=100;

h=(g^2\*lambda)/(4\*pi\*d); %%%channel coef.

y= h\*x+n; %%%received signal

x\_est=y/(h\*sqrt(p));

threshold= (const(1)+const(2))/2; %%%threshold or decision boundary

if (m==const(1)) && (x\_est<threshold) %%%%condition for error

symbol\_err=symbol\_err+1;

end

if (m==const(2)) && (x\_est>threshold) %%%condition for error

symbol\_err=symbol\_err+1;

end

end

simulation\_avg= [simulation\_avg symbol\_err/num\_iter];

received\_snr=(abs(h)^2\*p)/noise\_power\_watt;

theoretical\_direct\_formula= [theoretical\_direct\_formula qfunc(sqrt(received\_snr))];

end

p\_axis= transmit\_power\_p\_min:10:transmit\_power\_p\_max ;

figure(1);

plot(p\_axis, simulation\_avg)

hold on

grid on

plot(p\_axis, theoretical\_direct\_formula)

legend('Simulation (Avg value)', 'Theoretical (Direct Formula)', 'location','Best')

grid on

xlabel('P')

ylabel('BER')

keyboard

**Q2(c):**

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close all

clear all

%%%%%%%%%%S M Zafaruddin%%%%%%%

%%%%%%%%EEE F311 Communication Systems%%%%%%%%%%%%%%%%%

%%%%%System parameters %%%%%%%%%%%%%

noise\_power\_watt= 2

transmit\_power\_p\_min= 100;

transmit\_power\_p\_max= 1000;

for p= transmit\_power\_p\_min:10:transmit\_power\_p\_max %%% this will increase the transmitted power of symbols.

num\_iter=10^2;

for iter=1:1:num\_iter

const=(1/sqrt(2)).\*[1+1j, 1-1j, -1-1j, -1+1j ];

m= const(randi(4));

x= sqrt(p)\*m;

n= sqrt(noise\_power\_watt)\*randn(1)+1j\*sqrt(noise\_power\_watt)\*randn(1);

g=10^0.5;

lambda=10;

d=100;

h=(g^2\*lambda)/(4\*pi\*d); %%%channel coef.

y= h\*x+n; %%%received signal

end

figure(1)

hold all

scatter(real(x),imag(x))

hold on

scatter(real(y), imag(y))

grid on

end