Bangabandhu Sheikh Mujibur Rahman Aviation and Aerospace University

(BSMRAAU)

LAB REPORT

Experiment No: 01
Name of Experiment: MATLAB and Simulink Example Problems and Solutions
Date of Experiment Submission: 19/09/2024
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Department: Department of Aerospace Engineering (Avionics)
Course Name: Modelling and Simulation Sessional
Course Code: AVE 4510
Submitted To: Asst. Prof. Md Samin Rahman
Asst. Prof. Dr. Md. Sakir Hossain
Remarks:

Modeling and Simulation Sessional
AVE: 4510

Experiment 1.1: Matrix Operations
Code:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

A = [3 4; 5 6];
B = [7 8; 9 10];

% Matrix Addition
C = A + B;

% Matrix Subtraction
D = A - B;

% Matrix Multiplication
E = A * B;

% Element-wise Multiplication
F = A .* B;

% Matrix Division
G = A / B;

% Display Results
disp('Matrix Addition:'), disp(C)
disp('Matrix Subtraction:'), disp(D)
disp('Matrix Multiplication:'), disp(E)
disp('Element-wise Multiplication:'), disp(F)
disp('Matrix Division:'), disp(G)
```

Output:

```
Matrix Addition:
    10    12
    14    16

Matrix Subtraction:
    -4    -4
    -4    -4

Matrix Multiplication:
    57    64
    89   100

Element-wise Multiplication:
    21    32
    45    60

Matrix Division:
     3    -2
     2    -1
```

Experiment 1.2: Solving Linear Equations:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

A = [1 2; 3 4];
b = [5; 6];

% Solve using inverse
x1 = inv(A) * b;

% Solve using backslash operator
x2 = A \ b;

% Display Results
disp('Solution using inverse:'), disp(x1)
disp('Solution using backslash operator:'), disp(x2)
```

Output:

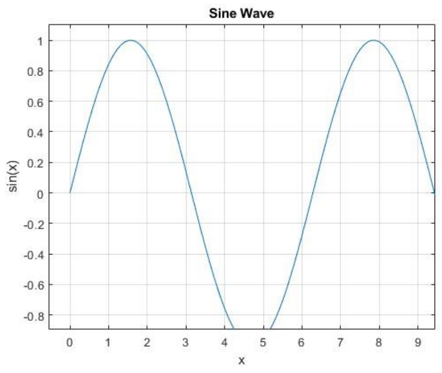
```
Solution using inverse:
   -4.0000
    4.5000

Solution using backslash operator:
   -4.0000
    4.5000
```

Experiment 2.1: Plotting Data

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

x = 0:0.1:10;
y = sin(x);

figure;
plot(x, y);
title('Sine Wave');
```

```
xlabel('x');
ylabel('sin(x)');
grid on;
```

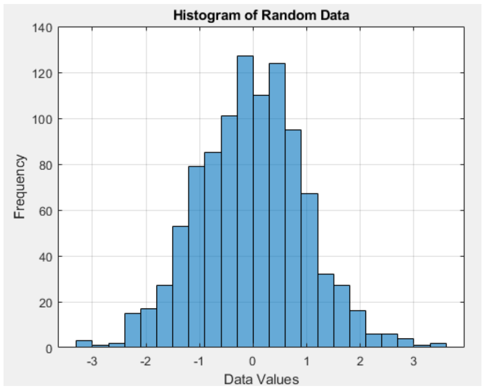
Output:



Experiment 2.2: Histogram

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

data = randn(1000, 1);

figure;
histogram(data);
title('Histogram of Random Data');
xlabel('Data Values');
ylabel('Frequency');
grid on;
```

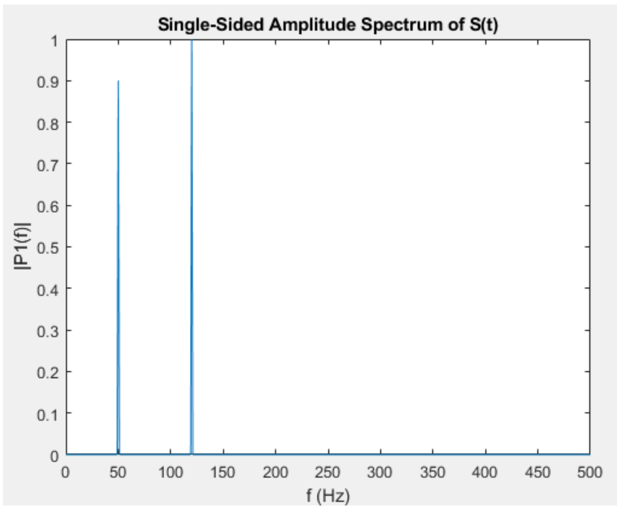
Output:



Experiment 3.1: FFT of a Signal

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

Fs = 1000;           % Sampling frequency
T = 1/Fs;              % Sampling period
L = 1000;             % Length of signal
t = (0:L-1)*T;        % Time vector

% Create a signal
S = 0.7*sin(2*pi*50*t) + sin(2*pi*120*t);

% Compute the FFT
Y = fft(S);

% Compute the two-sided spectrum P2 and the single-sided spectrum P1
P2 = abs(Y/L);
P1 = P2(1:L/2+1);
P1(2:end-1) = 2*P1(2:end-1);

% Define the frequency domain f
f = Fs*(0:(L/2))/L;

% Plot single-sided amplitude spectrum P1
figure;
plot(f,P1)
title('Single-Sided Amplitude Spectrum of S(t)')
xlabel('f (Hz)')
ylabel('|P1(f)|')
```

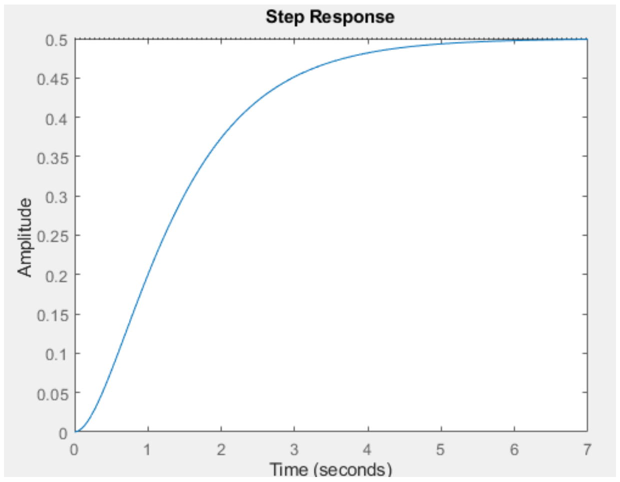
Output:



Experiment 4.1: Step Response of a Transfer Function

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

num = [1];
den = [1 3 2];
sys = tf(num, den);

figure;
step(sys);
title('Step Response');
```

Output:



Experiment 5.1: Minimizing a Function

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

fun = @(x) (x-4)^2 + 6;
 x0 = 0; % Initial guess
 x = fminsearch(fun, x0);

 disp(‘The minimum value is at:’), disp(x)
```

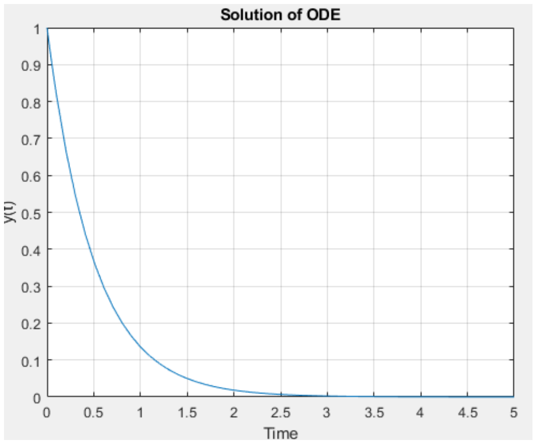
Output:

```
The minimum value is at:
    4.0000
```

Experiment 6.1: Solving ODEs

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Define the ODE
 ode = @(t, y) -2*y;

 % Initial condition
 y0 = 1;

 % Time span
 tspan = [0 5];

 % Solve ODE
 [t, y] = ode45(ode, tspan, y0);

 % Plot results
 figure;
 plot(t, y);
 title('Solution of ODE');
 xlabel('Time');
 ylabel('y(t)');
 grid on;
```

Output:



Experiment 7.1: Monte Carlo Simulation

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

%Number of simulations
 N = 10000;

 % Generate random samples
 samples = rand(N, 1);

 % Compute estimate of pi
 inside_circle = sum(samples.^2 + rand(N, 1).^2 <= 1);
 pi_estimate = 4 * inside_circle / N;

 disp('Estimated value of pi:'), disp(pi_estimate)
```

Output:

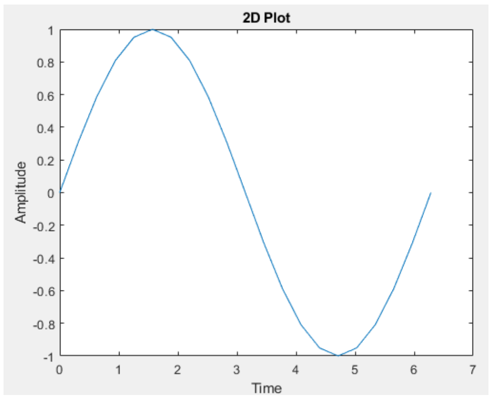
```
>> test1
Estimated value of pi:
    3.1500

>> test2
Estimated value of pi:
    3.1300

>> test3
Estimated value of pi:
    3.1368
```

2D Plot:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019
```

```
x=(0:pi/10:2*pi)
y=sin(x)
plot(x,y)
title('2D Plot')
xlabel('Time')
ylabel('Amplitude')
```

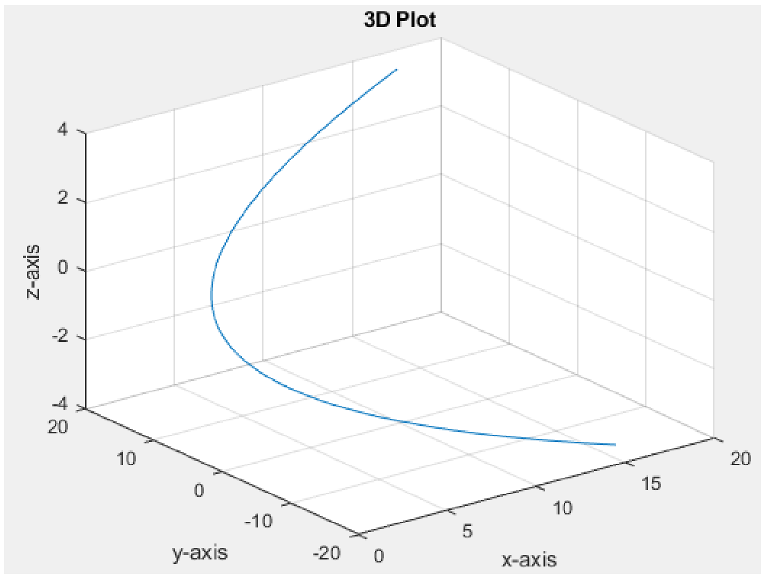
Output:



3D plot:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

t=(-4:0.01:4)
x=t.^2
y=4*t
plot3(x,y,t)
grid on
xlabel('x-axis')
ylabel('y-axis')
zlabel('z-axis')
title('3D Plot')
```

Output:



Experiment 10.1: Reading and Writing CSV Files

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Generate sample data
data = rand(10, 3);

% Write data to CSV
csvwrite('data.csv', data);

% Read data from CSV
data_read = csvread('data.csv');

disp('Data read from CSV:'), disp(data_read)
```

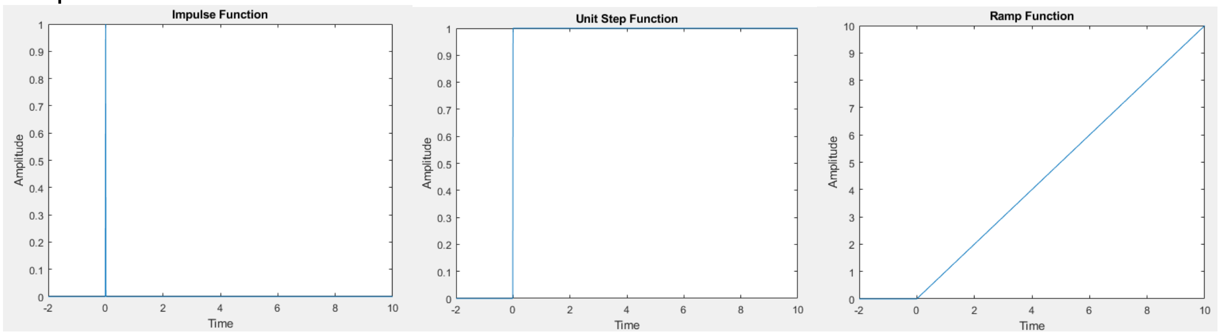
Output:

```
Data read from CSV:
    0.4596    0.7866    0.0222    0.9014
    0.6951    0.5821    0.2594    0.4888
    0.3880    0.9930    0.2136    0.9997
    0.8682    0.8606    0.3072    0.6387
    0.3510    0.0358    0.5015    0.8051
    0.7321    0.2902    0.7039    0.1264
    0.0098    0.0452    0.8136    0.9392
    0.4641    0.6310    0.7792    0.3837
    0.9319    0.6587    0.1746    0.6526
    0.7498    0.5415    0.6724    0.2099
```

Impulse Function, Step Function and Ramp Function:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

t = (-2:0.01:10);

impulse = t==0;
unitstep = t>=0;
ramp = t.*unitstep;

% Plot impulse function
figure;
plot(t, impulse);
title('Impulse Function');
xlabel('Time');
ylabel('Amplitude');

% Plot unit step function
figure;
plot(t, unitstep);
title('Unit Step Function');
xlabel('Time');
ylabel('Amplitude');

% Plot ramp function
figure;
plot(t, ramp);
title('Ramp Function');
xlabel('Time');
ylabel('Amplitude');
```

Output:

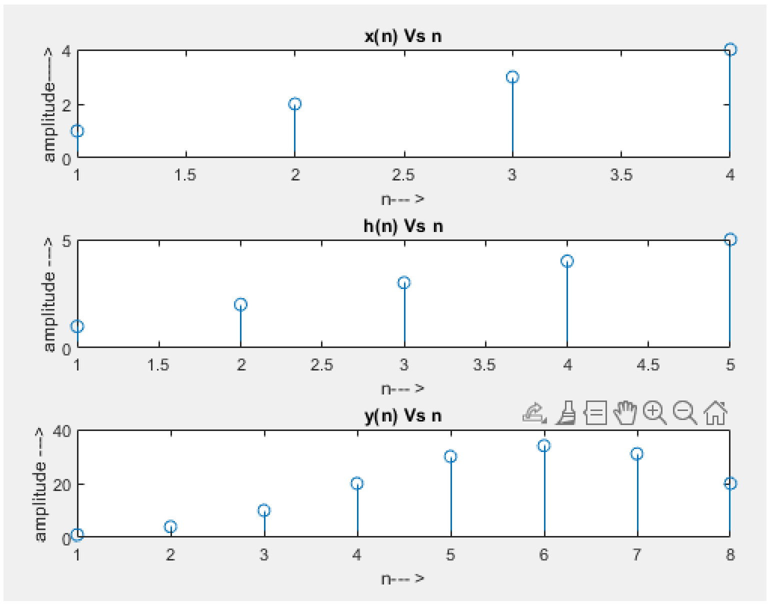


Linear Convolution:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

disp('enter the length of the first sequence m=');
m=input('');

disp('enter the first sequence x[m]=');
for i=1:m
x(i)=input('');
end

disp('enter the length of the second sequence n=');
n=input('');
disp('enter the second sequence h[n]=');
for j=1:n
h(j)=input('');
end

y=conv(x,h);

figure;
subplot(3,1,1);
stem(x);
ylabel ('amplitude---->');
xlabel('n--- >');
title('x(n) Vs n');

subplot(3,1,2);
stem(h);
ylabel('amplitude --->');
xlabel('n--- >');
title('h(n) Vs n');

subplot(3,1,3);
stem(y);
ylabel('amplitude --->');
xlabel('n--- >');
title('y(n) Vs n');

disp('linear convolution of x[m] and h[n] is y');
```

Output:

```
enter the length of the first sequence m=
4
enter the first sequence x[m]=
1
2
3
4
enter the length of the second sequence n=
5
enter the second sequence h[n]=
1
2
3
4
5
linear convolution of x[m] and h[n] is y
>>
```



```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Step 1: Define the resistance and current
R = 10;           % resistance in ohms
I = 2;               % current in amperes

% Step 2: Calculate the voltage
V = R * I;
```

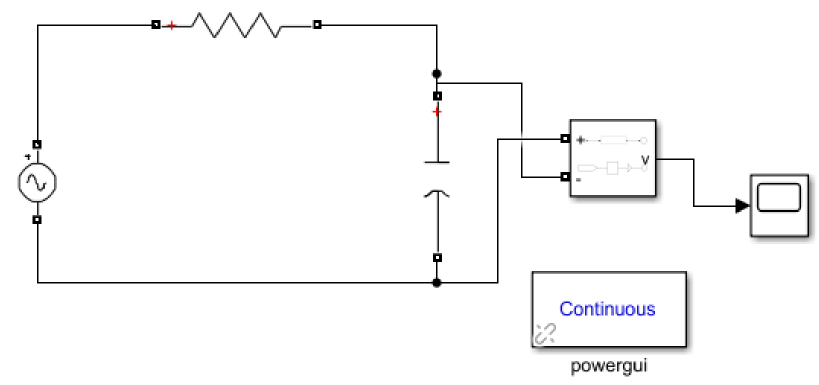
```
% Step 3: Display the result
disp(['Voltage (V) = ', num2str(V), ' V']);
```

Ohm's Law Verification:

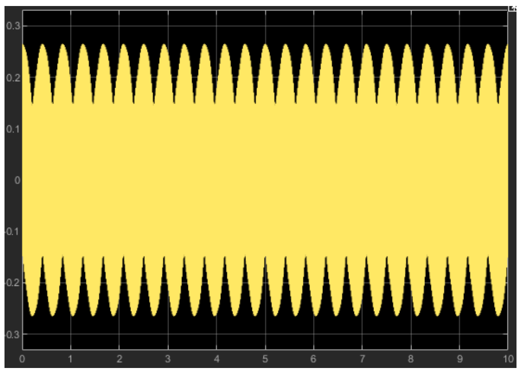
Output:

```
Voltage (V) = 20 V
```

2. Series RC Circuit Response



Output:



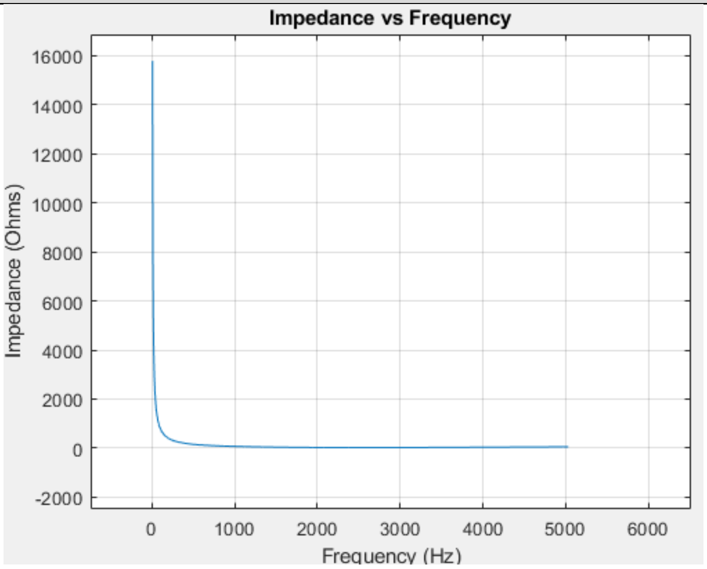
3. Parallel RLC Circuit

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019
```

```
% Step 1: Define the values of R, L, and C
R = 20; % resistance in ohms
L = 2e-3; % inductance in henries
C = 2e-6; % capacitance in farads

% Step 2: Calculate the resonance frequency
f_res = 1 / (2 * pi * sqrt(L * C));
disp(['Resonance Frequency (Hz) = ', num2str(f_res)]);

% Step 3: Plot the impedance vs. frequency
f = linspace(0, 2*f_res, 1000);
Z = abs(R + 1./(1i*2*pi*f*C) + 1i*2*pi*f*L);

plot(f, Z);
xlabel('Frequency (Hz)');
ylabel('Impedance (Ohms)');
title('Impedance vs Frequency');
grid on;
```

Output:

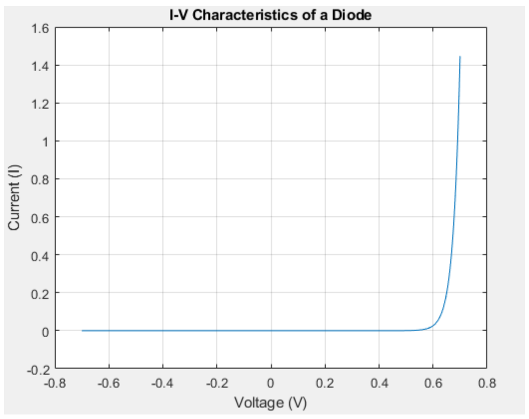
```
Resonance Frequency (Hz) = 2516.4606
```



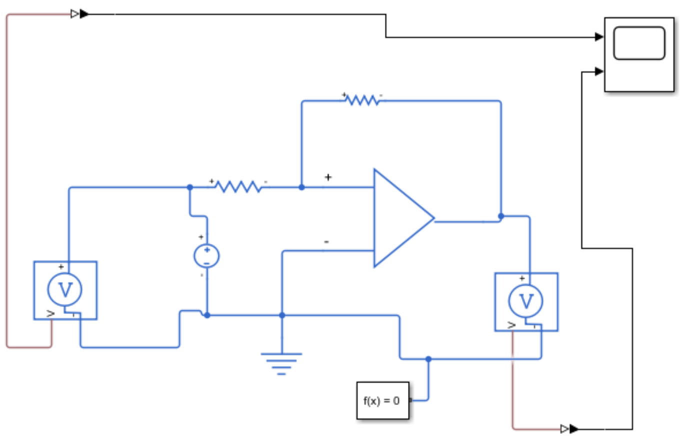
4. Diode Characteristics

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Step 1: Define the diode equation
Is = 1e-12; % saturation current in amperes
Vt = 0.025; % thermal voltage in volts

% Step 2: Plot the current vs. voltage
V = linspace(-0.7, 0.7, 1000);
I = Is * (exp(V/Vt) - 1);
plot(V, I);
xlabel('Voltage (V)');
ylabel('Current (I)');
title('I-V Characteristics of a Diode');
grid on;
```

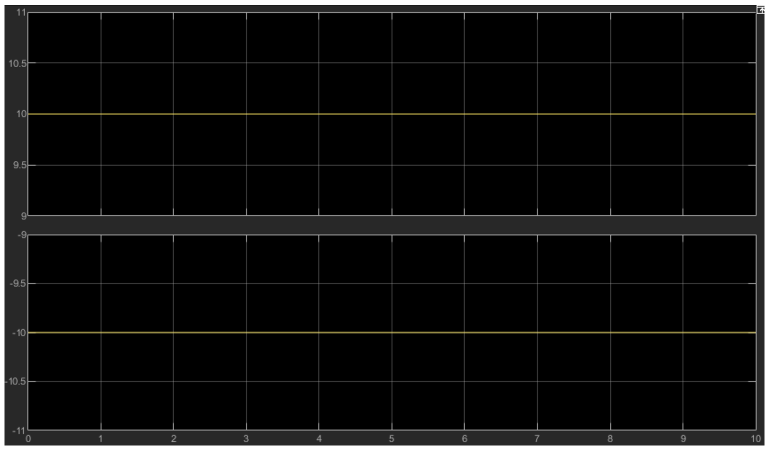
Output:



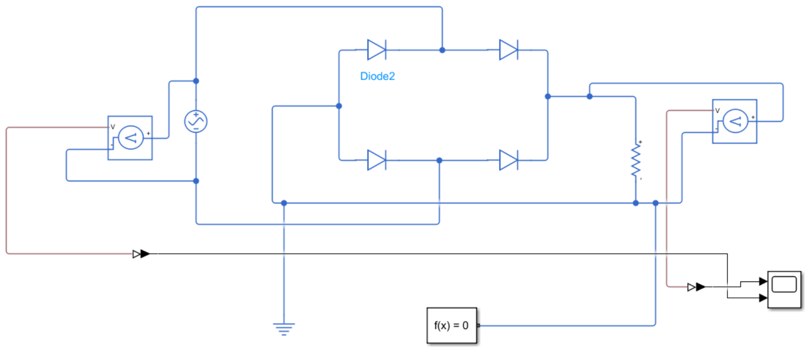
5. Transistor as a Switch



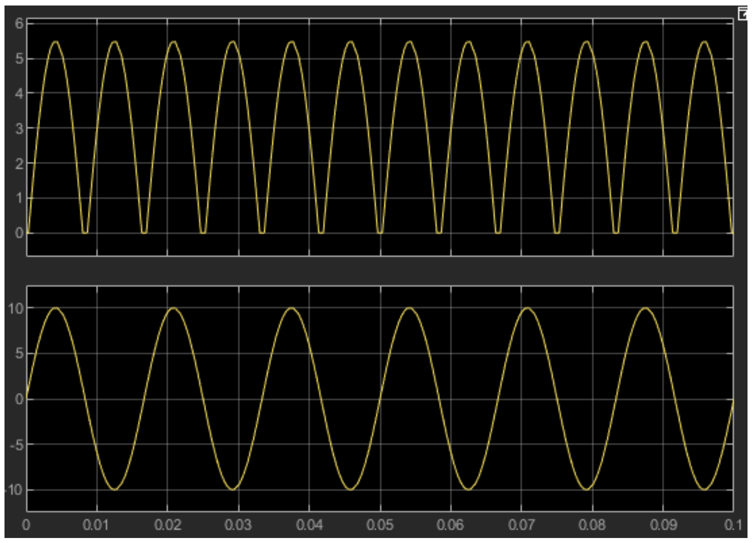
Output:



Full-wave Rectifier:



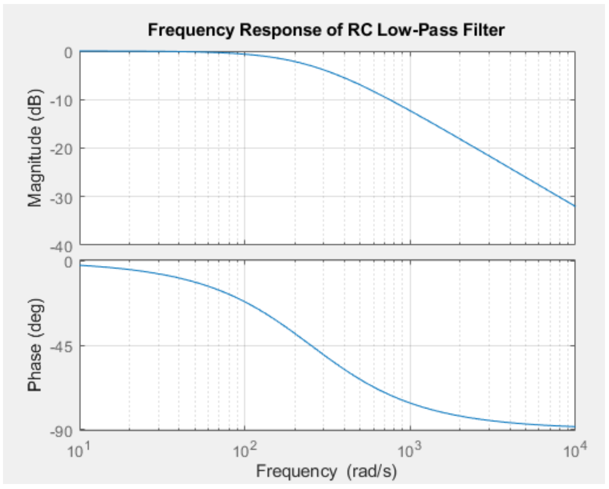
Output:



8. RC Low-Pass Filter

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Step 1: Define the values of R and C
R = 2e3; % resistance in ohms
C = 2e-6; % capacitance in farads

% Step 2: Calculate the transfer function
H = tf([1], [R*C 1]);

% Step 3: Plot the frequency response
bode(H);
title('Frequency Response of RC Low-Pass Filter');
grid on;
```

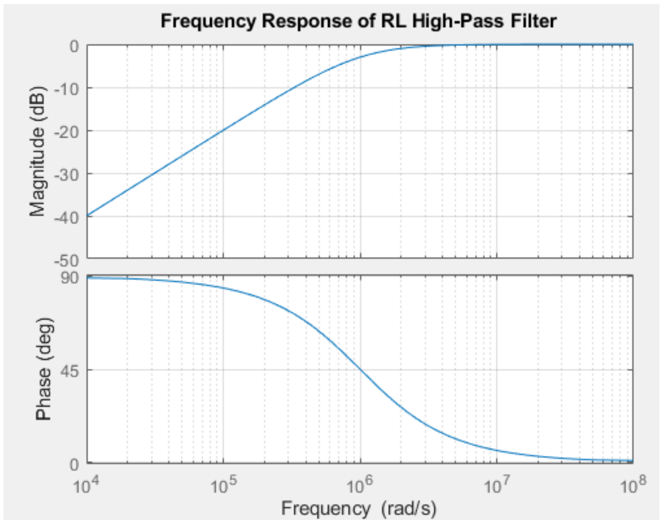
Output:



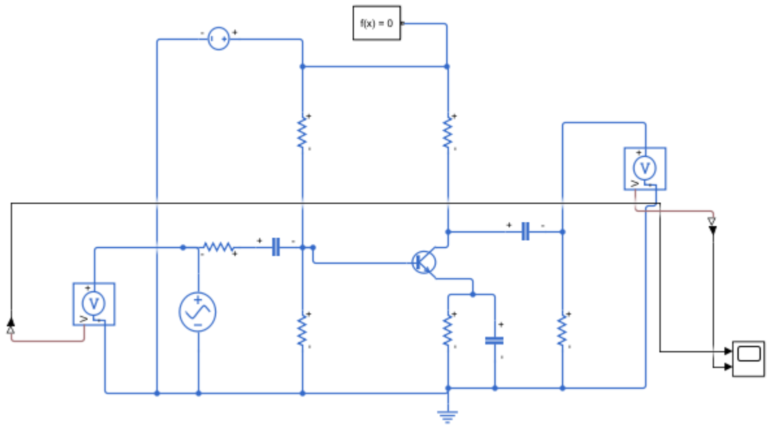
9. RL High-Pass Filter

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Step 1: Define the values of R and L
R = 2e3; % resistance in ohms
L = 2e-3; % inductance in henries

% Step 2: Calculate the transfer function
H = tf([L 0], [L R]);
% Step 3: Plot the frequency response
bode(H);
title('Frequency Response of RL High-Pass Filter');
grid on;
```

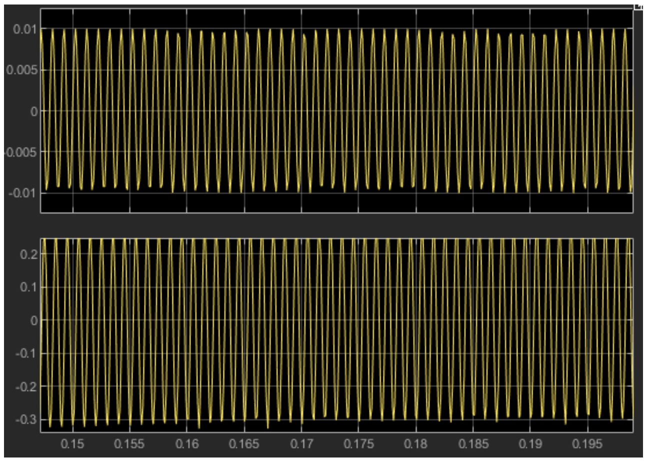
Output:



10. BJT Amplifier



Output:

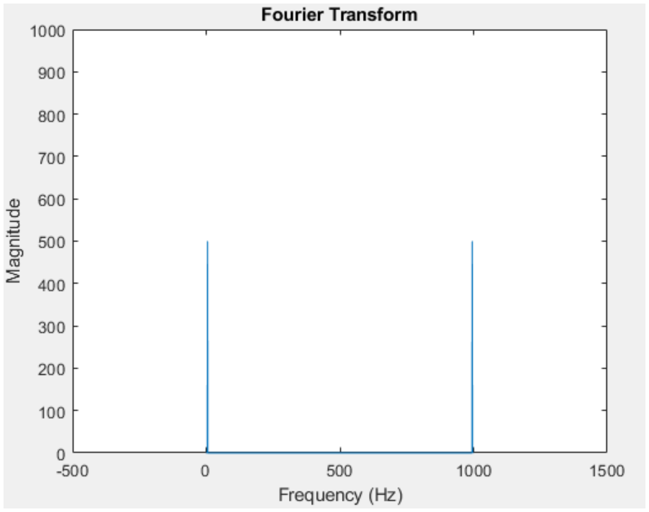


4. Fourier Transform:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019
```

```
% Fourier Transform of a sine wave
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
f = 5; % Frequency of sine wave
x = sin(2*pi*f*t);
X = fft(x);
n = length(x);
f = (0:n-1)*(Fs/n); % Frequency range
magnitude = abs(X);

plot(f,magnitude);
axis([-500 1500 0 1000]);
title('Fourier Transform');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

Output:



6. AC Voltage Analysis:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% AC Voltage Analysis
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
f = 50; % Frequency of AC voltage
V_peak = 20; % Peak voltage
V_ac = V_peak * sin(2*pi*f*t);
V_rms = rms(V_ac);
disp(['RMS Voltage: ', num2str(V_rms), ' V']);
```

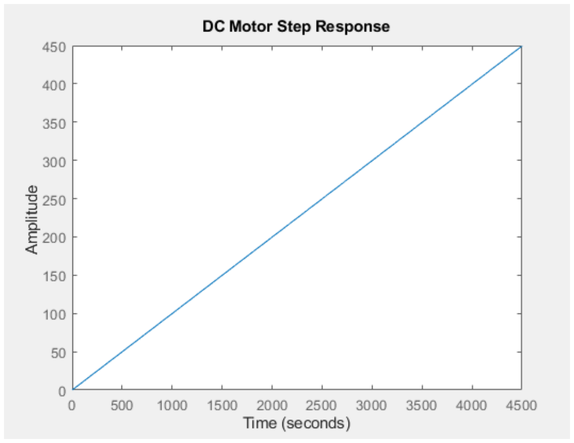
Output:

```
RMS Voltage: 14.1421 V
```

7. DC Motor Simulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% DC Motor Simulation
J = 0.01; % Moment of inertia of the rotor
b = 0.1; % Damping ratio of the mechanical system
K = 0.01; % Electromotive force constant
R = 1; % Electric resistance
L = 0.5; % Electric inductance
A = [0 1 0; 0 -b/J K/J; 0 -K/L -R/L];
B = [0; 0; 1/L];
C = [1 0 0];
D = 0;
sys = ss(A,B,C,D);
step(sys);
title('DC Motor Step Response');
```

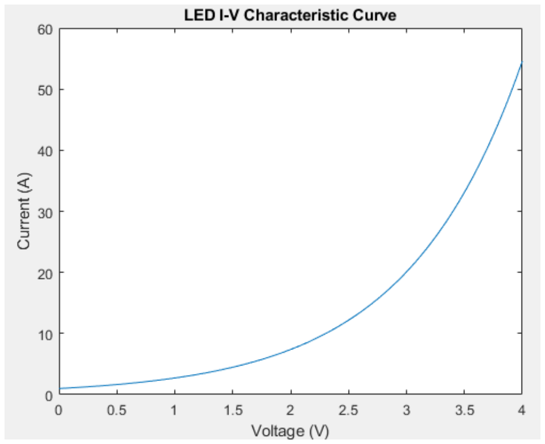
Output:



8. LED Characteristic Curve:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% LED Characteristic Curve
V = 0:0.01:4; % Voltage range
I = exp(V); % Simplified exponential I-V relationship
plot(V, I);
title('LED I-V Characteristic Curve');
xlabel('Voltage (V)');
ylabel('Current (A)');
```

Output:



9. BJT Common Emitter Amplifier:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% BJT Common Emitter Amplifier
beta = 100; % Current gain
R_C = 1e3; % Collector resistor in ohms
V_CC = 15; % Supply voltage in volts
I_B = 50e-6; % Base current in amperes
I_C = beta * I_B; % Collector current in amperes
V_CE = V_CC - I_C * R_C; % Collector-emitter voltage
disp(['Collector-Emitter Voltage: ', num2str(V_CE), ' V']);
```

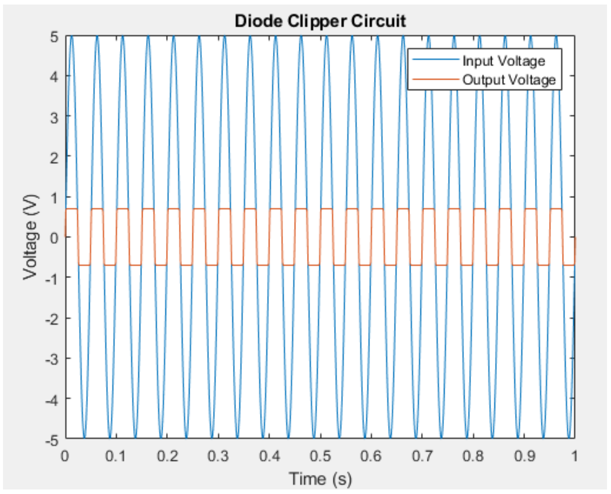
Output:

```
Collector-Emitter Voltage: 10 V
```

10. Diode Clipper Circuit:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Diode Clipper Circuit
t = 0:0.001:1; % Time vector
Vi = 5*sin(2*pi*20*t); % Input sine wave
Vd = 0.7; % Diode forward voltage
Vo = Vi;
Vo(Vi > Vd) = Vd;
Vo(Vi < -Vd) = -Vd;
plot(t, Vi, t, Vo);
title('Diode Clipper Circuit');
xlabel('Time (s)');
ylabel('Voltage (V)');
legend('Input Voltage', 'Output Voltage');
```

Output:



11. Transmission Line Impedance:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Transmission Line Impedance
L = 1e-6; % Inductance per unit length (H/m)
C = 2e-12; % Capacitance per unit length (F/m)
Z0 = sqrt(L/C); % Characteristic impedance
disp(['Characteristic Impedance: ', num2str(Z0), ' Ohms']);
```

Output:

```
Characteristic Impedance: 707.1068 Ohms
```

12. Phase Shift in RC Circuit:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Phase Shift in RC Circuit
R = 1e3; % Resistance in ohms
C = 1e-6; % Capacitance in farads
f = 1000; % Frequency in Hz
omega = 2*pi*f; % Angular frequency
phi = atan(1/(omega*R*C)); % Phase shift
disp(['Phase Shift: ', num2str(rad2deg(phi)), ' degrees']);
```

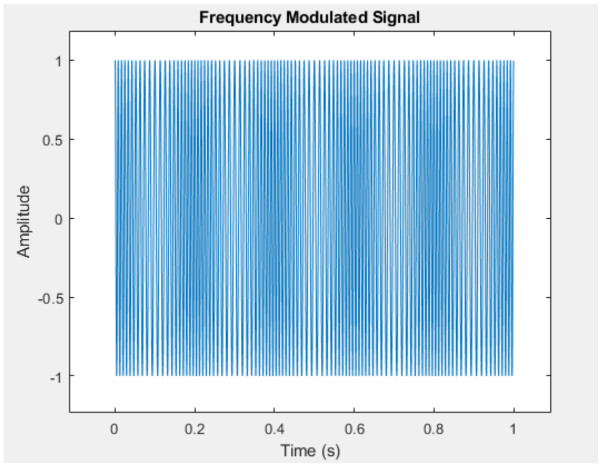
Output:

```
Phase Shift: 9.0431 degrees
```

13. Frequency Modulation (FM):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

Fs = 10000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
Fc = 100; % Carrier frequency
Fm = 5; % Modulating frequency
Am = 1; % Modulating amplitude
beta = 5; % Modulation index
carrier = cos(2*pi*Fc*t);
modulator = cos(2*pi*Fm*t);
fm_signal = cos(2*pi*Fc*t + beta*sin(2*pi*Fm*t));
plot(t, fm_signal);
title('Frequency Modulated Signal');
xlabel('Time (s)');
ylabel('Amplitude');
```

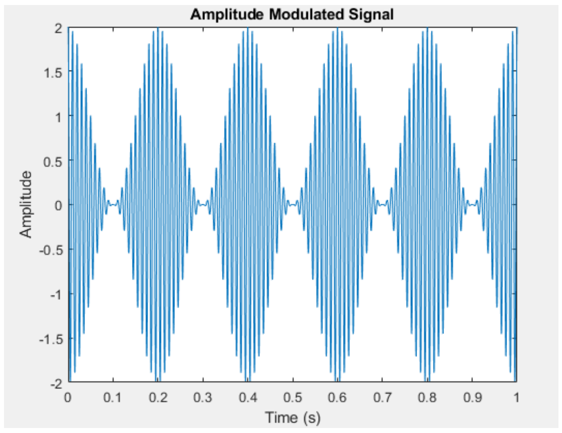
Output:



14. AM Modulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Amplitude Modulation
Fs = 10000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
Fc = 100; % Carrier frequency
Fm = 5; % Modulating frequency
Am = 1; % Modulating amplitude
carrier = cos(2*pi*Fc*t);
modulator = cos(2*pi*Fm*t);
am_signal = (1 + Am*modulator) .* carrier;
plot(t, am_signal);
title('Amplitude Modulated Signal');
xlabel('Time (s)');
ylabel('Amplitude');
```

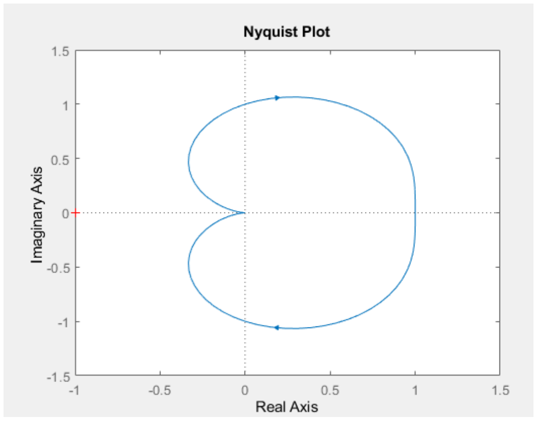
Output:



15. Nyquist Plot:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Nyquist Plot
sys = tf([1], [1 1 1]);
nyquist(sys);
title('Nyquist Plot');
```

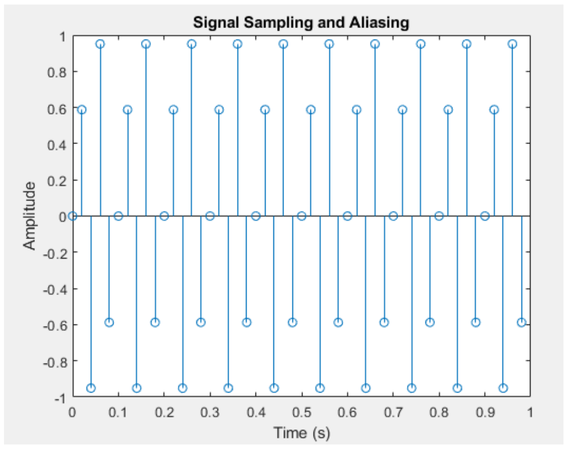
Output:



17. Signal Sampling and Aliasing:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Signal Sampling and Aliasing
Fs = 50; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
f_signal = 20; % Signal frequency
x = sin(2*pi*f_signal*t);
stem(t, x);
title('Signal Sampling and Aliasing');
xlabel('Time (s)');
ylabel('Amplitude');
```

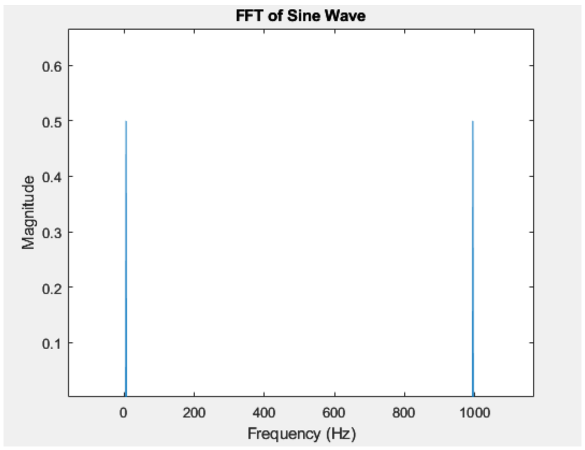
Output:



18. Fast Fourier Transform (FFT):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Fast Fourier Transform (FFT)
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
f = 5; % Frequency of sine wave
x = sin(2*pi*f*t);
X = fft(x);
n = length(x);
f = (0:n-1)*(Fs/n); % Frequency range
magnitude = abs(X)/n;
plot(f, magnitude);
title('FFT of Sine Wave');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

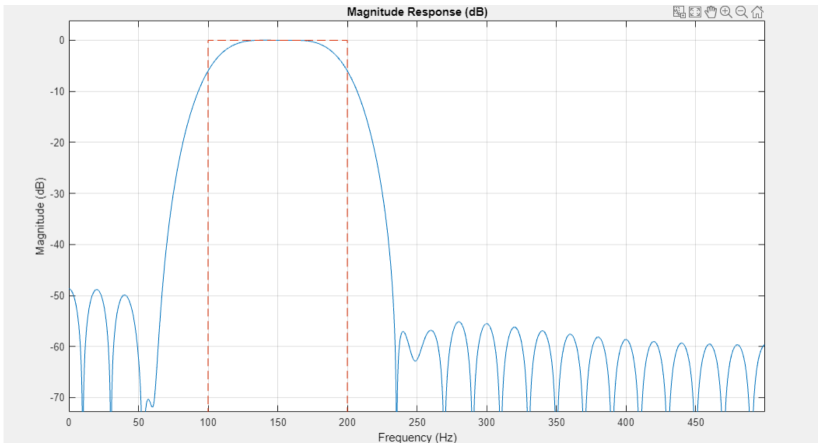
Output:



19. Bandpass Filter Design:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Bandpass Filter Design
Fs = 1000; % Sampling frequency
Fpass1 = 100; % First passband frequency
Fpass2 = 200; % Second passband frequency
N = 50; % Filter order
bpFilt = designfilt('bandpassfir', 'FilterOrder', N, ...
 'CutoffFrequency1', Fpass1, 'CutoffFrequency2', Fpass2, ...
 'SampleRate', Fs);
fvtool(bpFilt);
title('Bandpass Filter Design');
```

Output:



20. Operational Amplifier (Op-Amp) Inverting Amplifier:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Op-Amp Inverting Amplifier
Rin = 10e3; % Input resistor in ohms
Rf = 100e3; % Feedback resistor in ohms
Av = -Rf/Rin; % Voltage gain
Vin = 1; % Input voltage in volts
Vout = Av * Vin; % Output voltage
disp(['Output Voltage: ', num2str(Vout), ' V']);
```

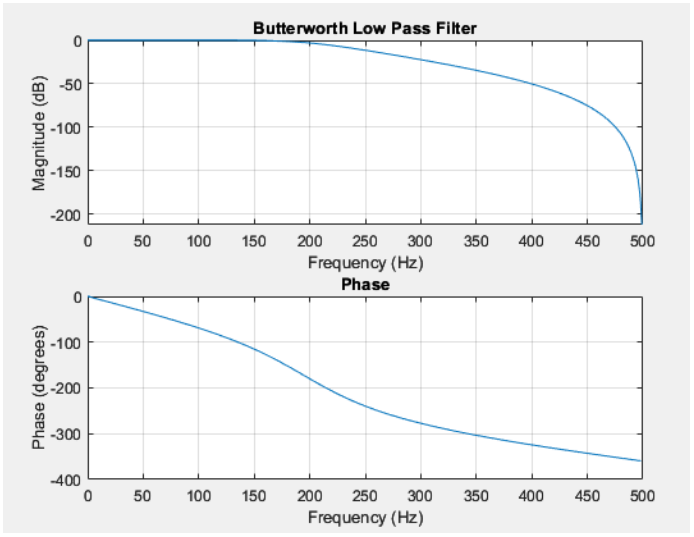
Output:

```
Output Voltage: -10 V
```

21. Butterworth Low Pass Filter Design:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Butterworth Low Pass Filter Design
Fs = 1000; % Sampling frequency
Fc = 200; % Cutoff frequency
[b, a] = butter(4, Fc/(Fs/2)); % 4th order Butterworth filter
freqz(b, a, [], Fs);
title('Butterworth Low Pass Filter');
```

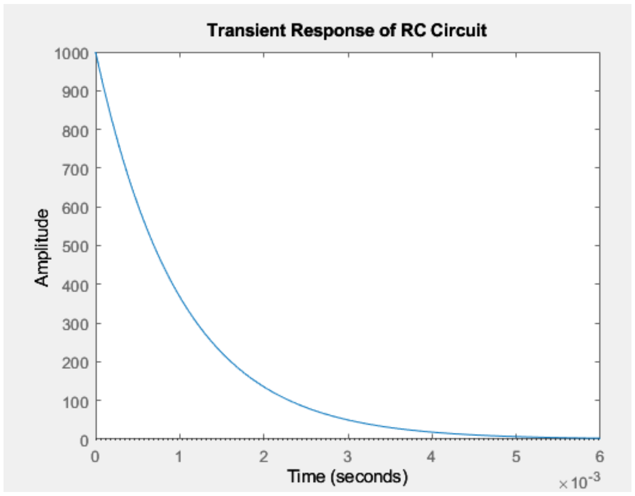
Output:



22. Transient Analysis of RC Circuit:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Transient Analysis of RC Circuit
R = 1e3; % Resistance in ohms
C = 1e-6; % Capacitance in farads
sys = tf([1], [R*C 1]);
impulse(sys);
title('Transient Response of RC Circuit');
```

Output:



23. Voltage Divider Rule:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Voltage Divider Rule
R1 = 10e3; % Resistor 1 in ohms
R2 = 20e3; % Resistor 2 in ohms
Vin = 10; % Input voltage in volts
Vout = (R2 / (R1 + R2)) * Vin; % Output voltage
disp(['Output Voltage: ', num2str(Vout), ' V']);
```

Output:

```
Output Voltage: 6.6667 V
```

24. Digital to Analog Conversion (DAC):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Digital to Analog Conversion (DAC)
digital_signal = [0 1 1 0 1 0 0 1];
analog_signal = filter(1, [1 -0.9], digital_signal); % Simple DAC
model
stem(analog_signal);
title('Digital to Analog Conversion');
xlabel('Sample');
ylabel('Amplitude');
```

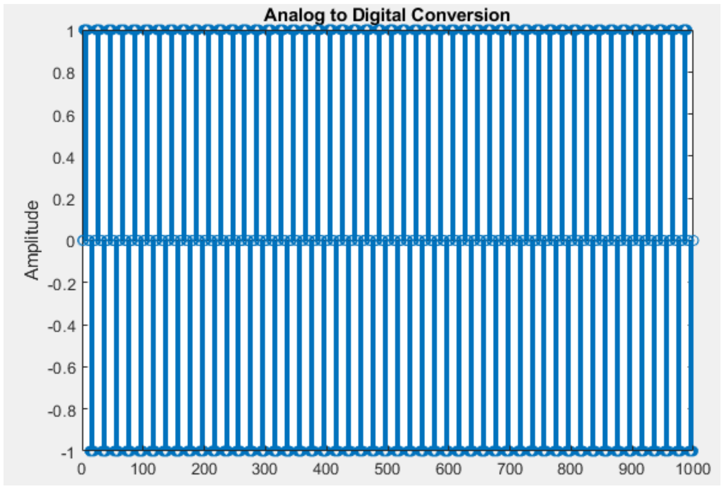
Output:

```
Output Voltage: 6.6667 V
```

25. Analog to Digital Conversion:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Analog to Digital Conversion (ADC)
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
analog_signal = sin(2*pi*50*t); % Analog signal
digital_signal = round(analog_signal); % Simple ADC model
stem(digital_signal);
title('Analog to Digital Conversion');
xlabel('Sample');
ylabel('Amplitude');
```

Output:



26. Impedance of RLC Circuit:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Impedance of RLC Circuit
R = 50; % Resistance in ohms
L = 100e-3; % Inductance in henrys
C = 10e-6; % Capacitance in farads
f = 60; % Frequency in Hz
omega = 2*pi*f; % Angular frequency
Z = R + 1i*(omega*L - 1/(omega*C)); % Impedance
disp(['Impedance: ', num2str(abs(Z)), ' Ohms']);
```

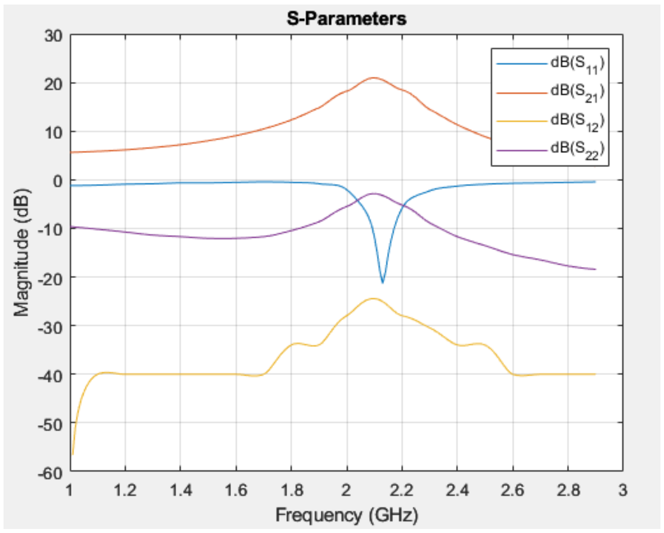
Output:

```
Impedance: 232.9875 Ohms
```

27. S-Parameters in RF Circuit:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% S-Parameters in RF Circuit
s_params = sparameters('default.s2p'); % Load S-parameter file
rfplot(s_params);
title('S-Parameters');
```

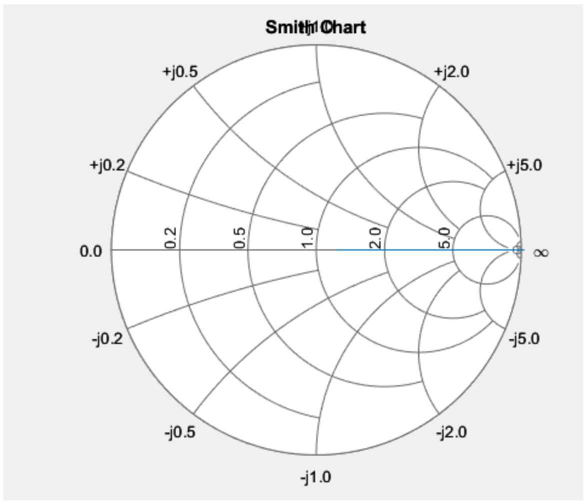
Output:



28. Smith Chart:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Smith Chart
z = linspace(0.1, 10, 100); % Normalized impedance values
smithchart(z);
title('Smith Chart');
```

Output:



29. Resonance in RLC Circuit:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Resonance in RLC Circuit
L = 1e-3; % Inductance in henrys
C = 100e-9; % Capacitance in farads
f_resonance = 1/(2*pi*sqrt(L*C)); % Resonance frequency
disp(['Resonance Frequency: ', num2str(f_resonance), ' Hz']);
```

Output:

```
Resonance Frequency: 15915.4943 Hz
```

30. Stability Analysis Using Routh-Hurwitz Criterion:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Stability Analysis Using Routh-Hurwitz Criterion
coefficients = [1 3 3 1]; % Coefficients of the characteristic
equation
Routh_table = routh(coefficients); % Routh array
disp('Routh Table:');
disp(Routh_table);
```

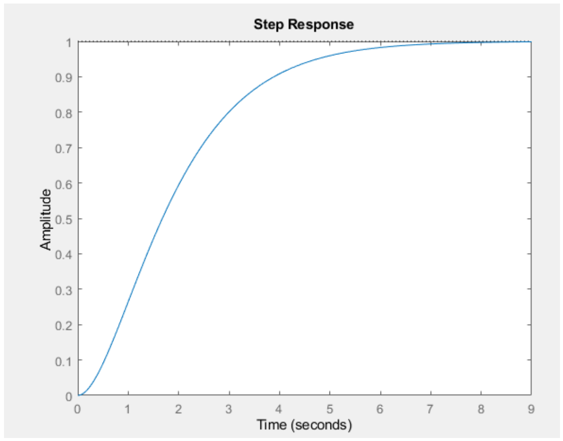
31. Power Spectral Density (PSD):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Power Spectral Density (PSD)
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
x = cos(2*pi*100*t) + randn(size(t)); % Signal with noise
[Pxx, f] = pwelch(x, [], [], [], Fs);
plot(f, 10*log10(Pxx));
title('Power Spectral Density');
xlabel('Frequency (Hz)');
ylabel('Power/Frequency (dB/Hz)');
```

32. Step Response of a Transfer Function:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Step Response of a Transfer Function
sys = tf([1], [1 2 1]);
step(sys);
title('Step Response');
```

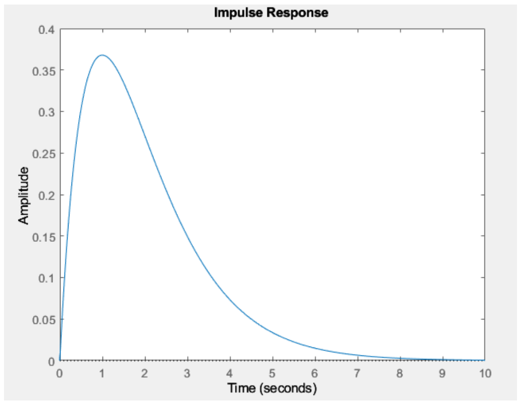
Output:



33. Impulse Response of a Transfer Function:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Impulse Response of a Transfer Function
sys = tf([1], [1 2 1]);
impulse(sys);
title('Impulse Response');
```

Output:



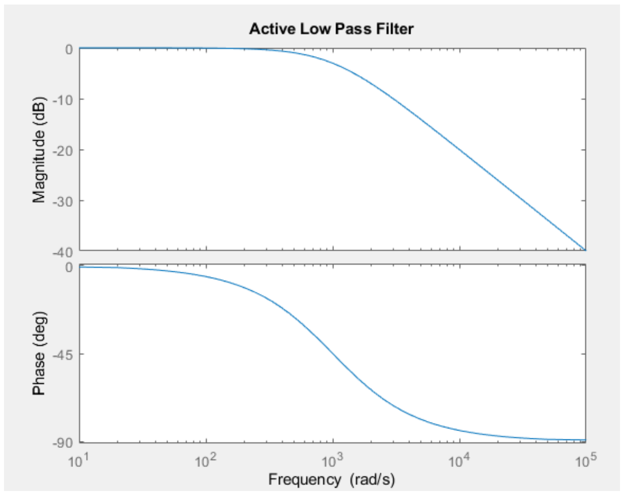
34. Phase Locked Loop (PLL) Simulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Phase Locked Loop (PLL) Simulation
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
F0 = 50; % Initial frequency
input_signal = cos(2*pi*F0*t + pi/4); % Input signal
[~, pll_output] = pll(input_signal, Fs); % Using a PLL function
plot(t, input_signal, t, pll_output);
title('Phase Locked Loop (PLL) Simulation');
xlabel('Time (s)');
ylabel('Amplitude');
legend('Input Signal', 'PLL Output');
```

35. Active Low Pass Filter:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Active Low Pass Filter
R = 1e3; % Resistance in ohms
C = 1e-6; % Capacitance in farads
sys = tf([1], [R*C 1]);
bode(sys);
title('Active Low Pass Filter');
```

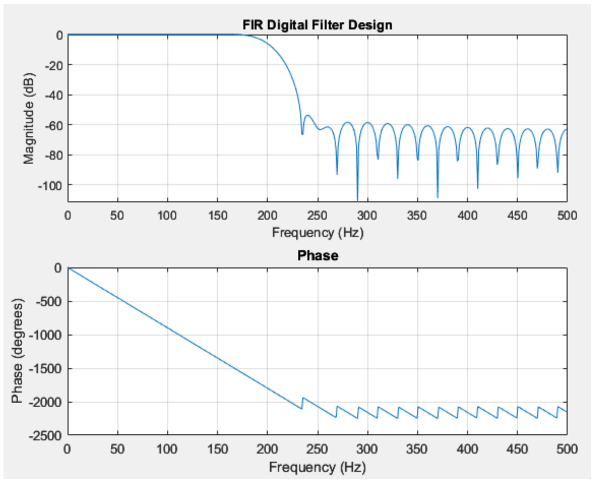
Output:



36. Digital Filter Design (FIR):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Digital Filter Design (FIR)
Fs = 1000; % Sampling frequency
N = 50; % Filter order
Fc = 200; % Cutoff frequency
fir_coeff = fir1(N, Fc/(Fs/2));
freqz(fir_coeff, 1, [], Fs);
title('FIR Digital Filter Design');
```

Output:

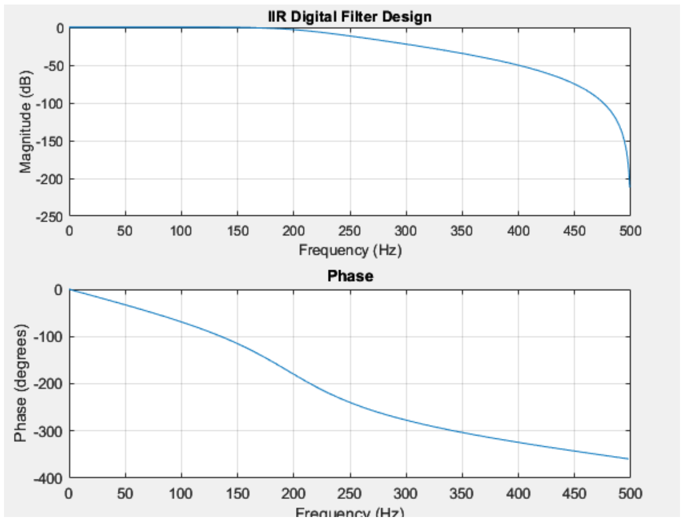


37. Digital Filter Design (IIR):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019
```

```
% Digital Filter Design (IIR)
Fs = 1000; % Sampling frequency
Fc = 200; % Cutoff frequency
[b, a] = butter(4, Fc/(Fs/2));
freqz(b, a, [], Fs);
title('IIR Digital Filter Design');
```

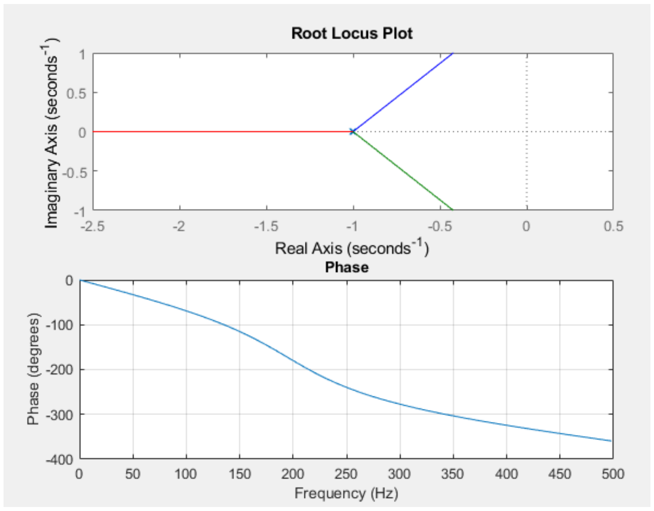
Output:



38. Root Locus Plot:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Root Locus Plot
sys = tf([1], [1 3 3 1]);
rlocus(sys);
title('Root Locus Plot');
```

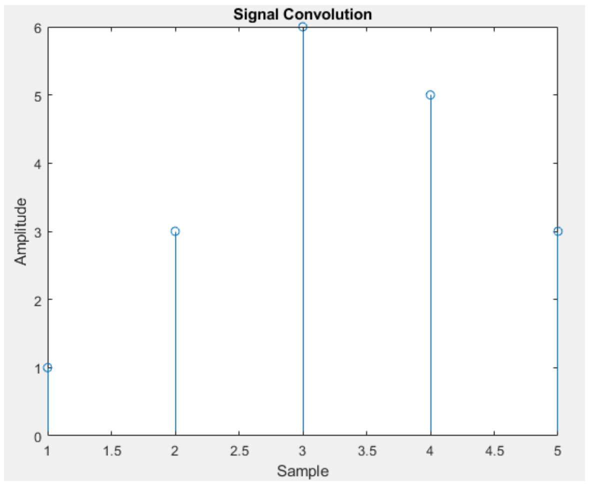
Output:



39. Signal Convolution:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Signal Convolution
x = [1 2 3];
h = [1 1 1];
y = conv(x, h);
stem(y);
title('Signal Convolution');
xlabel('Sample');
ylabel('Amplitude');
```

Output:

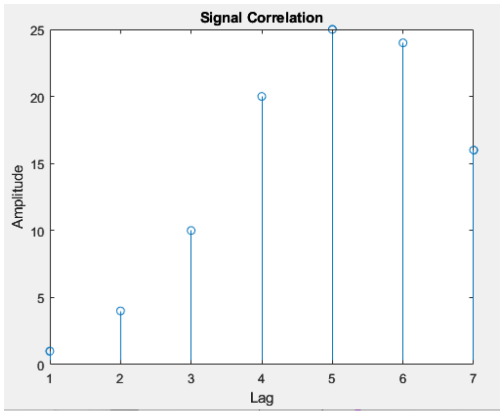


40. Signal Correlation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019
```

```
% Signal Correlation
x = [1 2 3 4];
y = [4 3 2 1];
correlation = xcorr(x, y);
stem(correlation);
title('Signal Correlation');
xlabel('Lag');
ylabel('Amplitude');
```

Output:



41. Power Factor Calculation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Power Factor Calculation
P = 100; % Real power in watts
Q = 75; % Reactive power in VAR
S = sqrt(P^2 + Q^2); % Apparent power in VA
power_factor = P / S;
disp(['Power Factor: ', num2str(power_factor)]);
```

Output:

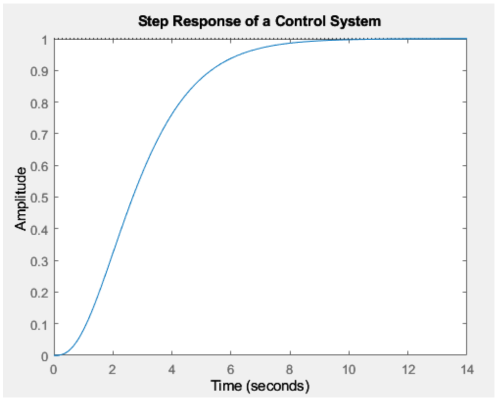
```
Power Factor: 0.8
```

42. Step Response of a Control System:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Step Response of a Control System
sys = tf([1], [1 3 3 1]);
step(sys);
```

```
title('Step Response of a Control System');
```

Output:



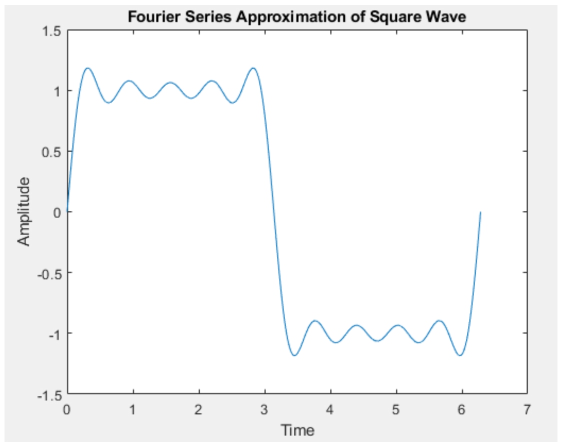
43. Nyquist Stability Criterion:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Nyquist Stability Criterion
sys = tf([1], [1 3 3 1]);
nyquist(sys);
title('Nyquist Stability Criterion');
```

44. Fourier Series Approximation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Fourier Series Approximation
T = 2*pi; % Period
t = linspace(0, T, 1000); % Time vector
n_terms = 10; % Number of terms in the series
square_wave = 0;
for n = 1:2:n_terms
 square_wave = square_wave + (4/pi)*(sin(n*t)/n);
end
plot(t, square_wave);
title('Fourier Series Approximation of Square Wave');
xlabel('Time');
ylabel('Amplitude');
```

Output:



45. Transmission Line Reflection Coefficient:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Transmission Line Reflection Coefficient
Z0 = 50; % Characteristic impedance
ZL = 100; % Load impedance
reflection_coefficient = (ZL - Z0) / (ZL + Z0);
disp(['Reflection Coefficient: ', num2str(reflection_coefficient)]);
```

Output:

```
Reflection Coefficient: 0.33333
```

46. State Space Representation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% State Space Representation
A = [0 1; -1 -1];
B = [0; 1];
C = [1 0];
D = 0;
sys = ss(A, B, C, D);
step(sys);
title('State Space Representation');
```

47. Electrostatic Force Calculation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Electrostatic Force Calculation
```

```
q1 = 1e-6; % Charge 1 in coulombs
q2 = 2e-6; % Charge 2 in coulombs
r = 0.01; % Distance between charges in meters
epsilon_0 = 8.854e-12; % Permittivity of free space
F = (q1 * q2) / (4 * pi * epsilon_0 * r^2); % Force in newtons
disp(['Electrostatic Force: ', num2str(F), ' N']);
```

Output:

```
Electrostatic Force: 179.7548 N
```

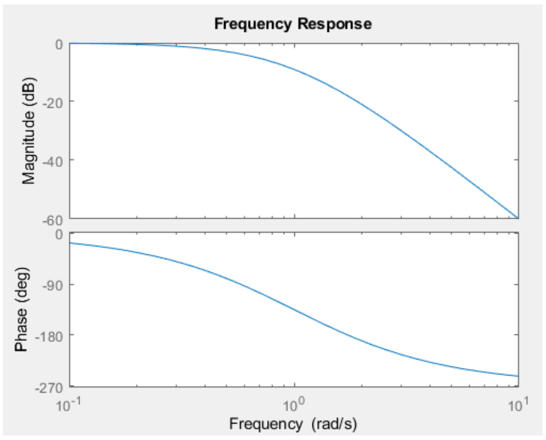
48. Electromagnetic Wave Propagation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Electromagnetic Wave Propagation
c = 3e8; % Speed of light in m/s
f = 1e9; % Frequency in Hz
lambda = c / f; % Wavelength in meters
x = linspace(0, lambda, 1000); % Space vector
E = sin(2 * pi * x / lambda); % Electric field
plot(x, E);
title('Electromagnetic Wave Propagation');
xlabel('Distance (m)');
ylabel('Electric Field (V/m)');
```

49. Frequency Response of a System:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Frequency Response of a System
sys = tf([1], [1 3 3 1]);
bode(sys);
title('Frequency Response');
```

Output:



50. Pulse Width Modulation (PWM):

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Pulse Width Modulation (PWM)
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
duty_cycle = 0.5; % Duty cycle
pwm_signal = square(2*pi*10*t, duty_cycle*100); % PWM signal
plot(t, pwm_signal);
title('Pulse Width Modulation (PWM)');
xlabel('Time (s)');
ylabel('Amplitude');
```

51. H-Bridge Circuit Simulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% H-Bridge Circuit Simulation
V_dc = 12; % DC supply voltage in volts
R_load = 10; % Load resistance in ohms
t = 0:0.001:1; % Time vector
V_out = V_dc * square(2*pi*10*t); % Output voltage with PWM control
plot(t, V_out);
title('H-Bridge Circuit Simulation');
xlabel('Time (s)');
ylabel('Voltage (V)');
```

52. PID Controller Design:

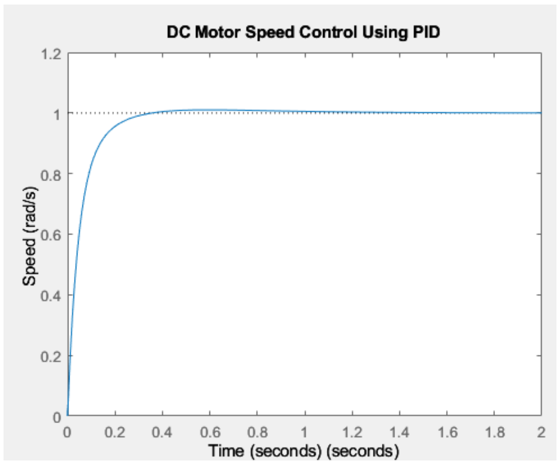
```
%Author: Md. Mahdi Kamal Alif
```

```matlab
%ID: 22024019

% PID Controller Design
Kp = 1; % Proportional gain
Ki = 1; % Integral gain
Kd = 0.1; % Derivative gain
sys = tf([1], [1 3 3 1]); % Plant transfer function
pid_controller = pid(Kp, Ki, Kd);
closed_loop_system = feedback(pid_controller * sys, 1);
step(closed_loop_system);
title('PID Controller Step Response');
```

53. Motor Speed Control Using PID:

```matlab
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Motor Speed Control Using PID
J = 0.01; % Moment of inertia of the rotor
b = 0.1; % Damping ratio
K = 0.01; % Motor constant
R = 1; % Electrical resistance
L = 0.5; % Electrical inductance
% Transfer function of the DC motor
s = tf('s');
P_motor = K / (J*L*s^2 + (J*R + L*b)*s + (b*R + K^2));
% PID controller design
Kp = 100;
Ki = 200;
Kd = 10;
C = pid(Kp, Ki, Kd);
% Closed-loop transfer function
sys_cl = feedback(C*P_motor, 1);
% Simulation
t = 0:0.01:2;
step(sys_cl, t);
title('DC Motor Speed Control Using PID');
xlabel('Time (seconds)');
ylabel('Speed (rad/s)');
```

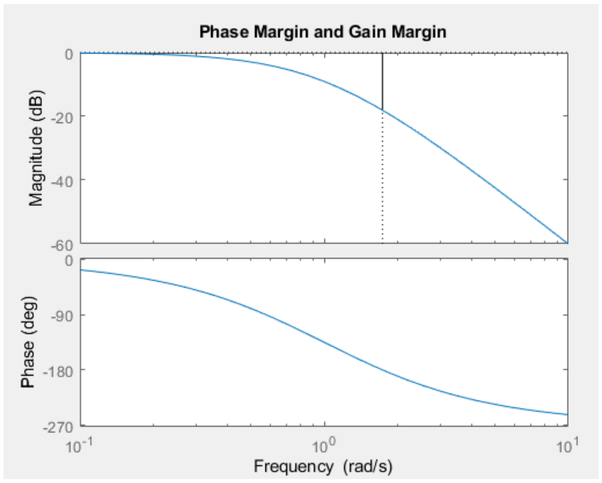
Output:



54. Phase Margin and Gain Margin:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Phase Margin and Gain Margin
sys = tf([1], [1 3 3 1]);
margin(sys);
title('Phase Margin and Gain Margin');
```

Output:



55. State Observer Design:

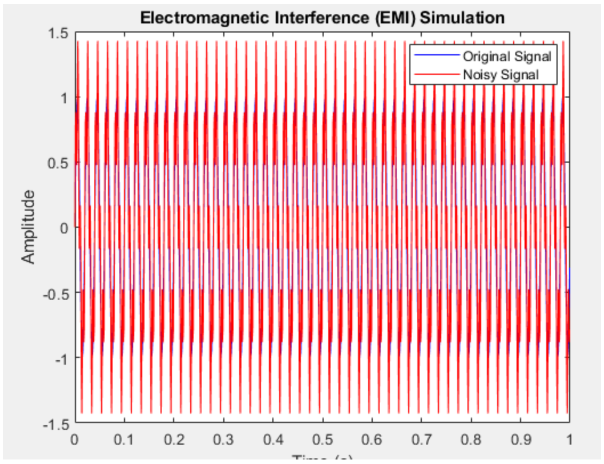
```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% State Observer Design
A = [0 1; -2 -3];
B = [0; 1];
C = [1 0];
```

```
D = 0;
sys = ss(A, B, C, D);
% Desired poles for the observer
poles = [-5 -6];
L = place(A', C', poles)';
% Observer simulation
t = 0:0.01:5;
u = ones(size(t));
x0 = [0; 0];
[y, ~, x] = lsim(sys, u, t, x0);
% State estimation
x_hat = zeros(size(x));
for i = 2:length(t)
 x_hat(:, i) = x_hat(:, i-1) + 0.01 * (A*x_hat(:, i-1) + B*u(i) +
L*(y(i-1) - C*x_hat(:, i-1)));
end
plot(t, x(1, :), 'b', t, x_hat(1, :), 'r--');
legend('True State', 'Estimated State');
title('State Observer Design');
xlabel('Time (s)');
ylabel('State');
```

56. Electromagnetic Interference (EMI) Simulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Electromagnetic Interference (EMI) Simulation
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
signal = sin(2*pi*50*t); % Original signal
EMI = 0.5 * sin(2*pi*200*t); % Interference signal
noisy_signal = signal + EMI;
plot(t, signal, 'b', t, noisy_signal, 'r');
legend('Original Signal', 'Noisy Signal');
title('Electromagnetic Interference (EMI) Simulation');
xlabel('Time (s)');
ylabel('Amplitude');
```

Output:



57. Transmission Line Impedance Matching:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Transmission Line Impedance Matching
Z0 = 50; % Characteristic impedance
ZL = 100; % Load impedance
matching_impedance = sqrt(Z0 * ZL); % Matching impedance
disp(['Matching Impedance: ', num2str(matching_impedance), ' Ohms']);
```

Output:

```
Matching Impedance: 70.7107 Ohms
```

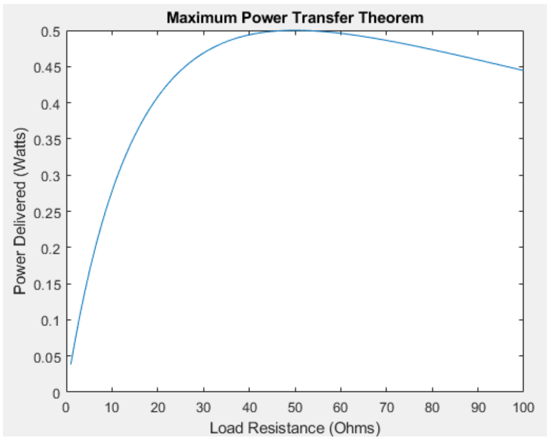
58. Switched-Mode Power Supply (SMPS) Simulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Switched-Mode Power Supply (SMPS) Simulation
V_in = 12; % Input voltage in volts
D = 0.5; % Duty cycle
L = 1e-3; % Inductance in henries
C = 1e-6; % Capacitance in farads
R = 10; % Load resistance in ohms
t = linspace(0, 0.01, 1000); % Time vector
V_out = V_in * D * (1 - exp(-t / (L / R))); % Output voltage
plot(t, V_out);
title('Switched-Mode Power Supply (SMPS) Simulation');
xlabel('Time (s)');
ylabel('Voltage (V)');
```

61. Maximum Power Transfer Theorem:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Maximum Power Transfer Theorem
R_source = 50; % Source resistance in ohms
R_load = linspace(1, 100, 100); % Load resistance in ohms
V_source = 10; % Source voltage in volts
P_load = (V_source^2) * (R_load ./ (R_source + R_load).^2); % Power
delivered to the load
plot(R_load, P_load);
title('Maximum Power Transfer Theorem');
xlabel('Load Resistance (Ohms)');
ylabel('Power Delivered (Watts)');
```

Output:



62. Mutual Inductance Calculation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Mutual Inductance Calculation
L1 = 10e-3; % Inductance of coil 1 in henrys
L2 = 20e-3; % Inductance of coil 2 in henrys
k = 0.5; % Coupling coefficient
M = k * sqrt(L1 * L2); % Mutual inductance
disp(['Mutual Inductance: ', num2str(M), ' H']);
```

Output:

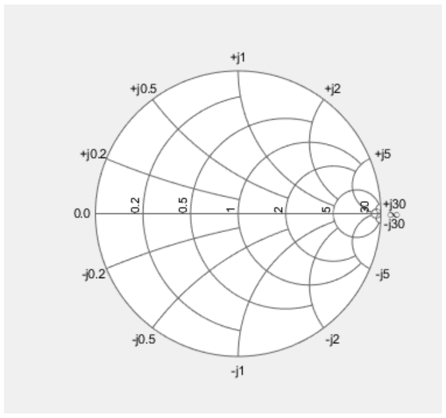
```
Mutual Inductance: 0.0070711 H
```

63. Impedance Matching Using Smith Chart:

```
%Author: Md. Mahdi Kamal Alif
```

```
%ID: 22024019

% Impedance Matching Using Smith Chart
z_load = 2 + 3j; % Normalized load impedance
smithplot(z_load);
title('Impedance Matching Using Smith Chart');
```

Output:



64. Sallen-Key Low Pass Filter:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Sallen-Key Low Pass Filter
R = 1e3; % Resistance in ohms
C = 1e-6; % Capacitance in farads
sys = tf(1, [R^2*C^2 3*R*C 1]);
bode(sys);
title('Sallen-Key Low Pass Filter');
```

65. Thermistor Resistance Calculation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Thermistor Resistance Calculation
T = 25; % Temperature in Celsius
T0 = 25; % Reference temperature in Celsius
R0 = 10e3; % Resistance at T0 in ohms
B = 3950; % Beta coefficient
R = R0 * exp(B * ((1 / (T + 273.15)) - (1 / (T0 + 273.15))));
disp(['Thermistor Resistance: ', num2str(R), ' Ohms']);
```

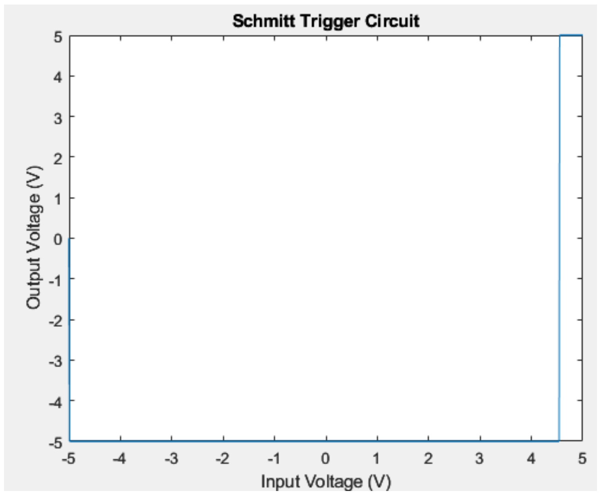
Output:
```
Thermistor Resistance: 10000 Ohms
```

66. Phase Shifter Circuit:
```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Phase Shifter Circuit
f = 1000; % Frequency in Hz
R = 1e3; % Resistance in ohms
C = 1e-6; % Capacitance in farads
omega = 2 * pi * f;
phi = atan(1 / (omega * R * C)); % Phase shift in radians
disp(['Phase Shift: ', num2str(phi * (180/pi)), ' degrees']);
```

Output:
```
Phase Shift: 9.0431 degrees
```

67. Schmitt Trigger Circuit:
```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Schmitt Trigger Circuit
Vcc = 5; % Supply voltage in volts
R1 = 1e3; % Resistance R1 in ohms
R2 = 10e3; % Resistance R2 in ohms
Vin = linspace(-Vcc, Vcc, 1000); % Input voltage sweep
Vout = zeros(size(Vin));
Vh = Vcc * (R2 / (R1 + R2)); % High threshold voltage
Vl = -Vcc * (R2 / (R1 + R2)); % Low threshold voltage
for i = 2:length(Vin)
 if Vin(i) > Vh
 Vout(i) = Vcc;
 elseif Vin(i) < Vl
 Vout(i) = -Vcc;
 else
 Vout(i) = Vout(i-1);
 end
end
plot(Vin, Vout);
title('Schmitt Trigger Circuit');
xlabel('Input Voltage (V)');
ylabel('Output Voltage (V)');
```

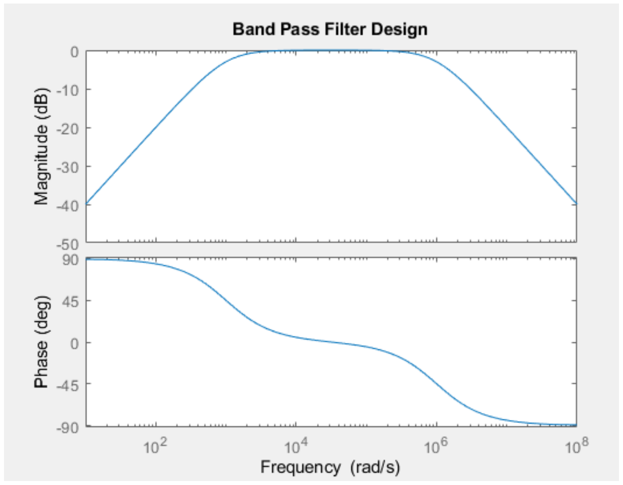
Output:



68. Band Pass Filter Design:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Band Pass Filter Design
R = 1e3; % Resistance in ohms
L = 1e-3; % Inductance in henrys
C = 1e-6; % Capacitance in farads
sys = tf([R*C 0], [L*C R*C 1]);
bode(sys);
title('Band Pass Filter Design');
```

Output:

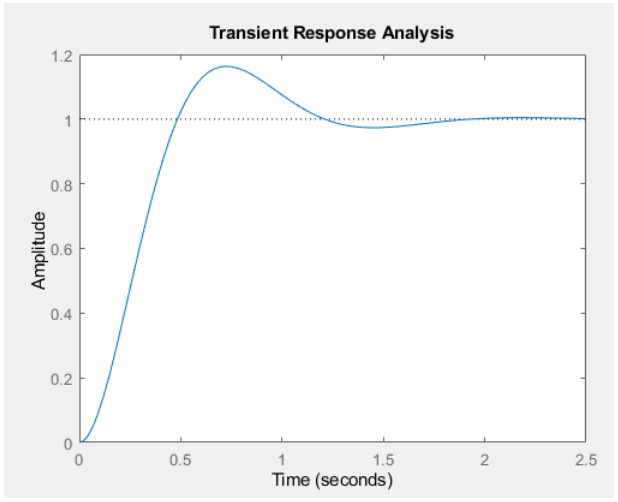


69. Transient Response Analysis:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Transient Response Analysis
wn = 5; % Natural frequency
```

```
zeta = 0.5; % Damping ratio
sys = tf([wn^2], [1 2*zeta*wn wn^2]);
step(sys);
title('Transient Response Analysis');
```

Output:



70. Delta-Wye Transformation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Delta-Wye Transformation
Zab = 50; % Impedance between points A and B
Zbc = 50; % Impedance between points B and C
Zca = 50; % Impedance between points C and A
Z1 = Zab * Zbc / (Zab + Zbc + Zca);
Z2 = Zbc * Zca / (Zab + Zbc + Zca);
Z3 = Zca * Zab / (Zab + Zbc + Zca);
disp(['Z1: ', num2str(Z1), ' Ohms']);
disp(['Z2: ', num2str(Z2), ' Ohms']);
disp(['Z3: ', num2str(Z3), ' Ohms']);
```

Output:

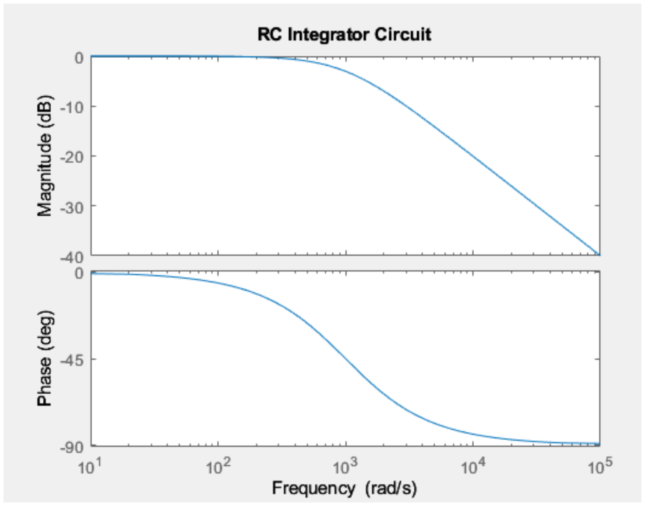
```
Z1: 16.6667 Ohms
Z2: 16.6667 Ohms
Z3: 16.6667 Ohms
```

71. RC Integrator Circuit

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% RC Integrator Circuit
R = 1e3; % Resistance in ohms
```

```
C = 1e-6; % Capacitance in farads
sys = tf([1], [R*C 1]);
bode(sys);
title('RC Integrator Circuit');
```

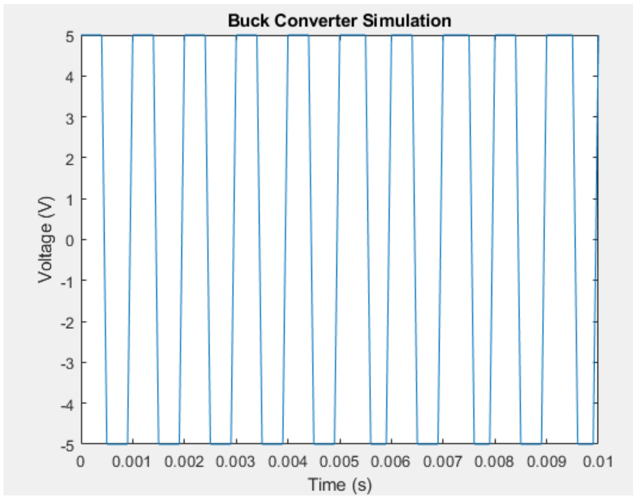
Output:



72. Buck Converter Simulation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Buck Converter Simulation
Vin = 12; % Input voltage in volts
Vout = 5; % Desired output voltage in volts
D = Vout / Vin; % Duty cycle
t = 0:0.0001:0.01; % Time vector
V = Vin * D * square(2*pi*1e3*t); % Output voltage waveform
plot(t, V);
title('Buck Converter Simulation');
xlabel('Time (s)');
ylabel('Voltage (V)');
```

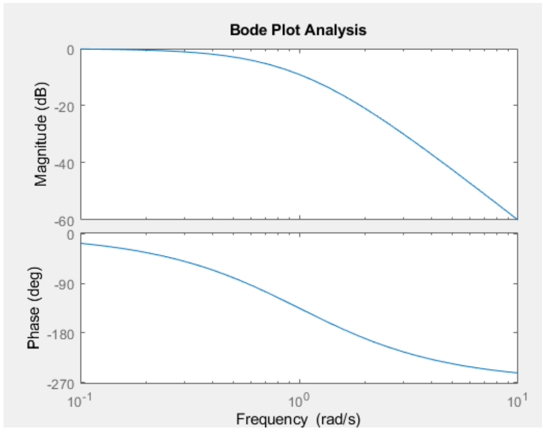
Output:



73. Bode Plot Analysis

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Bode Plot Analysis
sys = tf([1], [1 3 3 1]);
bode(sys);
title('Bode Plot Analysis');
```

Output:



74. Root Mean Square (RMS) Calculation:

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Root Mean Square (RMS) Calculation
t = linspace(0, 2*pi, 1000);
x = sin(t);
RMS = sqrt(mean(x.^2));
disp(['RMS Value: ', num2str(RMS)]);
```

Output:

```
RMS Value: 0.70675
```

75. AC Voltage Regulation

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% AC Voltage Regulation
V_no_load = 230; % No-load voltage in volts
V_full_load = 220; % Full-load voltage in volts
regulation = ((V_no_load - V_full_load) / V_full_load) * 100;
disp(['Voltage Regulation: ', num2str(regulation), '%']);
```

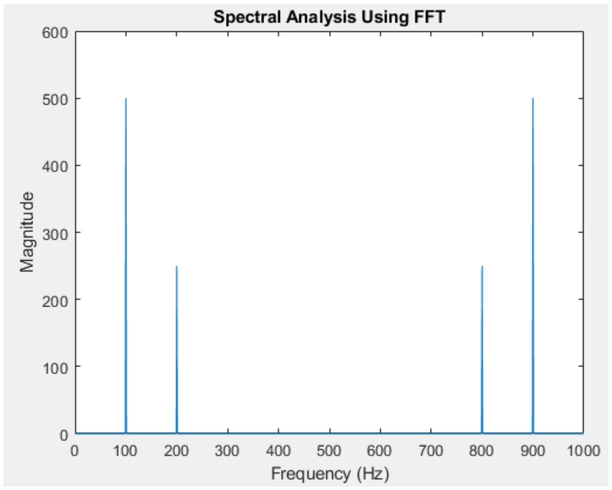
Output:

```
Voltage Regulation: 4.5455%
```

76. Spectral Analysis Using FFT

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Spectral Analysis Using FFT
Fs = 1000; % Sampling frequency
t = 0:1/Fs:1-1/Fs;
x = cos(2*pi*100*t) + 0.5*cos(2*pi*200*t); % Signal with two frequencies
X = fft(x);
f = (0:length(X)-1)*Fs/length(X); % Frequency vector
plot(f, abs(X));
title('Spectral Analysis Using FFT');
xlabel('Frequency (Hz)');
ylabel('Magnitude');
```

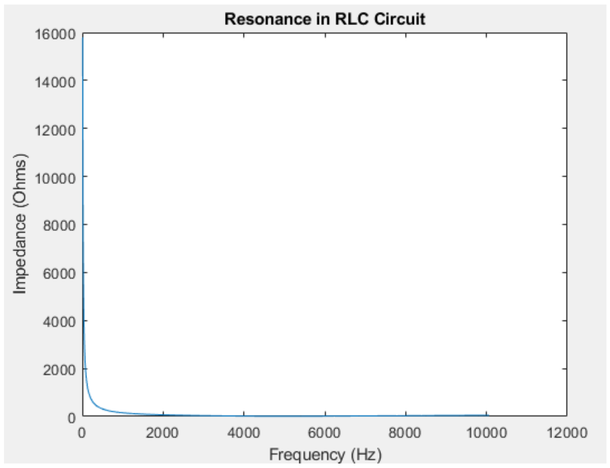
Output:



77. Resonance in RLC Circuit

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Resonance in RLC Circuit
R = 10; % Resistance in ohms
L = 1e-3; % Inductance in henrys
C = 1e-6; % Capacitance in farads
f_resonance = 1 / (2*pi*sqrt(L*C)); % Resonant frequency
disp(['Resonant Frequency: ', num2str(f_resonance), ' Hz']);
f = linspace(0, 2*f_resonance, 1000);
Z = sqrt(R^2 + (2*pi*f*L - 1./(2*pi*f*C)).^2); % Impedance
plot(f, Z);
title('Resonance in RLC Circuit');
xlabel('Frequency (Hz)');
ylabel('Impedance (Ohms)');
```

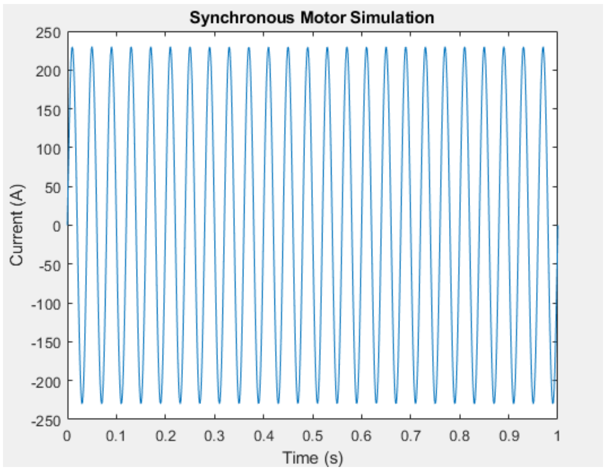
Output:



78. Synchronous Motor Simulation

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Synchronous Motor Simulation
V = 230; % Supply voltage in volts
f = 50; % Supply frequency in Hz
P = 4; % Number of poles
N_sync = 120*f/P; % Synchronous speed in RPM
t = linspace(0, 1, 1000);
theta = 2*pi*N_sync/60 * t; % Rotor angle in radians
I = V * sin(theta); % Induced current
plot(t, I);
title('Synchronous Motor Simulation');
xlabel('Time (s)');
ylabel('Current (A)');
```

Output:



79. Power System Load Flow Analysis

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Power System Load Flow Analysis using Newton-Raphson Method
% Define system parameters
Ybus = [
 10-20j -5+10j -5+10j;
 -5+10j 8-16j -3+6j;
 -5+10j -3+6j 8-16j
]; % Y-bus matrix
P = [-1.2; 1.0; 0.5]; % Active power demand (per unit)
Q = [-0.5; 0.3; 0.2]; % Reactive power demand (per unit)
V = [1; 1; 1]; % Initial guess for voltage magnitudes
theta = [0; 0; 0]; % Initial guess for voltage angles
% Newton-Raphson iteration
max_iter = 10;
tol = 1e-6;
for iter = 1:max_iter
 % Calculate power mismatches
 P_calc = real(V .* (Ybus * (V .* exp(1j*theta))));
 Q_calc = imag(V .* (Ybus * (V .* exp(1j*theta))));
 dP = P - P_calc;
 dQ = Q - Q_calc;
 mismatch = [dP; dQ];

 % Check for convergence
 if norm(mismatch) < tol
 break;
 end

 % Jacobian matrix calculation
 J11 = diag(V) * real(Ybus * diag(V .* exp(1j*theta)));
 J12 = diag(V) * imag(Ybus * diag(V .* exp(1j*theta)));
 J21 = diag(V) * imag(Ybus * diag(V .* exp(1j*theta)));
 J22 = -diag(V) * real(Ybus * diag(V .* exp(1j*theta)));
 J = [J11 J12; J21 J22];
 % Update voltage magnitudes and angles
 correction = inv(J) * mismatch;
 dtheta = correction(1:length(P));
 dV = correction(length(P)+1:end);
 theta = theta + dtheta;
 V = V + dV;
end
disp('Voltage magnitudes (pu):');
disp(V);
disp('Voltage angles (degrees):');
disp(rad2deg(theta));
```

Output:

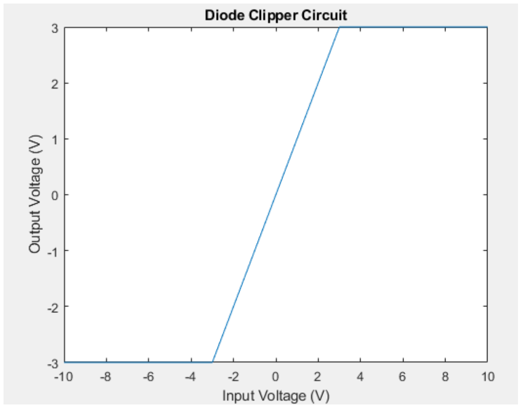
```
Voltage magnitudes (pu):
   1.0e+14 *

   -1.3511
   -1.3511
   -1.3511

Voltage angles (degrees):
   1.0e+15 *

   -3.8706
   -3.8706
   -3.8706
```

80. Diode Clipper Circuit

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Diode Clipper Circuit
V_in = linspace(-10, 10, 1000); % Input voltage range
V_clip = 3; % Clipping voltage
V_out = zeros(size(V_in));
for i = 1:length(V_in)
 if V_in(i) > V_clip
 V_out(i) = V_clip;
 elseif V_in(i) < -V_clip
 V_out(i) = -V_clip;
 else
 V_out(i) = V_in(i);
 end
end
plot(V_in, V_out);
title('Diode Clipper Circuit');
xlabel('Input Voltage (V)');
ylabel('Output Voltage (V)');
```

```
```

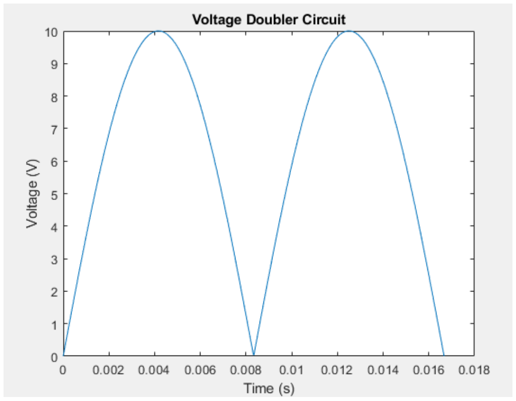
Output:



81. Voltage Doubler Circuit

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Voltage Doubler Circuit
V_in = 5; % Input AC voltage peak
f = 60; % Frequency in Hz
t = linspace(0, 1/f, 1000); % Time vector
V_out = 2 * V_in * abs(sin(2*pi*f*t)); % Output voltage waveform
plot(t, V_out);
title('Voltage Doubler Circuit');
xlabel('Time (s)');
ylabel('Voltage (V)');
```

Output:



82. Three-Phase Power Calculation

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Three-Phase Power Calculation
```

```
V_phase = 230; % Phase voltage in volts
I_phase = 10; % Phase current in amperes
pf = 0.8; % Power factor
P = 3 * V_phase * I_phase * pf; % Total real power
Q = 3 * V_phase * I_phase * sqrt(1 - pf^2); % Total reactive power
disp(['Total Real Power: ', num2str(P), ' W']);
disp(['Total Reactive Power: ', num2str(Q), ' VAR']);
```

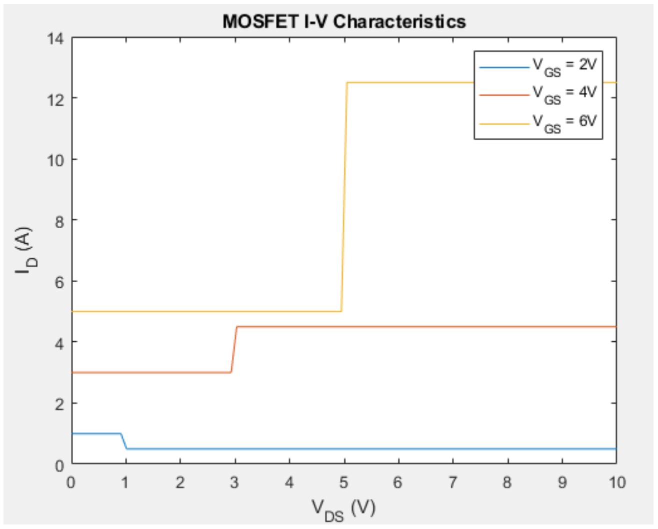
Output:

```
Total Real Power: 5520 W
Total Reactive Power: 4140 VAR
```

83. MOSFET Characteristics Plot

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% MOSFET Characteristics Plot
Vds = linspace(0, 10, 100); % Drain-source voltage range
Vgs = [2, 4, 6]; % Gate-source voltages
for Vg = Vgs
 Id = (Vg > 1) .* ((Vg - 1) .* (Vds < Vg - 1) + (Vg - 1)^2/2 .* (Vds >= Vg - 1));
 plot(Vds, Id);
 hold on;
end
hold off;
title('MOSFET I-V Characteristics');
xlabel('V_{DS} (V)');
ylabel('I_{D} (A)');
legend('V_{GS} = 2V', 'V_{GS} = 4V', 'V_{GS} = 6V');
```

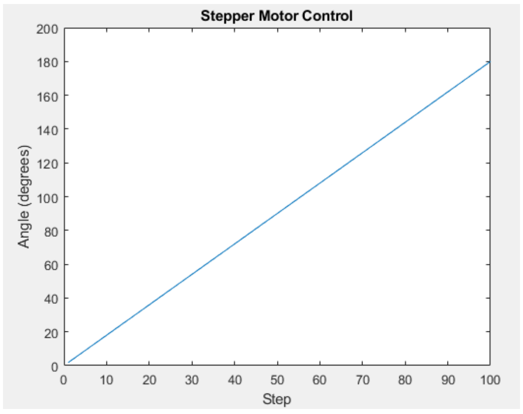
Output:



84. Stepper Motor Control

```matlab
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Stepper Motor Control
steps = 100; % Number of steps
step_angle = 1.8; % Step angle in degrees
angle = 0; % Initial angle
angles = zeros(1, steps);
for i = 1:steps
 angle = angle + step_angle;
 angles(i) = angle;
end
plot(1:steps, angles);
title('Stepper Motor Control');
xlabel('Step');
ylabel('Angle (degrees)');
```

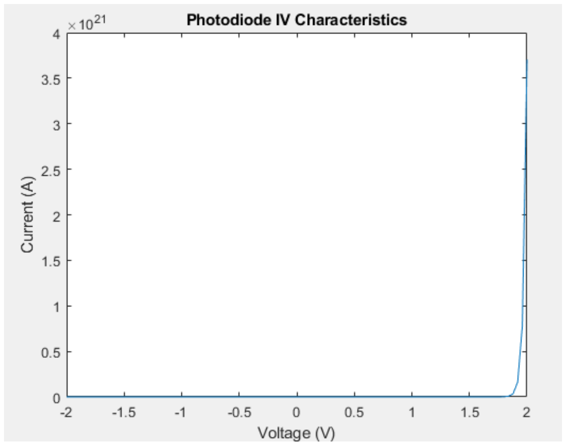
Output:



85. Photodiode IV Characteristics

```matlab
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Photodiode IV Characteristics
V = linspace(-2, 2, 100); % Voltage range
I_dark = 1e-9; % Dark current in amperes
n = 1; % Ideality factor
Is = 1e-12; % Saturation current in amperes
k = 1.38e-23; % Boltzmann constant
T = 300; % Temperature in Kelvin
q = 1.6e-19; % Electron charge
I = Is * (exp((q*V)/(n*k*T)) - 1) + I_dark; % Current
plot(V, I);
title('Photodiode IV Characteristics');
xlabel('Voltage (V)');
ylabel('Current (A)');
```

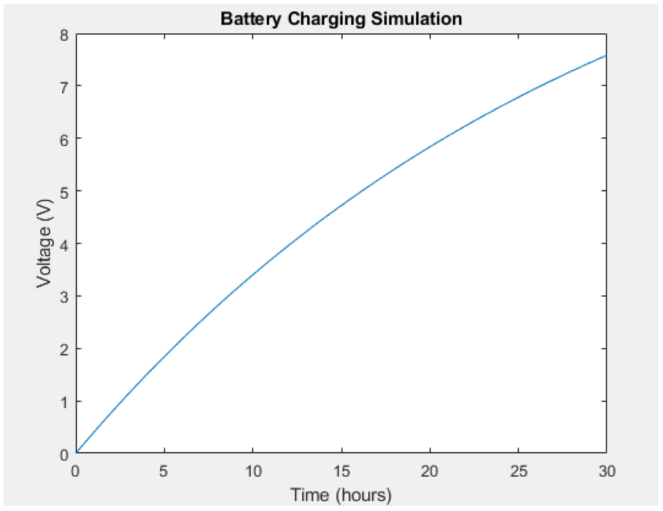
Output:



86. Battery Charging Simulation

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Battery Charging Simulation
V_batt = 12; % Battery voltage in volts
I_charge = 2; % Charging current in amperes
C = 60; % Battery capacity in Ah
t = linspace(0, C/I_charge, 1000); % Time vector
V = V_batt * (1 - exp(-t / (C/I_charge))); % Voltage during charging
plot(t, V);
title('Battery Charging Simulation');
xlabel('Time (hours)');
ylabel('Voltage (V)');
```

Output:

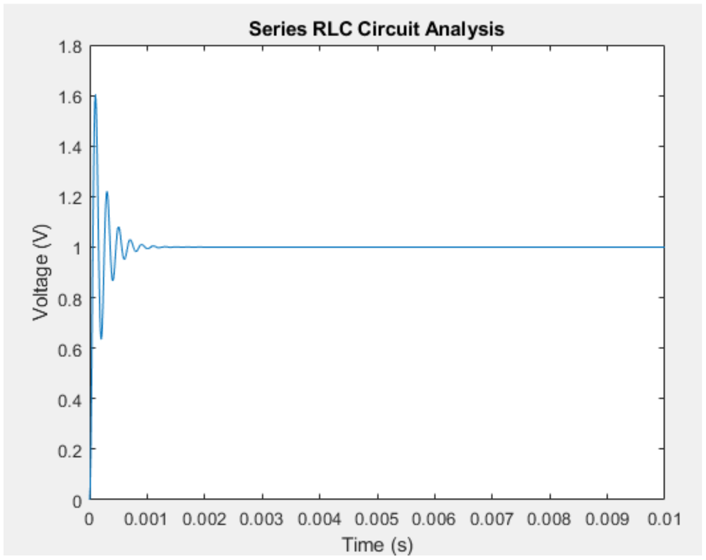


88. Series RLC Circuit Analysis

```
%Author: Md. Mahdi Kamal Alif
```

```
%ID: 22024019

% Series RLC Circuit Analysis
R = 10; % Resistance in ohms
L = 1e-3; % Inductance in henrys
C = 1e-6; % Capacitance in farads
V = 1; % Voltage step input in volts
sys = tf([1], [L*C R*C 1]);
t = linspace(0, 0.01, 1000);
step_response = step(V*sys, t);
plot(t, step_response);
title('Series RLC Circuit Analysis');
xlabel('Time (s)');
ylabel('Voltage (V)');
```

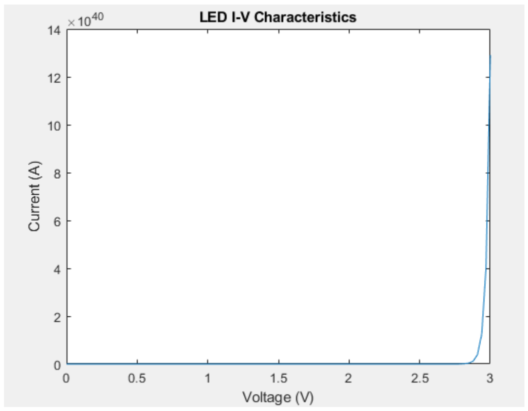
Output:



89. Light Emitting Diode (LED) Characteristics

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% LED Characteristics
V = linspace(0, 3, 100); % Voltage range
I = 1e-9 * (exp(V / 0.026) - 1); % Current
plot(V, I);
title('LED I-V Characteristics');
xlabel('Voltage (V)');
ylabel('Current (A)');
```

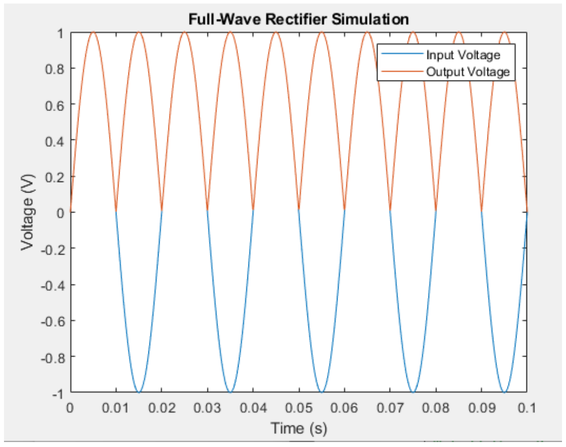
Output:



90. Full-Wave Rectifier Simulation

```
%Author: Md. Mahdi Kamal Alif
%ID: 22024019

% Full-Wave Rectifier Simulation
t = linspace(0, 0.1, 1000); % Time vector
V_in = sin(2 * pi * 50 * t); % Input AC voltage
V_out = abs(V_in); % Full-wave rectified voltage
plot(t, V_in, t, V_out);
title('Full-Wave Rectifier Simulation');
xlabel('Time (s)');
ylabel('Voltage (V)');
legend('Input Voltage', 'Output Voltage');
```

Output:


Full-Wave Rectifier Simulation
Input Voltage
Output Voltage
Voltage (V)
Time (s)