A Lab Course File

on

Applications of Soft Computing Tools in Electrical Engineering

Skill oriented course - IV

(20A02606)

Prepared by

Dr. A. Muni Sankar

Professor

Department of EEE

SREE RAMA ENGINEERING COLLEGE

Approved by AICTE, New Delhi – Affiliated to JNTUA, Ananthapuramu
Accredited by NAAC with 'A' Grade
An ISO 9001:2015 & ISO 14001:2015 certified Institution
Rami Reddy Nagar, Karakambadi road, Tirupati-517507

VISION

Sree Rama Engineering College strives to be one of the best educational institutions in the country by transforming the students into multifaceted individuals with a penchant for academic excellence in the field of Engineering & Management with moral & ethical values and moulding them as an empowered citizens to meet the global requirements.

MISSION

M1: To be a student-centric campus with innovative, creative learning by a collaborative approach with all the stakeholders for offering an industry specific course apart from the regular curriculum.

M2: To create a conducive environment for students towards research, innovation with state-of-the-art infrastructure facilities.

M3: To develop global leaders with human & ethical values by continuous mentoring and nurturing them to acquire their dreams

Department of Electrical and Electronics Engineering

VISION

To be the premier center of excellence in Electrical and Electronics Engineering and to produce globally competent engineers with values and ethics.

MISSION

M1. Provide professional skills in operating and design Electrical and electronic equipment.

M2. Bringing awareness among the students with emerging technologies to meet the dynamic needs of the society

M3. Develop collaborative research, internship, and entrepreneurial skills through Industry interaction in faculty and students

M4. Encourage multi-disciplinary activities through research and lifelong learning

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

After the completion of the Program, the graduates of B. Tech. (EEE) will be able to

PEO1. Demonstrate academic and professional excellence in the field of Electrical and Electronics Engineering.

PEO2. Pursue higher studies, research assignments and as entrepreneurs.

PEO3. Become employable with ethical values in multidisciplinary environments.

PROGRAM SPECIFIC OUTCOMES (PSO)

On successful completion of the B. Tech. (EEE) Program, the graduates will be able to

PSO1. Provide technical solutions to complex electrical engineering problems with the application of modern tools for sustainable development.

PSO2. Apply the appropriate techniques in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

PROGRAM OUTCOMES (PO)

On successful completion of the Program, the graduates of B. Tech. (EEE) Program will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (EEE)– III-II Sem	**L**	**T**	**P**	**C**
	1	**0**	**2**	**2**

(20A02606) APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING (Skill Oriented Course – IV)

Course Objectives:
The objectives of this course include:

- Understand the basic concepts of Electrical Engineering.
- Apply the concepts to design MATLAB models.
- Analyse various Electrical engineering applications through MATLAB.
- Develop real time models using MATLAB.

Course Outcomes:
At the end of the course the student will be able to:

- Understand the basic concepts of Electrical Engineering.
- Apply the concepts to design MATLAB models.
- Analyse various Electrical engineering applications through MATLAB.
- Develop real time models using MATLAB.

List of Experiments:
Theory:
MATLAB-Introduction, different tool boxes, creation of program files, creation of simulink files, GUI, commonly used blocks, Simpower system toolbox, control system toolbox, Sim Drive lines, Creation of functions, Project implementation through MATLAB

List of Experiments:

1. Transient analysis of given electrical network
2. Simulation of 1-phase and 3-phase transformers
3. Study of the dynamics of second order system
4. Implementation of buck and boost dc-dc converters
5. Study on the design of PI controllers and stability analysis for a DC-DC buck Converter
6. Sine-PWM techniques for single-phase half-bridge, full-bridge and three-phase inverters
7. Economic Load Dispatch of (i) Thermal Units and (ii) Thermal Plants using Conventional method
8. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)
9. Reactive Power Control in a transmission system (Ferranti effect, Effect of shunt Inductor)
10. Fault studies using Z_{bus} matrix
11. Design of virtual PMU
12. Wide area control of Two area Kundur system

Online Learning Resources/Virtual Labs:

1. **http://vem-iitg.vlabs.ac.in/**
2. **https://vp-dei.vlabs.ac.in/Dreamweaver/**

Department of Electrical and Electronics Engineering

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING LAB

(20A02606)

III B. TECH II SEMESTER - EEE

List of Experiments

1. Transient analysis of given electrical network
2. Simulation of 1-phase and 3-phase transformers
3. Study of the dynamics of second order system
4. Implementation of buck and boost dc-dc converters
5. Study on the design of PI controllers and stability analysis for a DC-DC buck Converter
6. Sine-PWM techniques for single-phase half-bridge, full-bridge and three-phase inverters
7. Economic Load Dispatch of (i) Thermal Units and (ii)Thermal Plants using Conventional method
8. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)
9. Reactive Power Control in a transmission system (Ferranti effect, Effect of shunt Inductor)
10. Fault studies using Z bus matrix

Additional Experiments:

11. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)
12. Wide area control of Two area Kundur system

Department of Electrical and Electronics Engineering

APPLICATIONS OF SOFT COMPUTING TOOLS IN

ELECTRICAL ENGINEERING LAB

(20A02606)

III B. TECH II SEMESTER - EEE

Course Outcomes (CO)

After completion of this course, students will be able to

CO1: Understand the process of creating, editing, and simulating circuit schematics using MATLAB

CO2: Analyse various Electrical engineering applications through MATLAB

CO3: Model and simulate various electrical and electronics circuits including buck boost DC-DC converters, PI controllers

CO4: Identify and troubleshoot errors in circuit design and simulation.

CO5: Develop real time models using MATLAB.

CO6: Understand the role of circuit simulation in the design process for electrical and electronic industries

CO7: Adhere to ethical guidelines in the selection of components, modeling, and design processes to ensure accuracy and fairness

CO8: Collaborate in teams to simulate and analyze complex circuits

CO9: Prepare professional reports documenting simulation results and insights

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Department of Electrical and Electronics Engineering

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING LAB (20A02606)

III B. TECH II SEMESTER - EEE

CO – PO – PSO Mapping

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING (Skill Oriented Course – IV)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
After completion of this course, students will be able to															
C329.1	Understand the process of creating, editing, and simulating circuit schematics using MATLAB	3				3								3	3
C329.2	Analyse various Electrical engineering applications through MATLAB	2	3			3								3	3
C329.3	Model and simulate various electrical and electronics circuits including buck boost DC-DC converters, PI controllers	2	2	3		3								3	3
C329.4	Identify and troubleshoot errors in circuit design and simulation.	2	2		3	3								3	3
C329.5	Develop real time models using MATLAB.	2	2	2		3								3	3
C329.6	Understand the role of circuit simulation in the design process for electrical and electronic industries	2	2			3	3							3	3
C329.7	Adhere to ethical guidelines in the selection of components, modeling, and design processes to ensure accuracy and fairness	2	2			3			3					3	3
C329.8	Collaborate in teams to simulate and analyze complex circuits	2	2	1	2	3				3				3	3
C329.9	Prepare professional reports documenting simulation results and insights	2									3			3	3
	Average	2.11	2.14	2	2.5	3	3		3	3	3			3	3

Department of Electrical and Electronics Engineering

Rubrics for

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING (20A02606)

(Skill Oriented Course – IV)

Course Outcome		Poor (0-1 Mark)	Average (2-3 Marks)	Good (4 Marks)
On successful completion of the course, students will be able to				
CO1	Understand the process of creating, editing, and simulating circuit schematics using MATLAB	Unable to understand the process of creating, editing, and simulating circuit schematics using MATLAB.	Able to understand process of creating, editing, and simulating circuit schematics using MATLAB up to some extent.	Able to understand the process of creating, editing, and simulating circuit schematics using MATLAB.
		Poor (0 - 1 Mark)	**Average (2 Marks)**	**Excellent (3 Marks)**
CO2	Analyse various Electrical engineering applications through MATLAB	Unable to Analyse various Electrical engineering applications through MATLAB	Able to Analyse various Electrical engineering applications through MATLAB up to some extent.	Able to Analyse various Electrical engineering applications through MATLAB.
CO3	Model and simulate various electrical and electronics circuits including buck boost DC-DC converters, PI controllers	Unable to develop a MATLAB program for various electrical and electronics circuits including buck boost DC-DC converters, PI controllers.	Able to develop a MATLAB program for various electrical and electronics circuits including buck boost DC-DC converters, PI controllers to some extent.	Able to develop a MATLAB program for various electrical and electronics circuits including buck boost DC-DC converters, PI controllers.
CO4	Identify and troubleshoot errors in circuit design and simulation.	Unable to troubleshoot errors in circuit design and simulation.	Able to troubleshoot errors in circuit design and simulation to some extent.	Able to identify and troubleshoot errors in circuit design and simulation.
CO5	Develop real time models using MATLAB.	Unable to Develop real time models using MATLAB.	Able to Develop real time models using MATLAB to some extent.	Able to Develop real time models using MATLAB.
CO6	Understand the role of circuit simulation in the design process for electrical and electronic industries	Unable to Understand the role of circuit simulation in the design process for electrical and electronic industries	Able to Understand the role of circuit simulation in the design process for electrical and electronic industries to some extent	Able to Understand the role of circuit simulation in the design process for electrical and electronic industries
CO7	Adhere to ethical guidelines in the selection of components, modeling, and design processes to ensure accuracy and fairness	Unable to follow ethical guidelines and standards.	Able to follow ethical guidelines and standards to some extent.	Able to follow ethical guidelines and standards.

CO8	Collaborate in teams to simulate and analyze complex circuits	Unable to Collaborate in teams to simulate and analyze complex circuits	Occasionally work individually or in a group	Able to work and execute the problem individually as well as in a group.
		Poor (1-2 Marks)	**Average (3-4 Marks)**	**Excellent (5 Marks)**
CO9	Prepare professional reports documenting simulation results and insights	Unable to Prepare professional reports documenting simulation results and insights.	Able to Prepare professional reports documenting simulation results and insights up to some extent.	Able to Prepare professional reports documenting simulation results and insights.

Faculty In-charge **HOD, EEE**

Department of Electrical and Electronics Engineering

Year and Semester	**III B. Tech II Semester**	Roll No :	
Name of the Laboratory	**APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING LAB**	Course Code	**20A02606**

DAY-TO-DAY EVALUATION: 30 Marks

S.No	Experiment Name	Page No.	CO1 Knowledge 3 M	CO2 Analysis 3 M	CO3 Design 3 M	CO4 Data Interpretation From Experiment 4 M	CO5 Engineer & Society 3 M	CO6 Ethics 3 M	CO7 Team Work 3 M	CO8 Record 5 M	TOTAL 30 M	Signature of the Faculty
1	Transient analysis of given electrical network											
2	Simulation of 1-phase and 3-phase transformers											
3	Study of the dynamics of second order system											
4	Implementation of buck and boost dc-dc converters											
5	Study on the design of PI controllers and stability analysis for a DC-DC buck Converter											
6	Sine-PWM techniques for single-phase half-bridge, full-bridge and three-phase inverters											
7	Economic Load Dispatch of (i) Thermal Units and (ii)Thermal Plants using Conventional method											
8	Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)											
9	Reactive Power Control in a transmission system (Ferranti effect, Effect of shunt Inductor)											
10	Fault studies using Z bus matrix											
11	Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)											
12	Wide area control of Two area Kundur system											

Faculty in-charge

Department of Electrical and Electronics Engineering

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING LAB (20A02606)

III B. TECH II SEMESTER - EEE

Lesson Plan

Sl. No.	Experiment Number	Name of the Experiment	No. of Slots required
CYCLE – I			
1		Introduction to the Lab	1
2	EXP –1	Transient analysis of given electrical network	1
3	EXP –2	Simulation of 1-phase and 3-phase transformers	1
4	EXP –3	Study of the dynamics of second order system	1
5	EXP –4	Implementation of buck and boost dc-dc converters	1
6	EXP –5	Study on the design of PI controllers and stability analysis for a DC-DC buck Converter	1
7	EXP –6	Sine-PWM techniques for single-phase half-bridge, full-bridge and three-phase inverters	1
CYCLE – II			
8	EXP – 7	Economic Load Dispatch of (i) Thermal Units and (ii)Thermal Plants using Conventional method	1
9	EXP – 8	Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)	1
10	EXP – 9	Reactive Power Control in a transmission system (Ferranti effect, Effect of shunt Inductor)	1
11	EXP – 10	Fault studies using Z bus matrix	1
12	EXP – 11	Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)	1
13	EXP – 12	Wide area control of Two area Kundur system	1
14		Repetition of Experiments	1
15		Lab Internal Exam	1

Signature of the Faculty In-Charge **Signature of the HOD**

Department of Electrical and Electronics Engineering

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING LAB (20A02606)

III B. TECH II SEMESTER - EEE

Lesson Diary

Sl. No.	Experiment Number	Date of conducting the experiment					
		BATCH-1	BATCH-2	BATCH-3	BATCH-4	BATCH-5	BATCH-6
CYCLE – I							
1		INTRODUCTION TO THE LABORATORY					
2	EXP - 1						
3	EXP – 2						
4	EXP –3						
5	EXP –4						
6	EXP –5						
7	EXP –6						
CYCLE – II							
8	EXP - 7						
9	EXP - 8						
10	EXP – 9						
11	EXP – 10						
12	EXP – 11						
13	EXP – 12						
14		Repetition of Experiments					
15		LAB INTERNAL EXAM					

Signature of the Faculty In-Charge **Signature of the HOD**

Department of Electrical and Electronics Engineering

APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING LAB

(20A02606)

III B. TECH II SEMESTER - EEE

List of Experiments

1. Transient analysis of given electrical network
2. Simulation of 1-phase and 3-phase transformers
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10. Fault studies using Z bus matrix

Additional Experiments:

11. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)
12. Wide area control of Two area Kundur system

1. Transient Analysis of Given Electrical Network

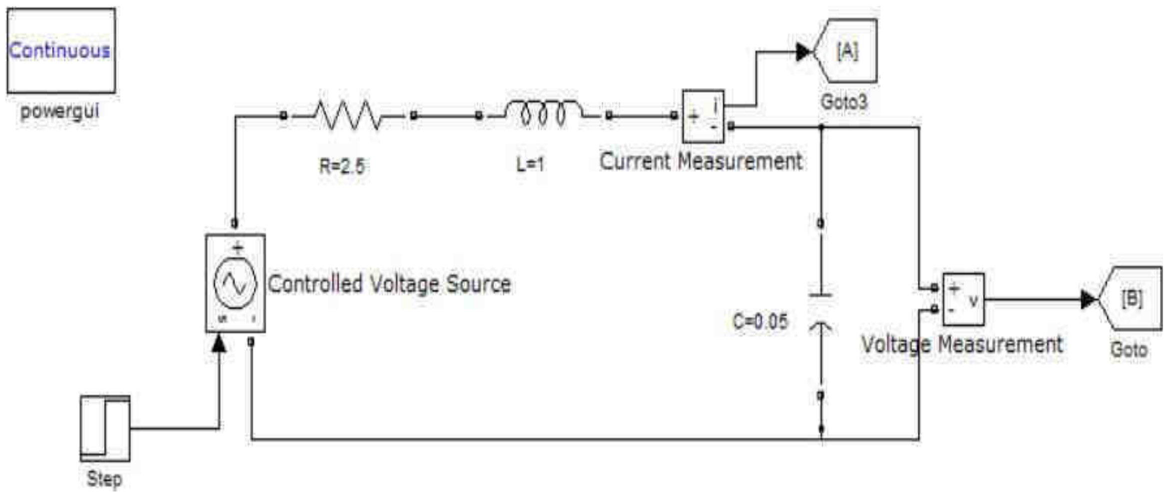
AIM:

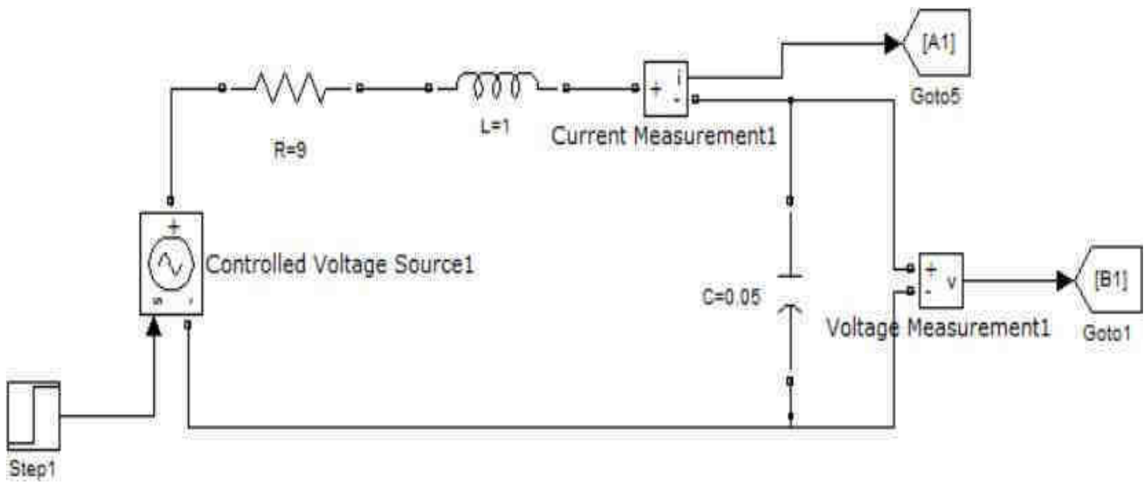
To study the transient analysis of RLC circuit for step input.

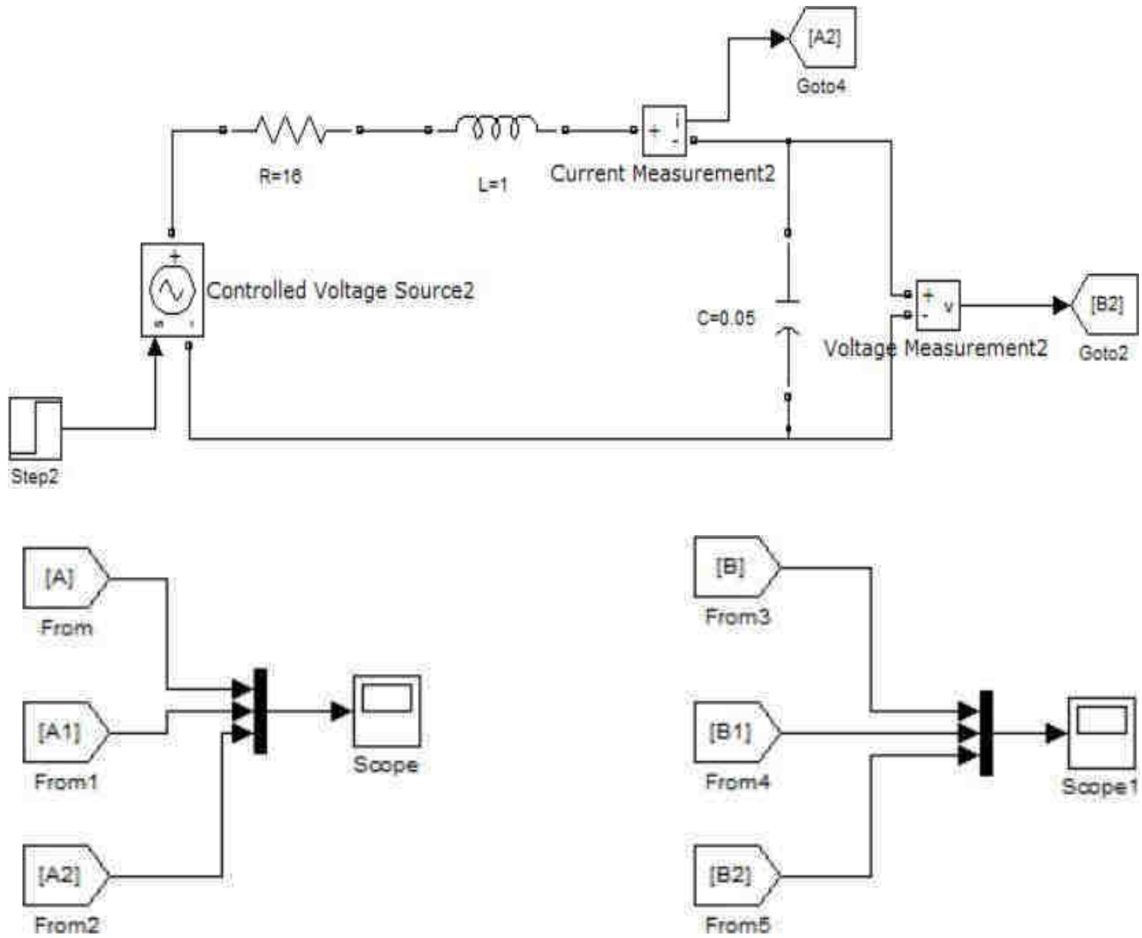
REQUIREDAPPARATUS&SOFTWAREUSED:

- Personal computer
- MATLAB software

CIRCUIT DIAGRAM:







PROCEDURE:

1) Open the MATLAB software and click on “Simulink library” on the top of the menu bar.

2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.

3) Initiate the all values as shown in diagram.

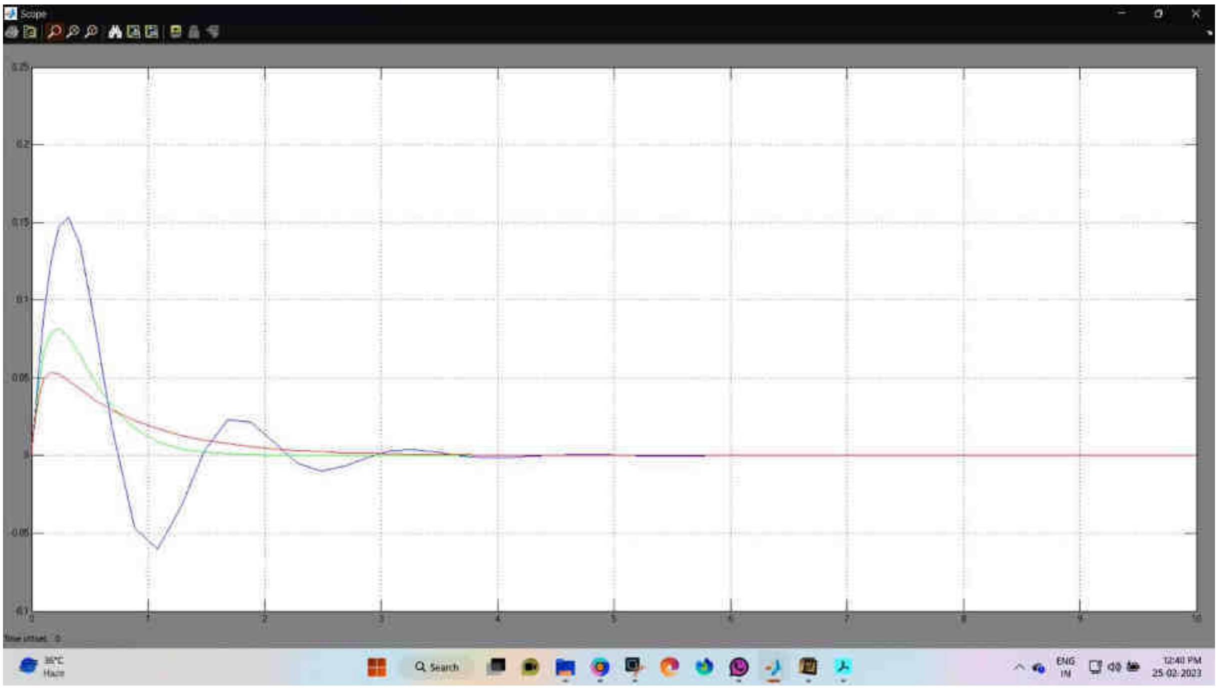
4) After arranging the blocks as per the circuit diagram, now click on “RUN” button provided on the top side of the tool bar.

5) Now, double click on “scope” and observe the waveforms carefully on scope.

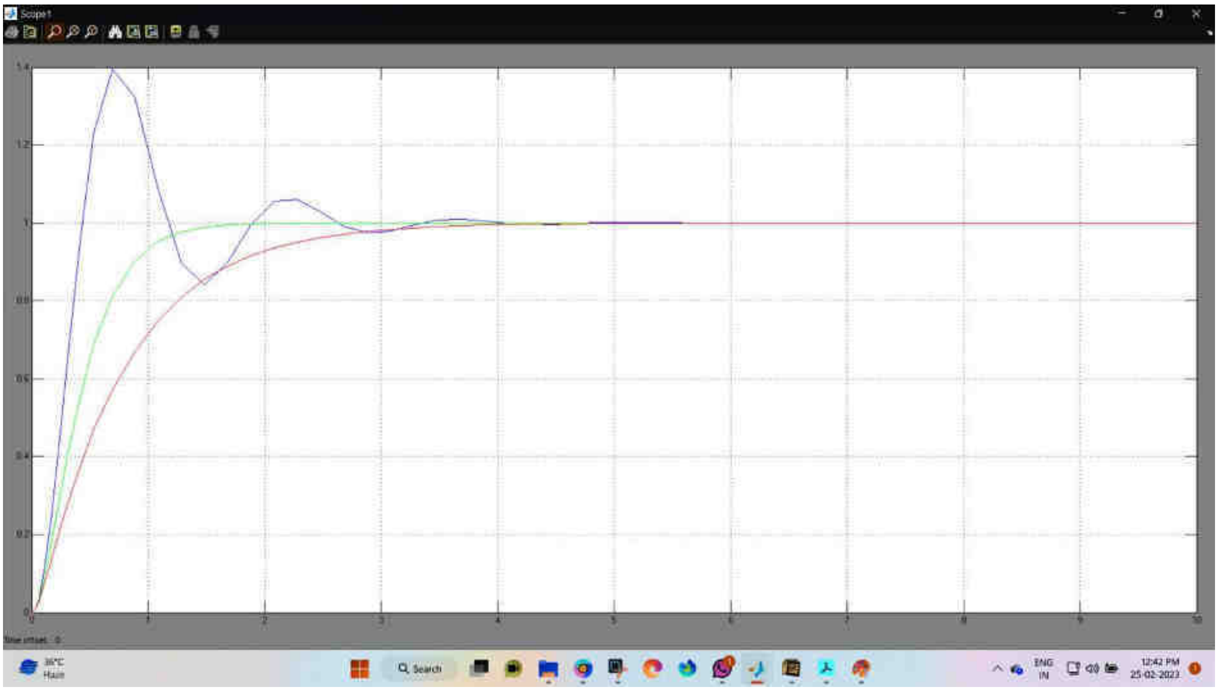
PRECAUTIONS:

Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

Output:



Current waveform



Voltage waveform

RESULT:

The transient analysis of RLC circuit for step input is designed and obtained by using MATLAB.

2. Simulationof1-Phaseand3-PhaseTransformers

AIM:

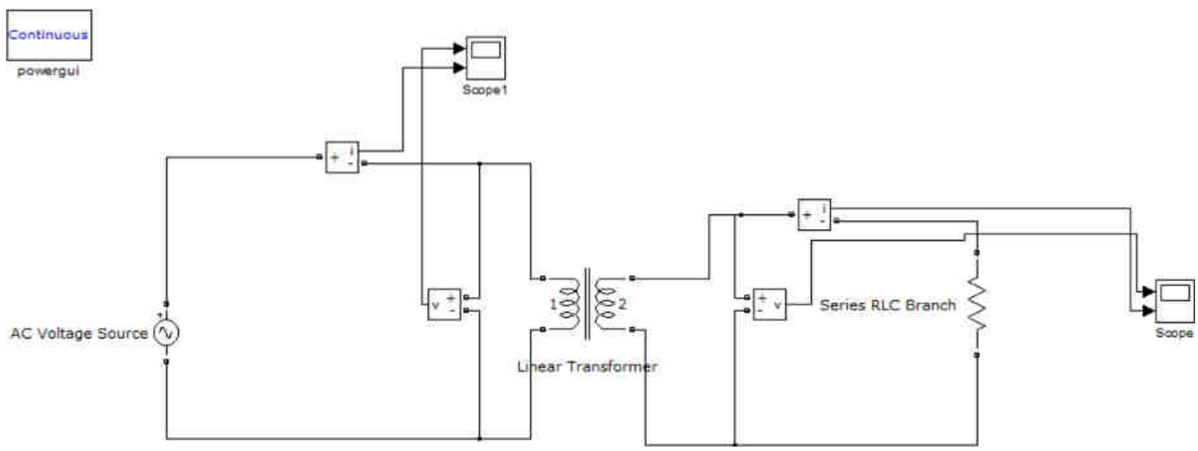
To design a1-phase and 3-phase transformers and to check their voltage magnitudes While acting as step-up and step-down using MATLAB.

REQUIREDAPPARATUS&SOFTWAREUSED:

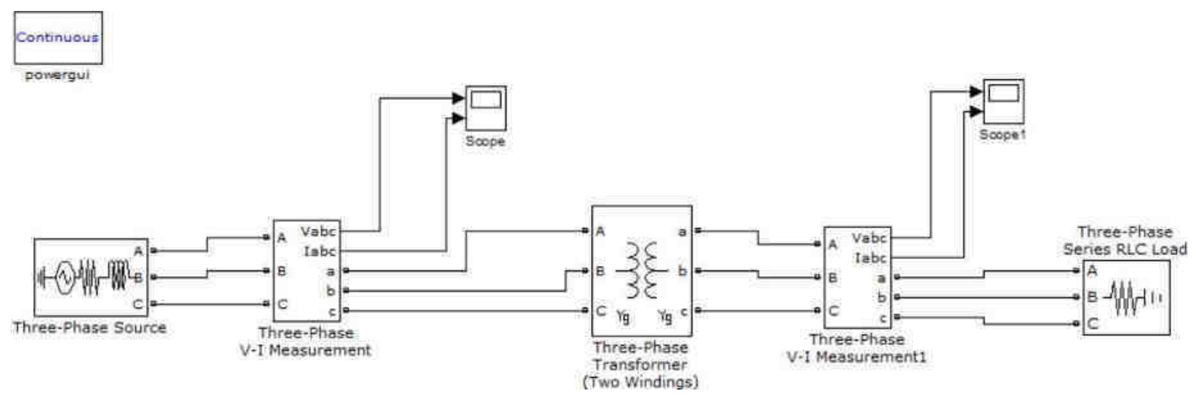
- Personal computer
- MATLAB software

CIRCUIT DIAGRAM:

1-Phase Transformer:-



3-Phase Transformer:-



PROCEDURE:

1-Phase Transformer:-

1) Open the MATLAB software and click on “Simulink library” on the top of the menu bar.

2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.

3) Initiate the all values as shown in diagram.

4) After arranging the blocks as per the circuit diagram & check down the step-up and step-down conditions, now click on "RUN" button provided on the top side of the tool bar.

5) Now, double click on "scope" and observe the waveforms carefully on scope.

3-Phase Transformer:-

1) Open the MATLAB software and click on "Simulink library" on the top of the menu bar.

2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.

3) Initiate the all values as shown in diagram.

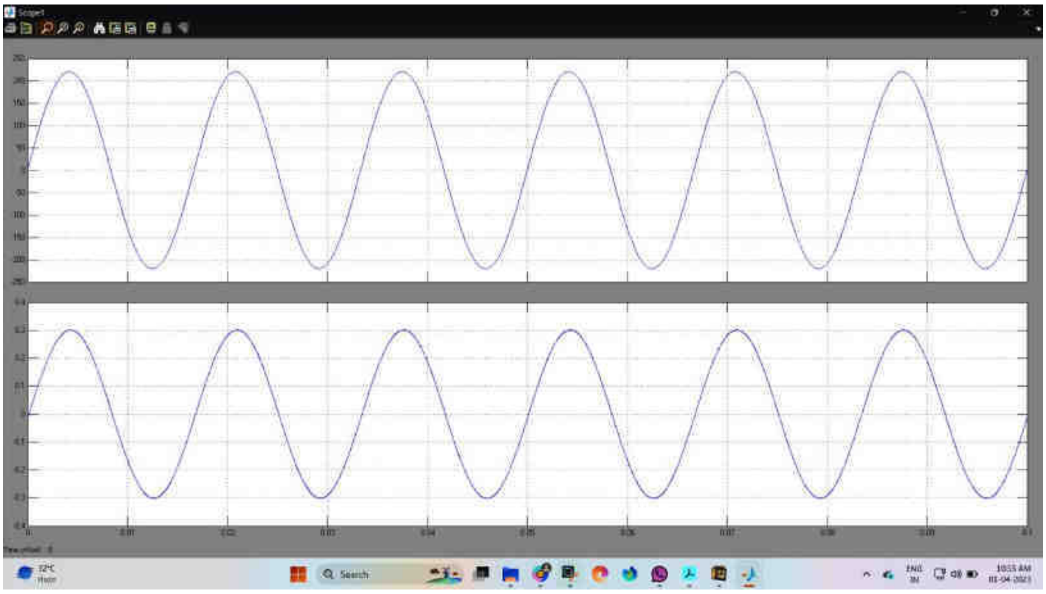
4) After arranging the blocks as per the circuit diagram & check down the step-up and step-down conditions, now click on "RUN" button provided on the top side of the tool bar.

5) Now, double click on "scope" and observe the waveforms carefully on scope.

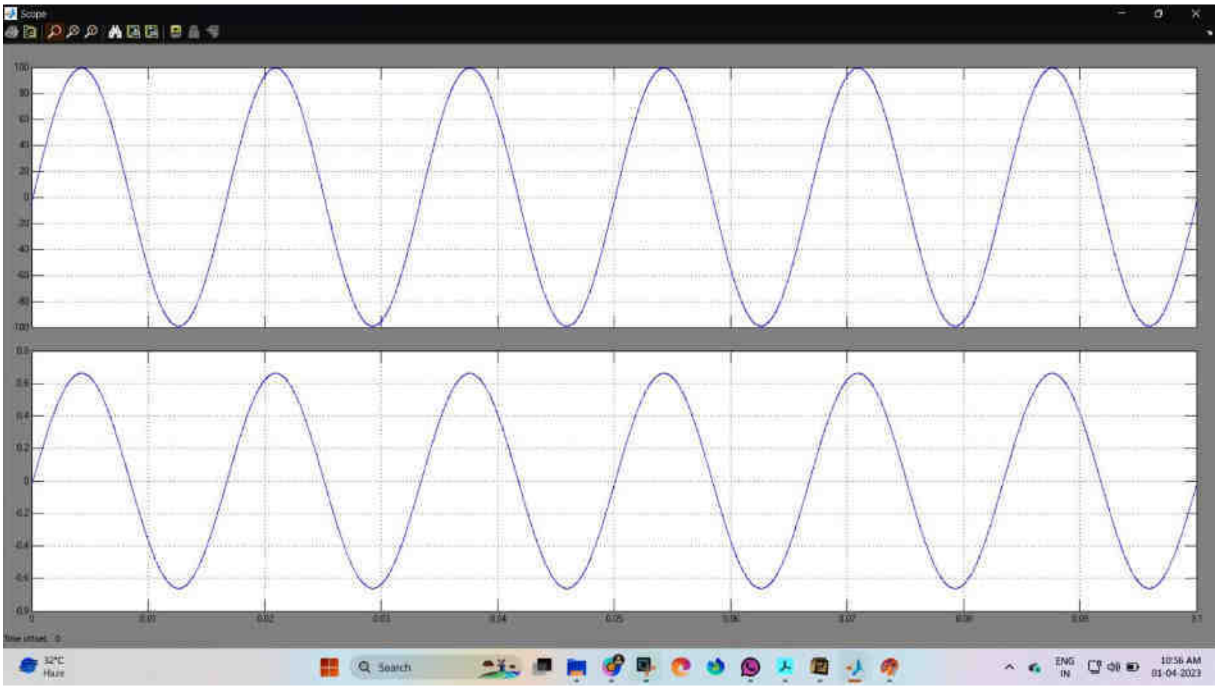
PRECAUTIONS:

Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

Output:*1-PhaseTransformer:-Step-down:-*

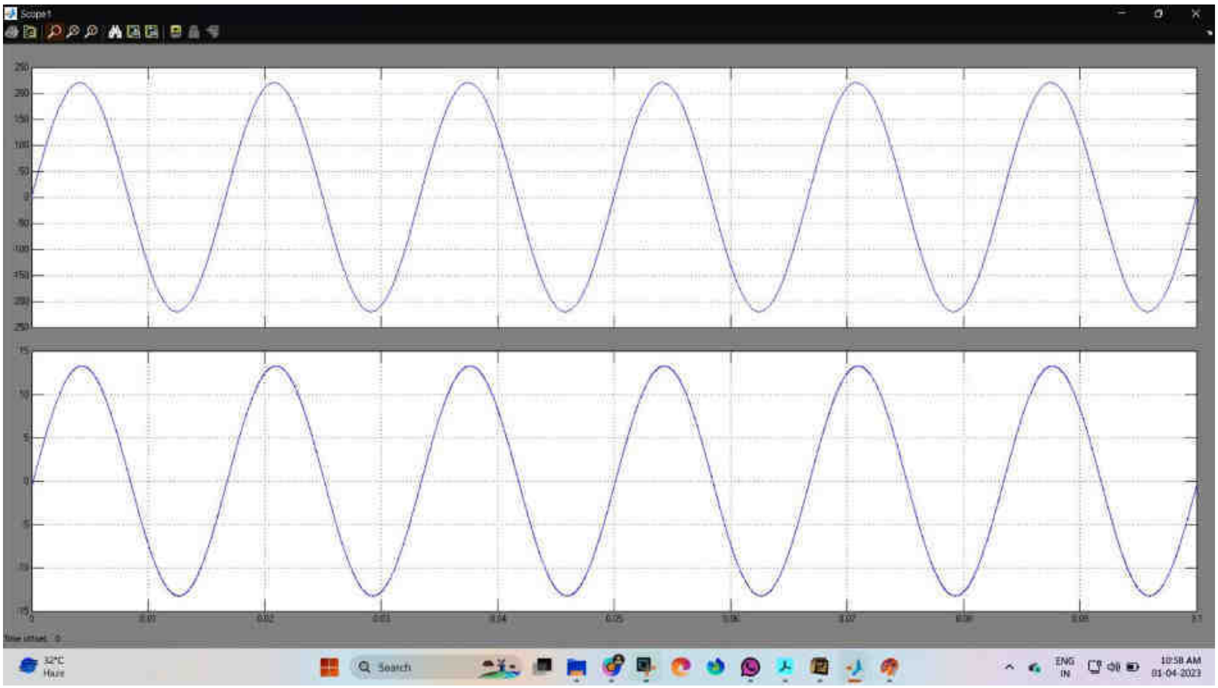


Input waveforms

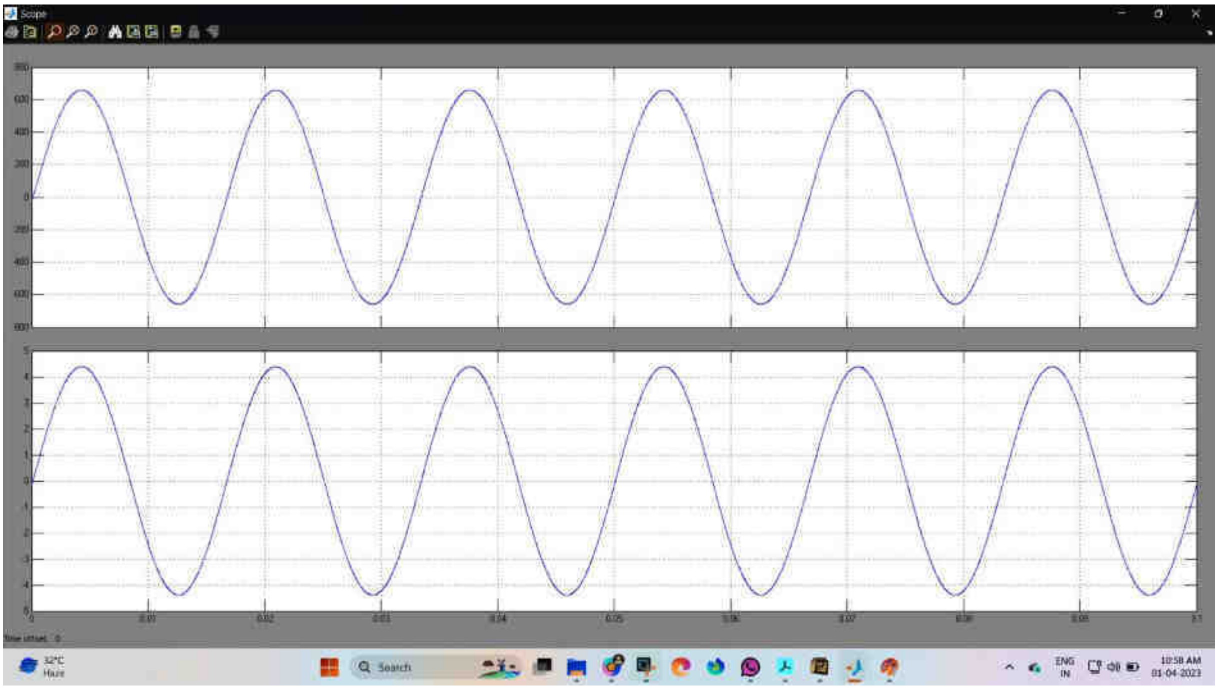


Output waveforms

Step-up:-

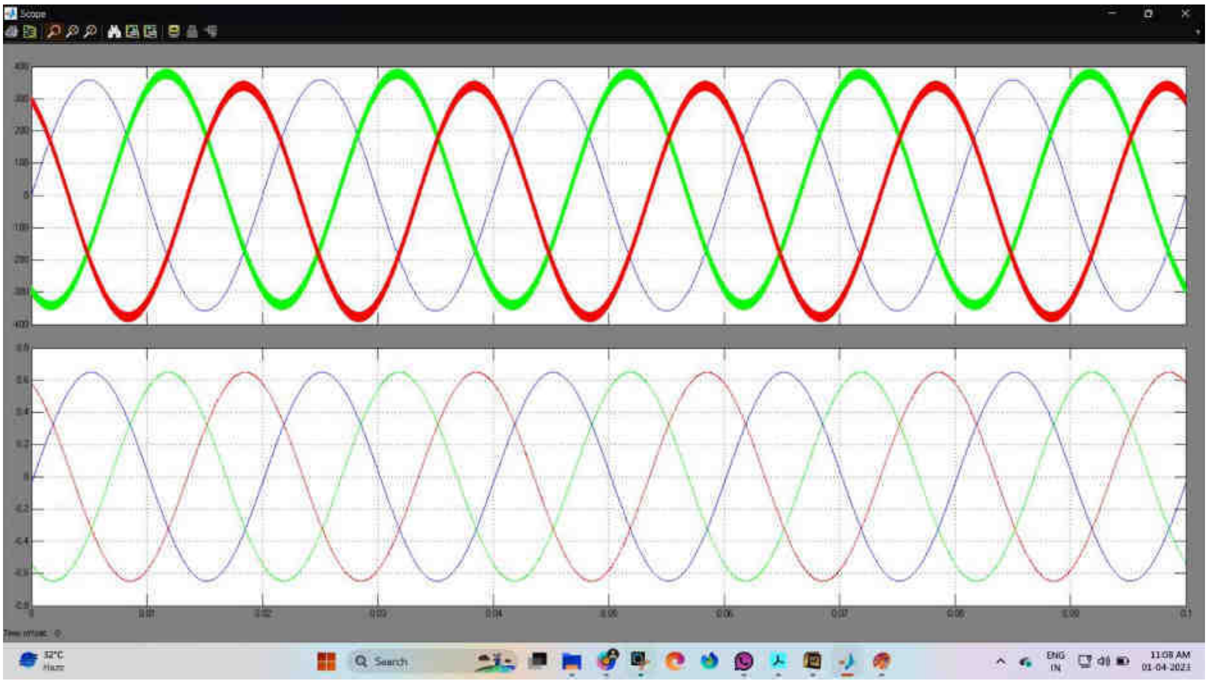


Input waveforms

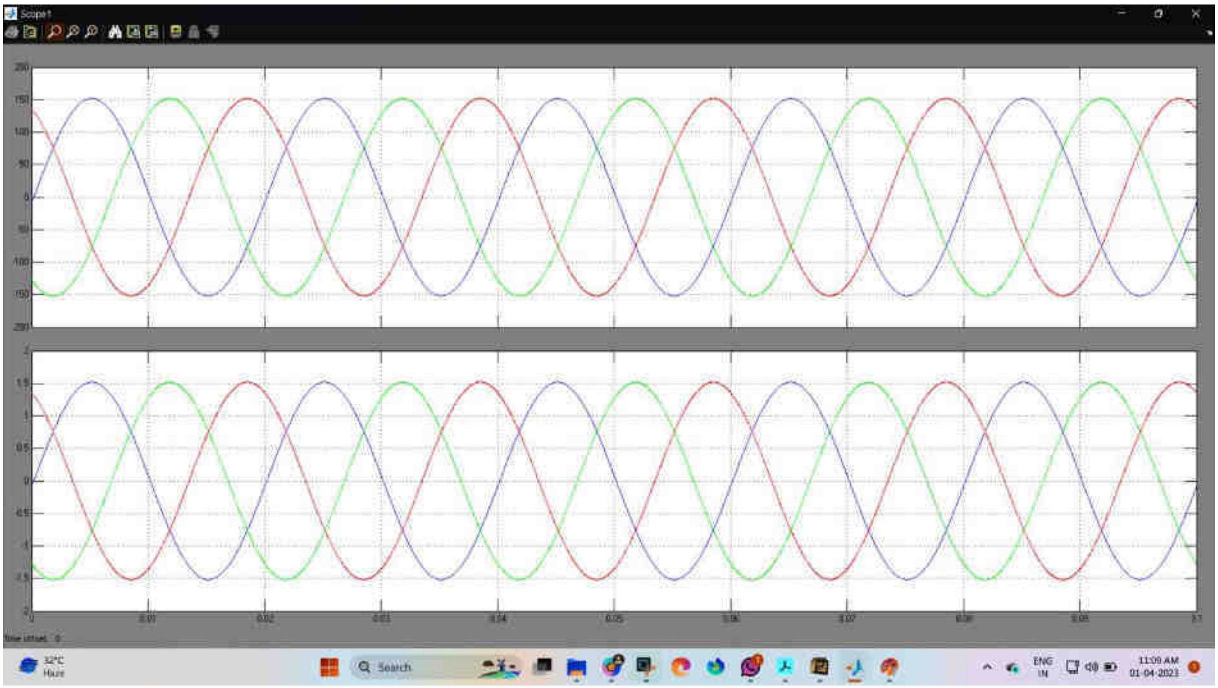


Output waveforms

3-PhaseTransformer:-Step-down:-

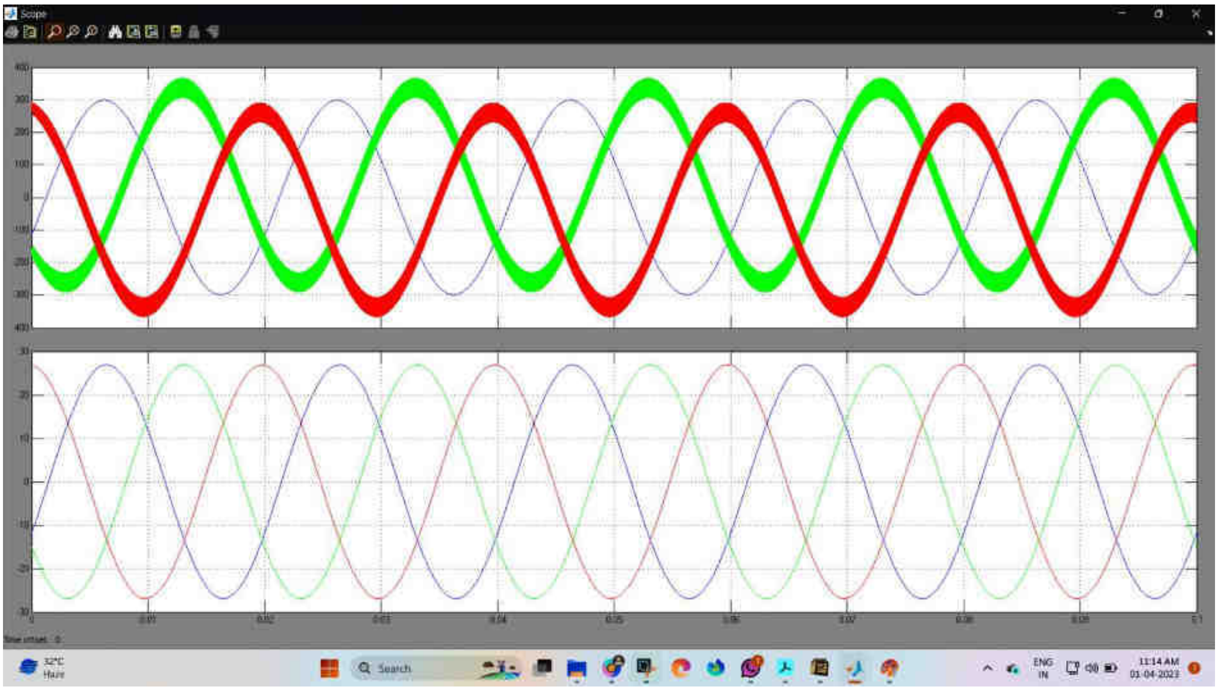


Input waveforms

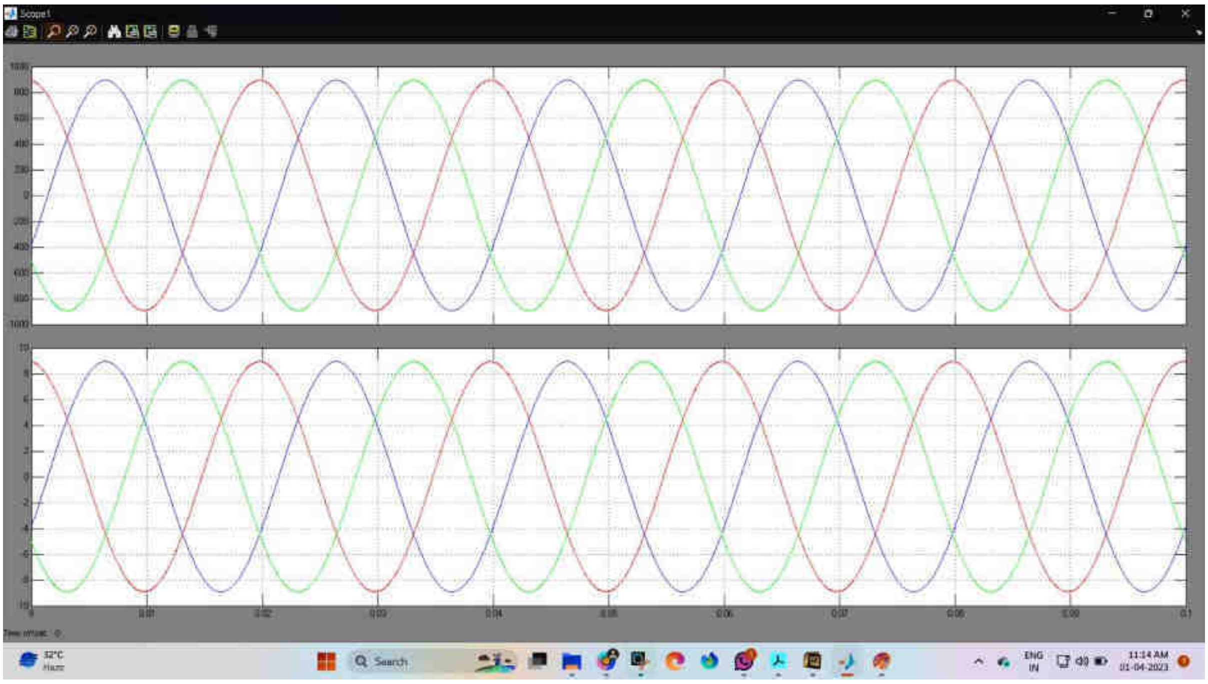


Output waveforms

Step-up:-



Input waveforms



Output waveforms

RESULT:

The1-phaseand3-phasetransformershavebeendesignedandverifiedforstep-up and step down transformers.

3. Study of the Dynamics of Second Order System

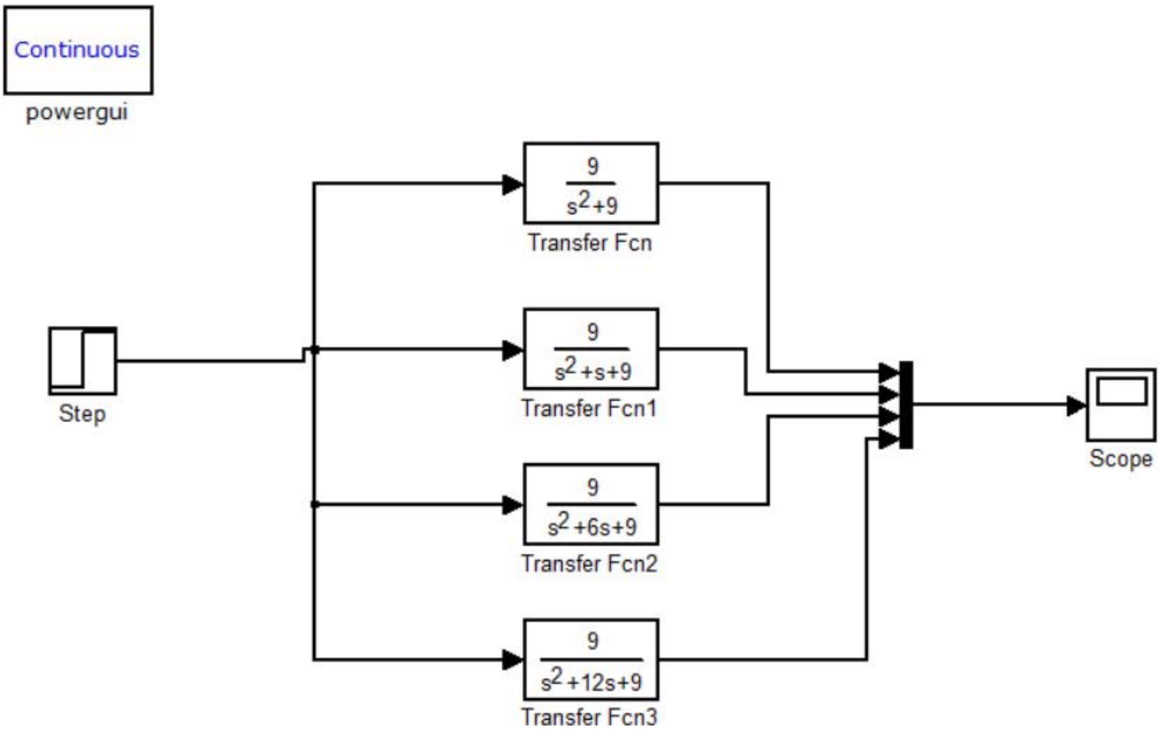
AIM:

To study and design the dynamics of un-damped, over-damped, critically damped and under-damped of a second order system using MATLAB.

REQUIREDAPPARATUS&SOFTWAREUSED:

- Personal computer
- MATLAB software

CIRCUIT DIAGRAM:



PROCEDURE:

1) Open the MATLAB software and click on "Simulink library" on the top of the menu bar.

2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.

3) Initiate the all values as shown in diagram.

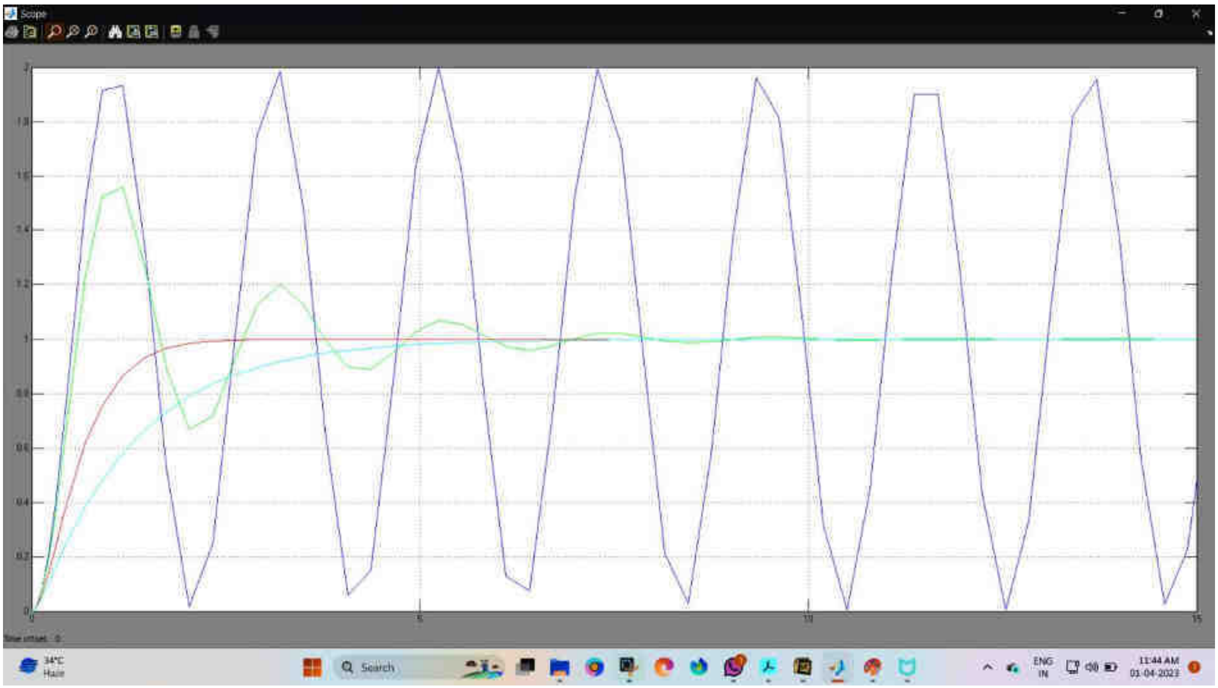
4) After arranging the blocks as per the circuit diagram & check down the step-up and step-down conditions, now click on "RUN" button provided on the top side of the tool bar.

5) Now, double click on "scope" and observe the waveforms carefully on scope.

PRECAUTIONS:

Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

Output:



RESULT:

The dynamics of various classifications of second order systems has been studied and designed.

4. Implementation of Buck and Boost DC-DC Converters

AIM:

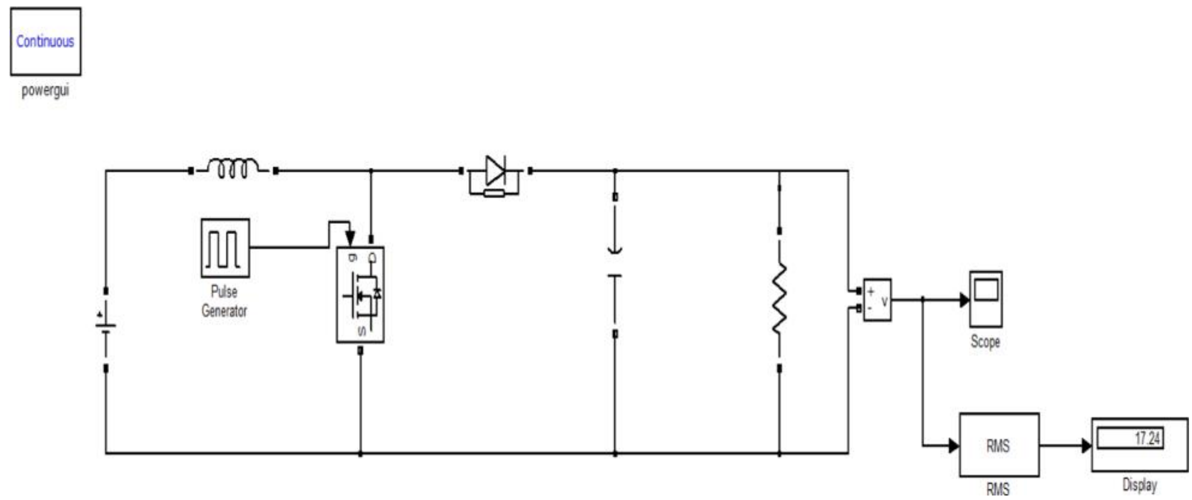
To design and verify the output voltage of buck and boost DC-DC converters.

REQUIREDAPPARATUS&SOFTWAREUSED:

- Personal computer
- MATLAB software

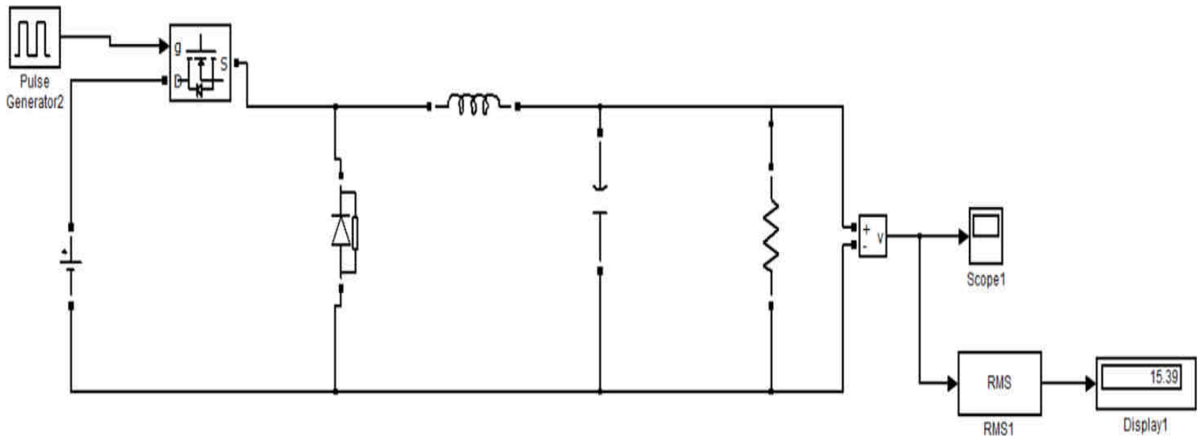
CIRCUIT DIAGRAM:

BOOSTCONVERTER:-



Vin=12v,L=60µH,C=16.44µF, R=16.2Ω

BUCKCONVERTER:-



Vin=48v,L=85µH,C=125µF,R=9Ω

PROCEDURE:

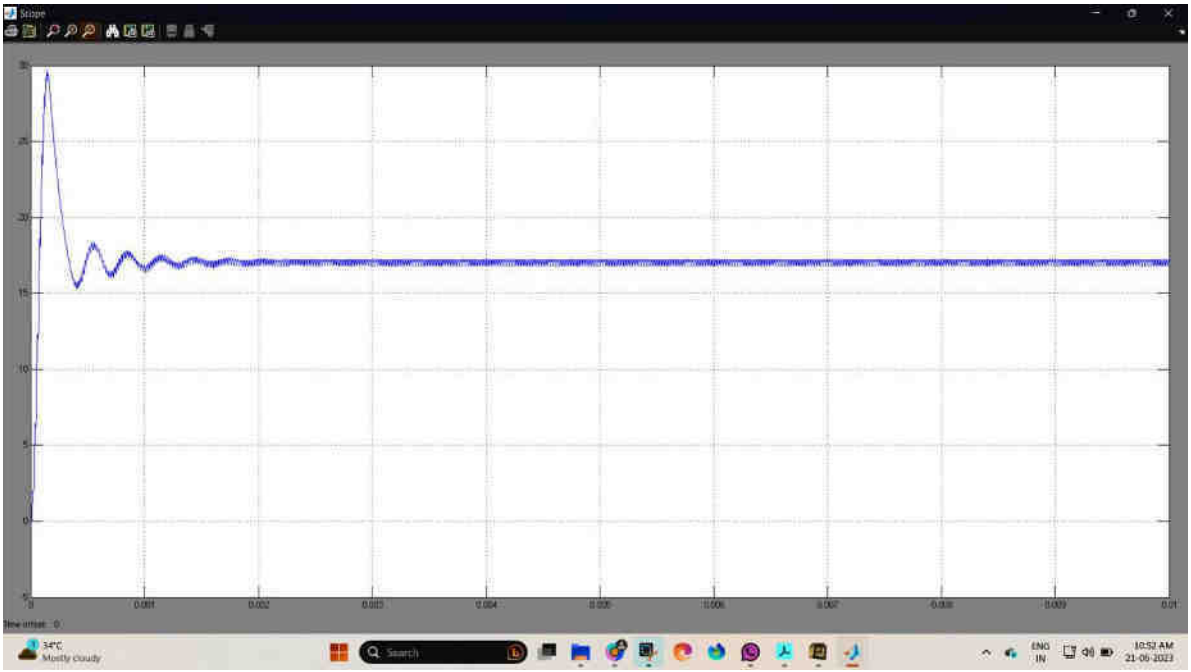
1) Open the MATLAB software and click on “Simulink library” on the top of the menu bar.
2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.
3) Initiate the all values as shown in diagram.
4) After arranging the blocks as per the circuit diagram & check down the step-up and step-down conditions, now click on “RUN” button provided on the top side of the tool bar.
5) Now, double click on “scope” and observe the waveforms carefully on scope.

PRECAUTIONS:

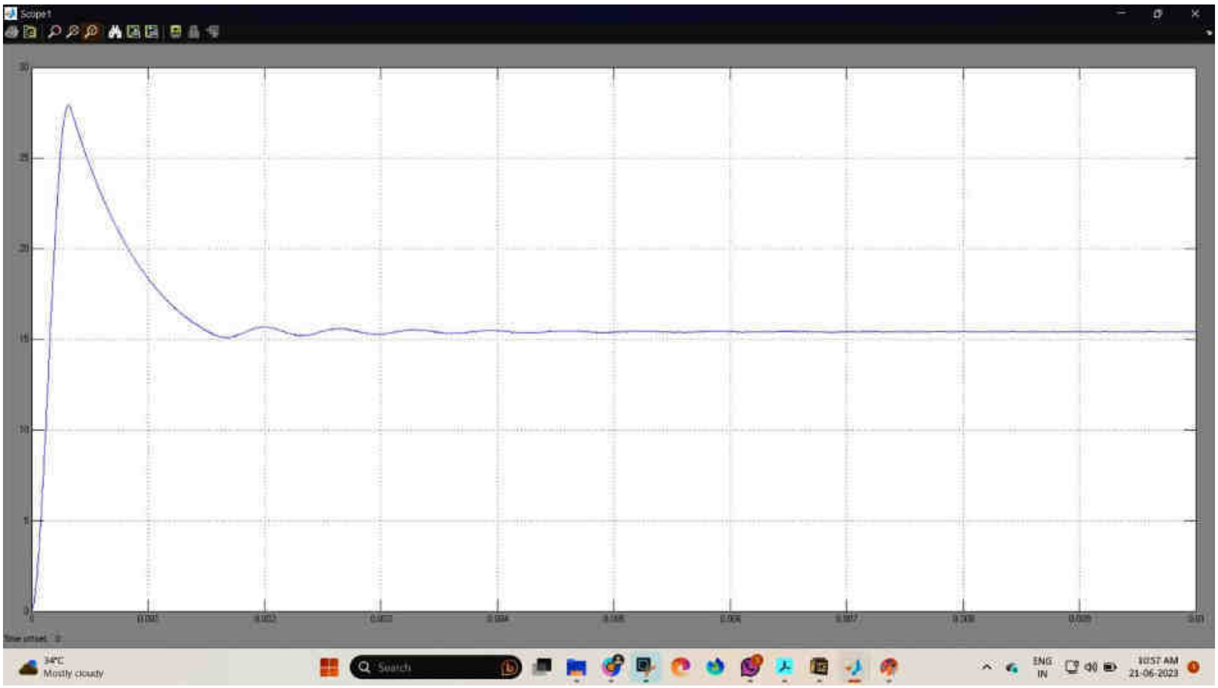
Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

Output:-

Boost converter:-



Buck converter:-



Result:-

Thus, designed and implemented both buck and boost DC-DC converters and output voltage is verified.

5. Study on the Design of PI Controllers and Stability Analysis for a DC-DC Buck Converter

AIM:

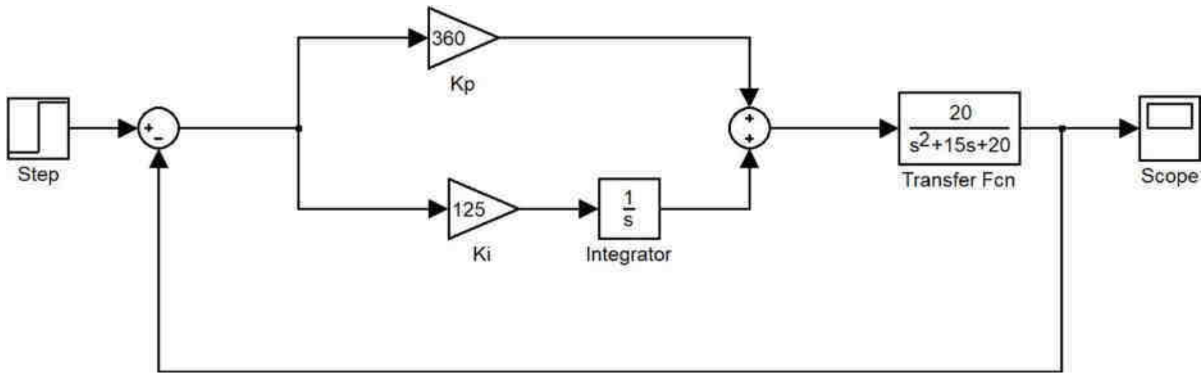
To design the PI controller for a practical transfer function and also to examine the Stability of DC-DC buck converter using PI controllers.

REQUIRED APPARATUS & SOFTWARE USED:

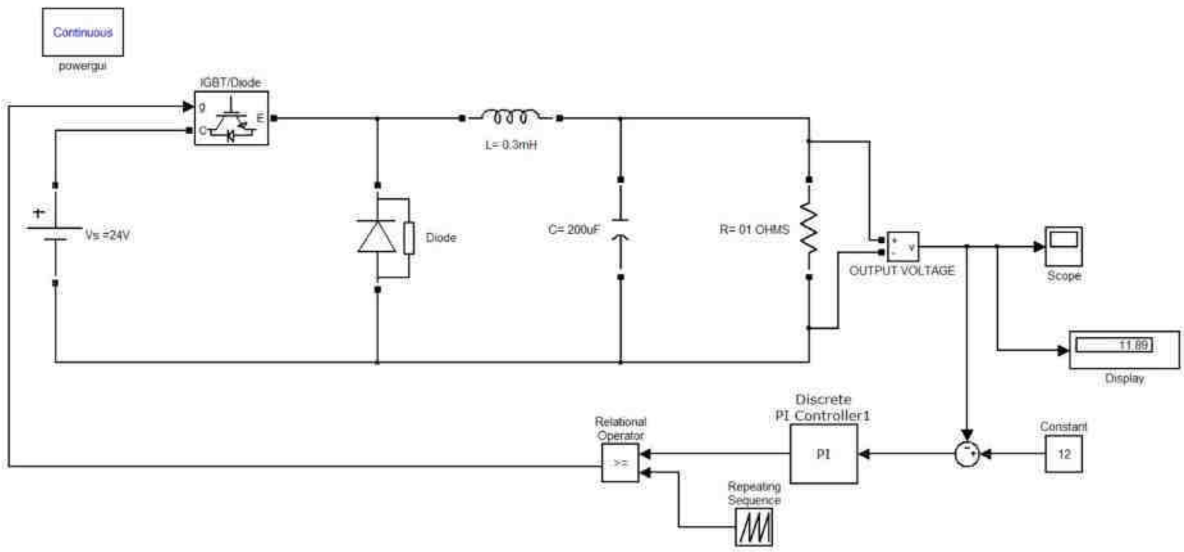
- Personal computer
- MATLAB software

CIRCUIT DIAGRAM:

PI Controller:-



PI with DC-DC Buck Converter:-



PROCEDURE:

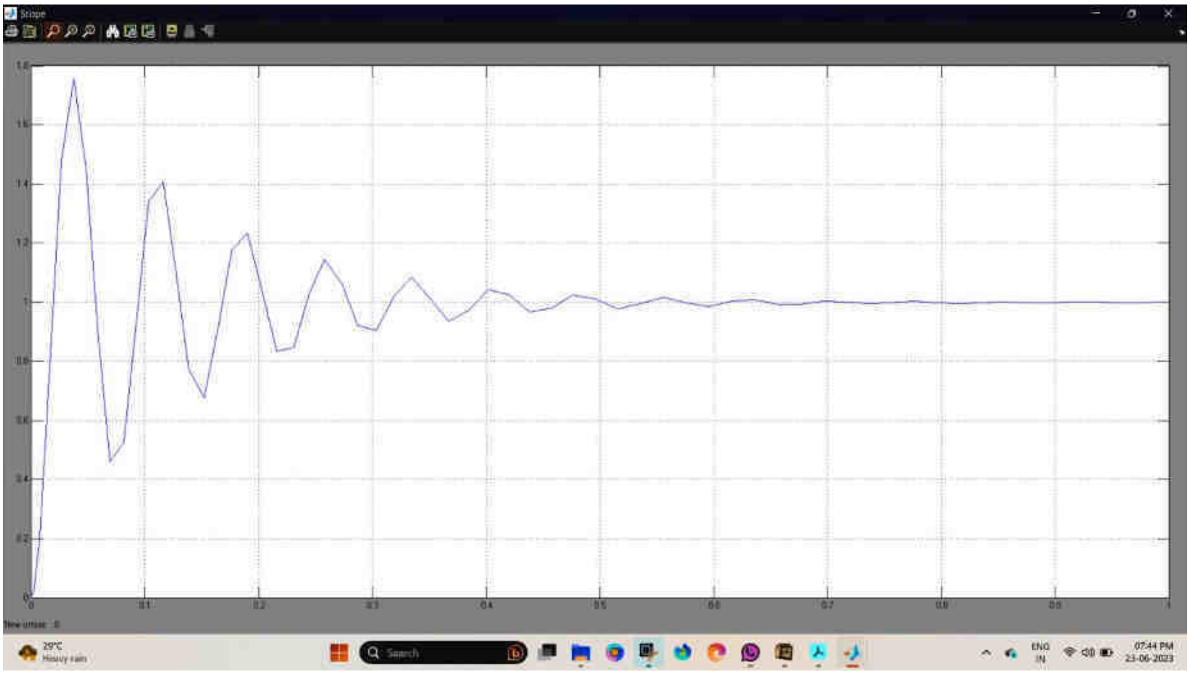
1) Open the MATLAB software and click on "Simulink library" on the top of the menu bar.
2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.
3) Initiate the all values as shown in diagram.
4) After arranging the blocks as per the circuit diagram & check down the step-up and step-down conditions, now click on "RUN" button provided on the top side of the tool bar.
5) Now, double click on "scope" and observe the waveforms carefully on scope.

PRECAUTIONS:

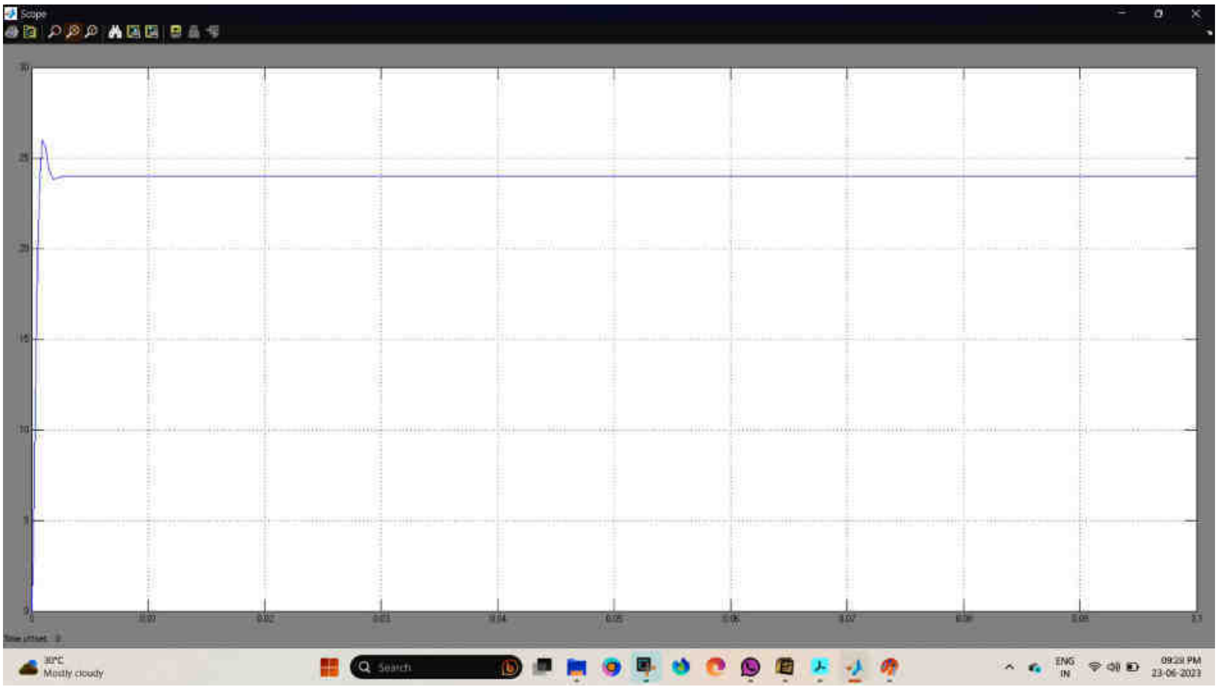
Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

Output:-

PI Controller:-



PI with DC-DC Buck Converter:-



RESULT:

Thus the design of PI controller is studied for various gain values and transfer function, also the buck converter has been stabilizer using PI controller by varying the gain values to get desired output.

6. Sine-PWM Techniques for Single-Phase Half-Bridge, Full-Bridge and Three-Phase Inverters

AIM;

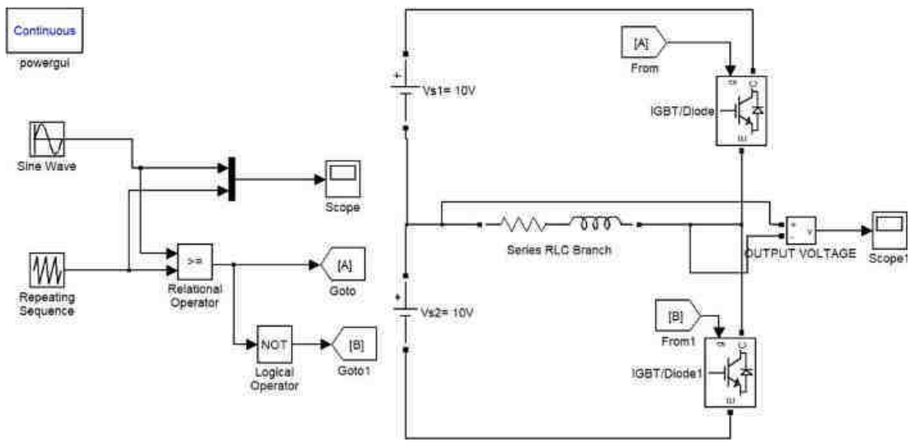
To study the performance of 1-phase half bridges, full bridges and 3-phase inverters For Sine PWM techniques using MATLAB simulation.

REQUIRED APPARATUS & SOFTWARE USED:

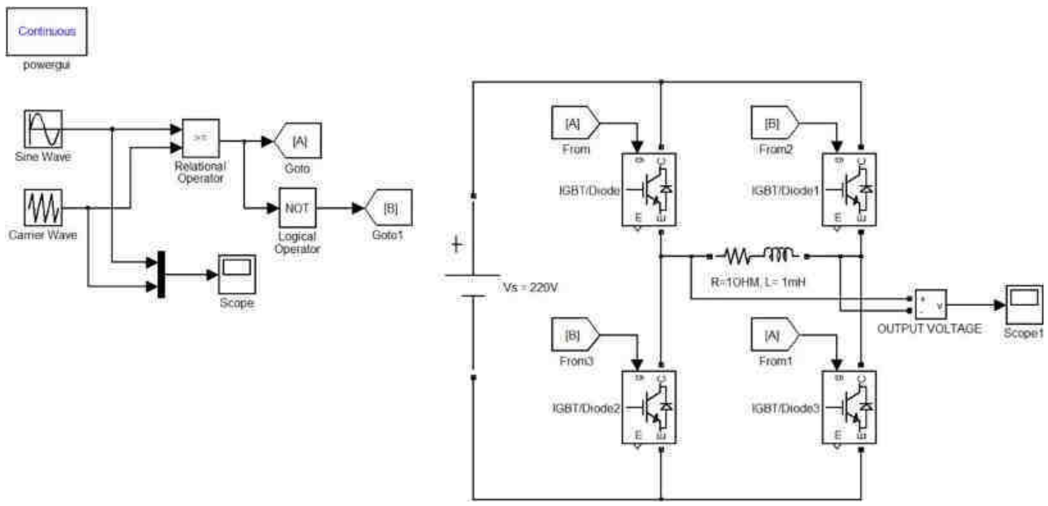
- Personal computer
- MATLAB software

CIRCUIT DIAGRAM:

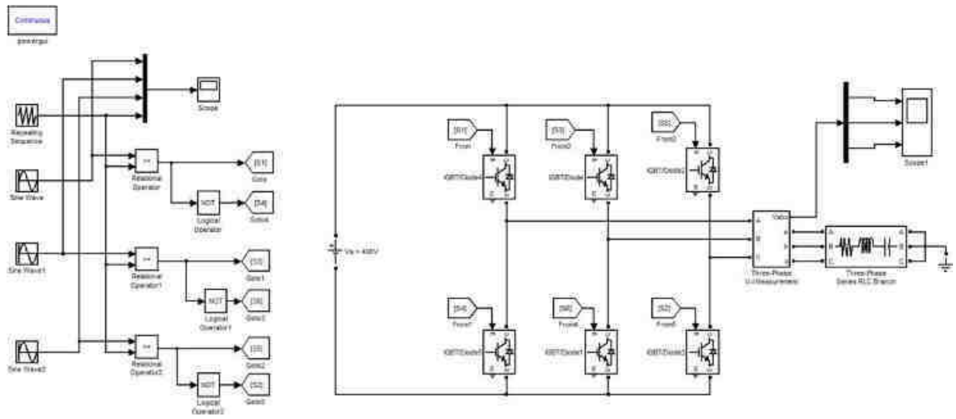
1-phase half bridge:-



1-phase full bridge:-



3-phase inverter:-



PROCEDURE:

1) Open the MATLAB software and click on “Simulink library” on the top of the menu bar.

2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.

3) Initiate the all values as shown in diagram.

4) After arranging the blocks as per the circuit diagram & check down the step-up and step-down conditions, now click on “RUN” button provided on the top side of the tool bar.

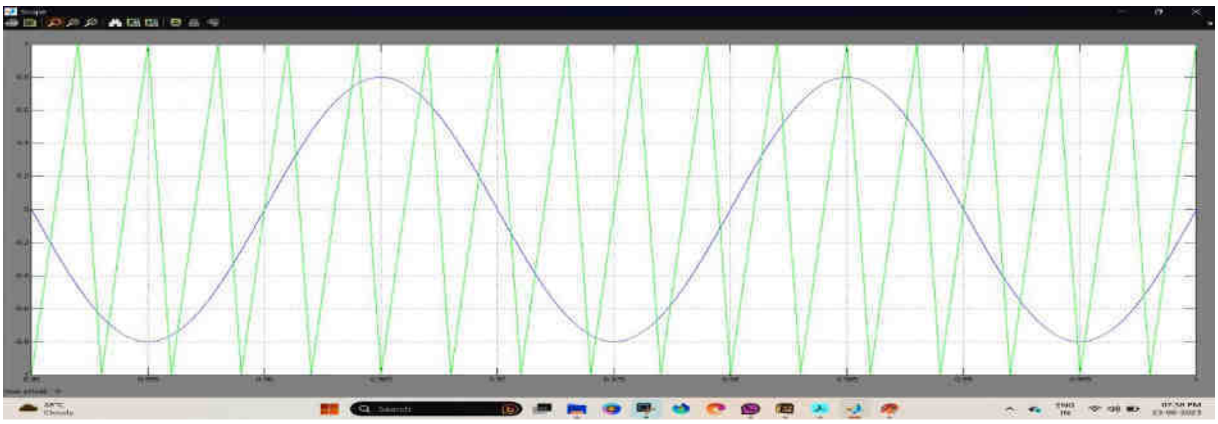
5) Now, double click on “scope” and observe the waveforms carefully on scope.

PRECAUTIONS:

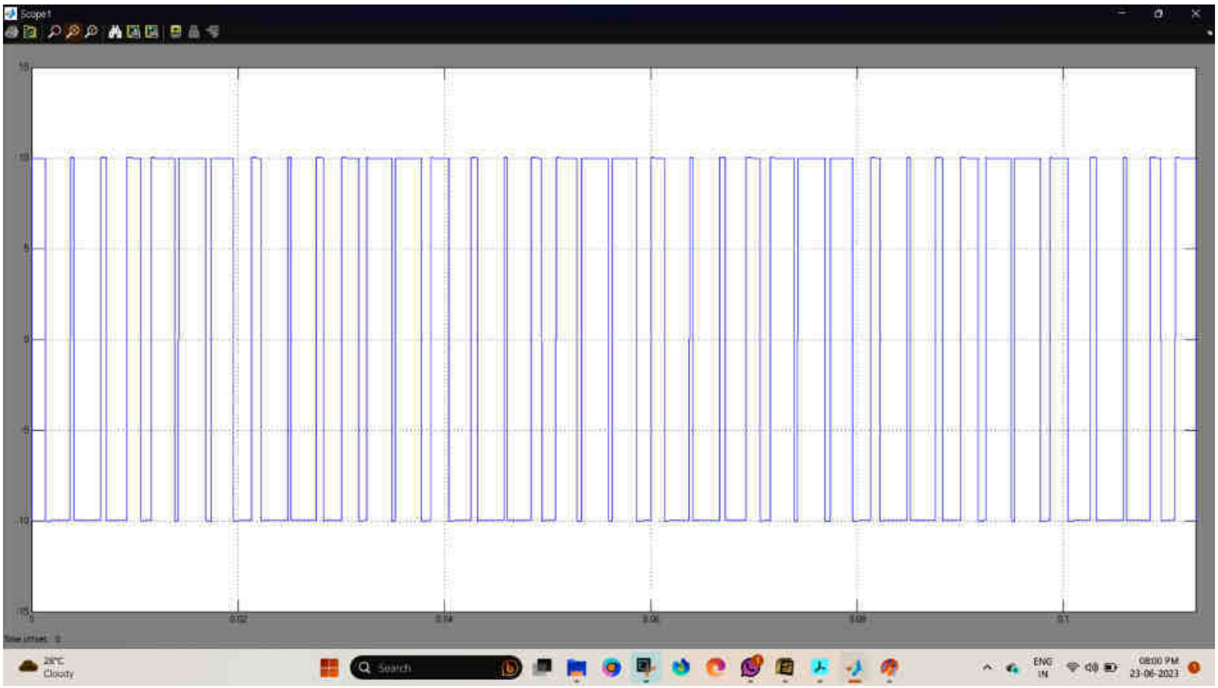
Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

Output:-

1-phase half bridge:-

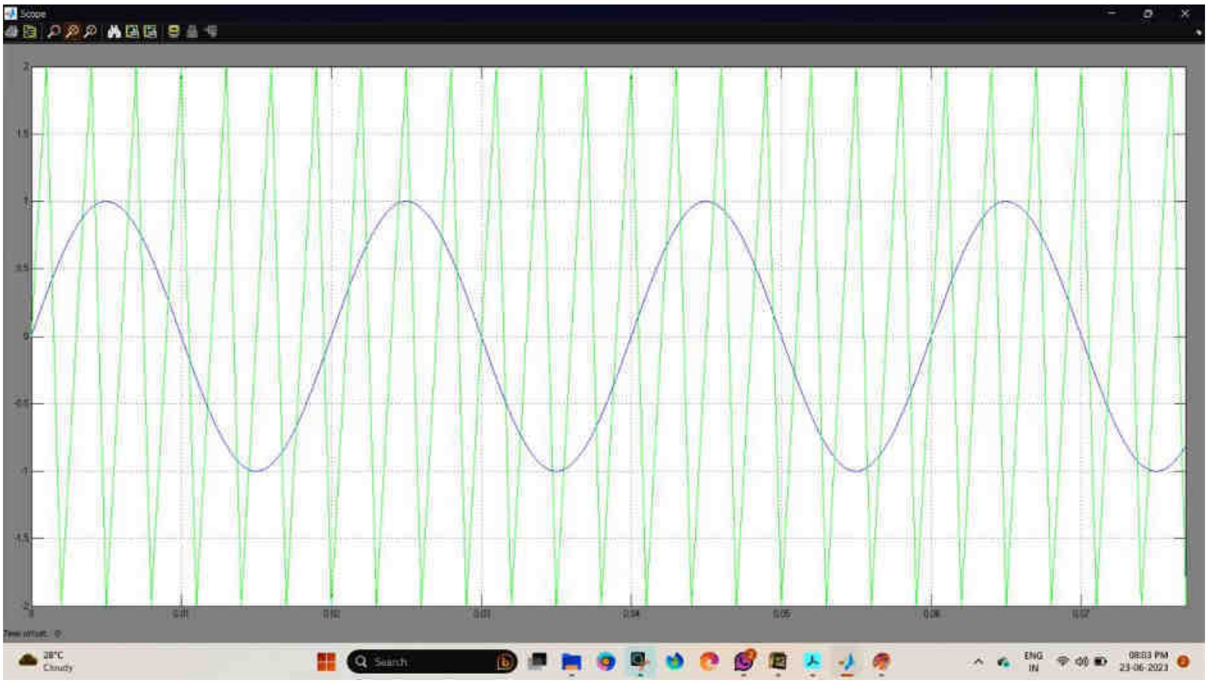


Input waveform

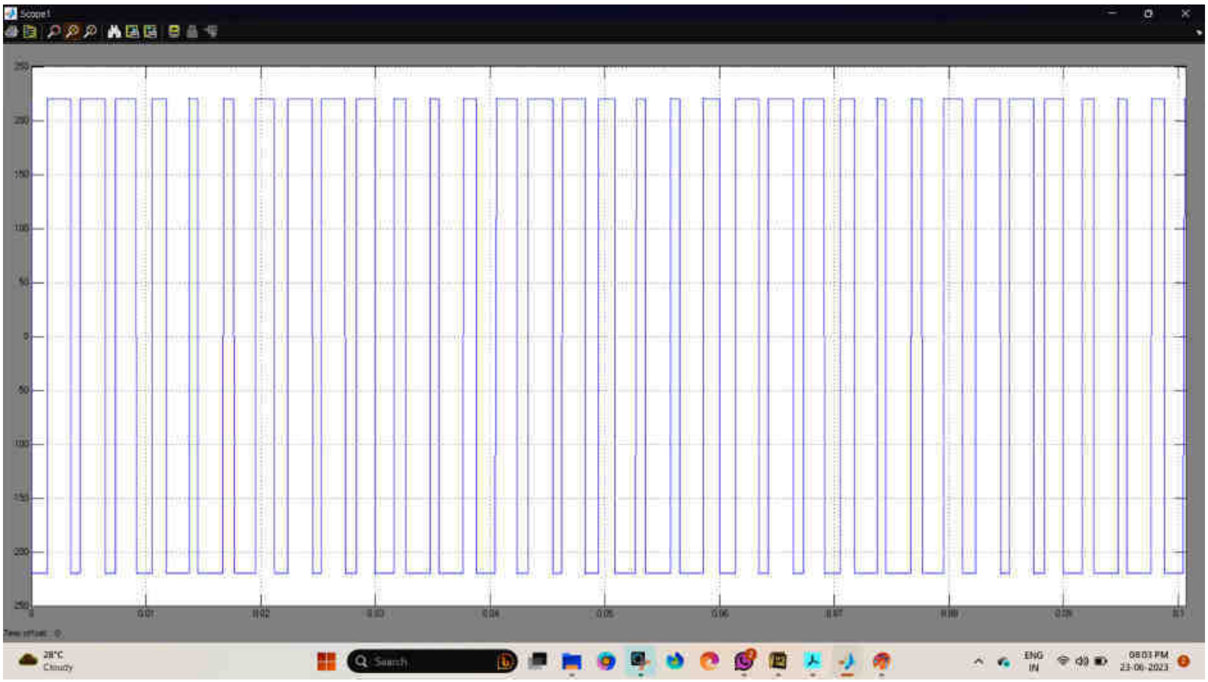


Output waveform

1-phase full bridge:-

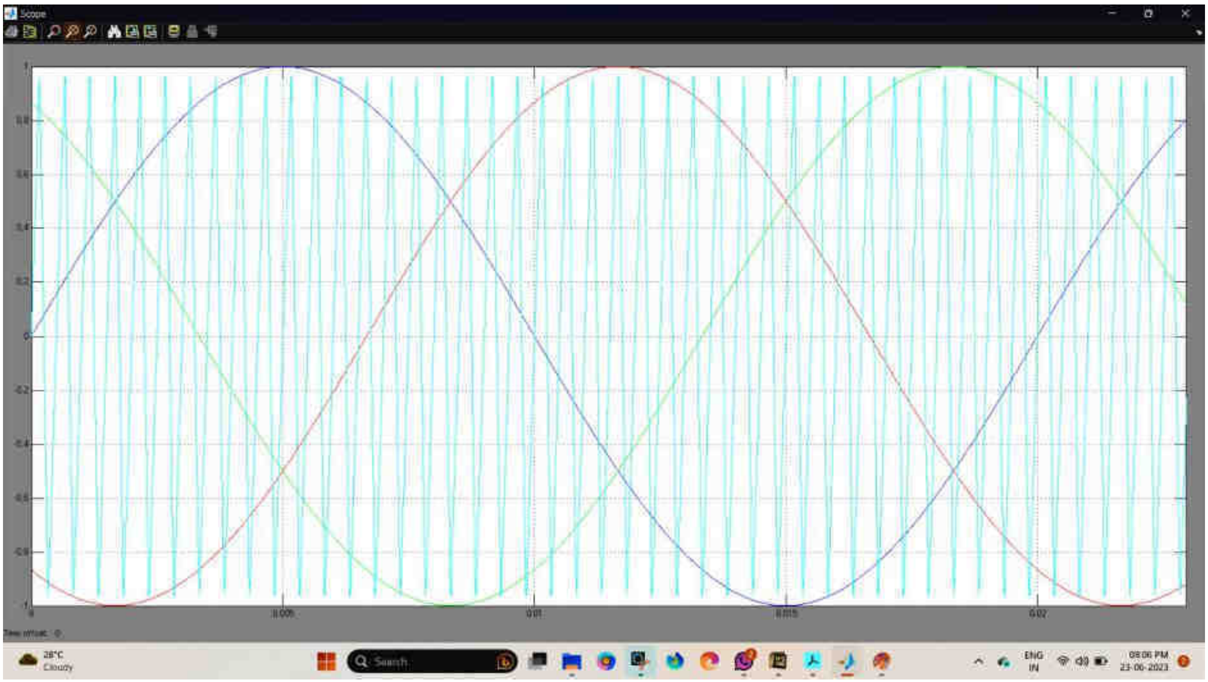


Inputwaveform

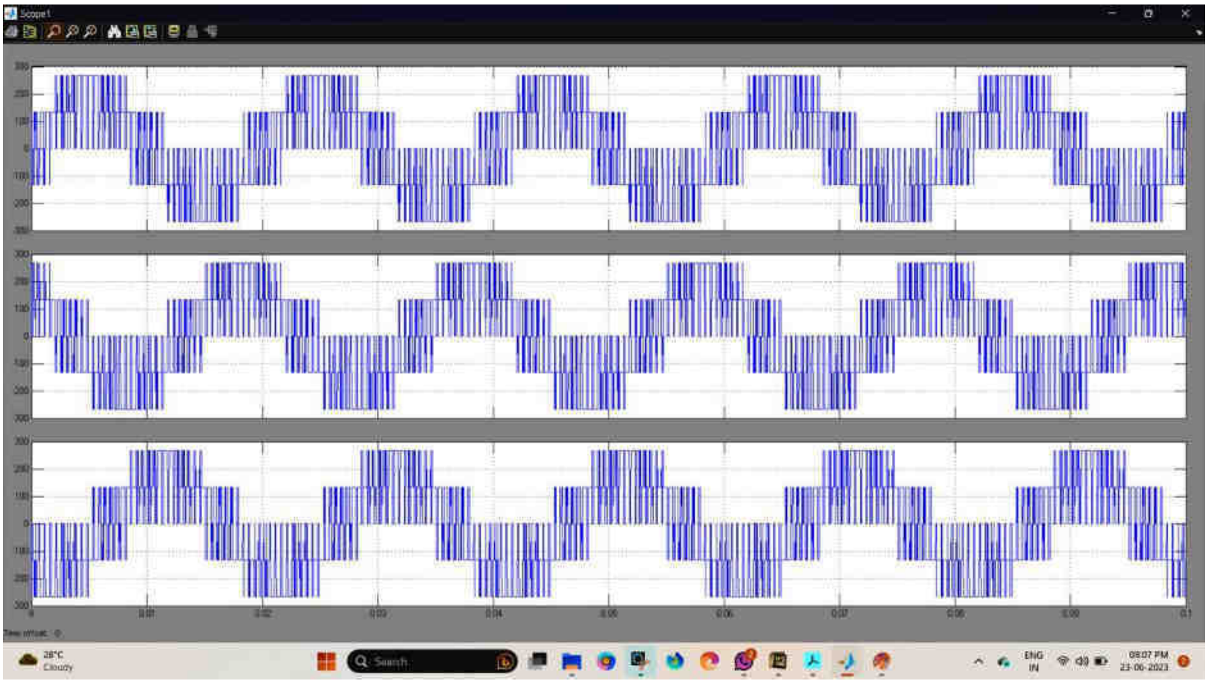


Output waveform

3-phase inverter:-



Inputwaveform



Output waveform

RESULT;

Thus, the performance of 1 phase half bridge, full bridge and 3 phase inverters using SPWM technique was studied and observed the waveforms using MATLAB.

7. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)

AIM:

To determine the transient stability analysis of single machine system by equal area criterian.

APPARATUS:

Personal computer

MATLAB Software

Power system toolbox

PROCEDURE:

1. Click on MATLAB icon, then the MATLAB window will open.
2. In the toolbar from file choose a blank M-File then the file will open.
3. Enter the program and click on the run option.
4. The output (or) result will be display in main MATLAB window.

PROGRAM:

CASE1: SUDDEN INCREASE IN MECHANICAL INPUT:

A)With zero initial mechanical power:

```
%Initial mechanical power in p.u. p0=0.0
%Generator e.m.f. in p.u. e=1.35
% Infinite bus-bar voltage inp.u. v=1
%Reactance between internal emf and infinite bus in p.u. x=0.65 p=0.0;e=1.35;v=1.0;x=0.65;
eacpower(p,e,v,x)
```

Output:-

Initial power =0.000 p.u.

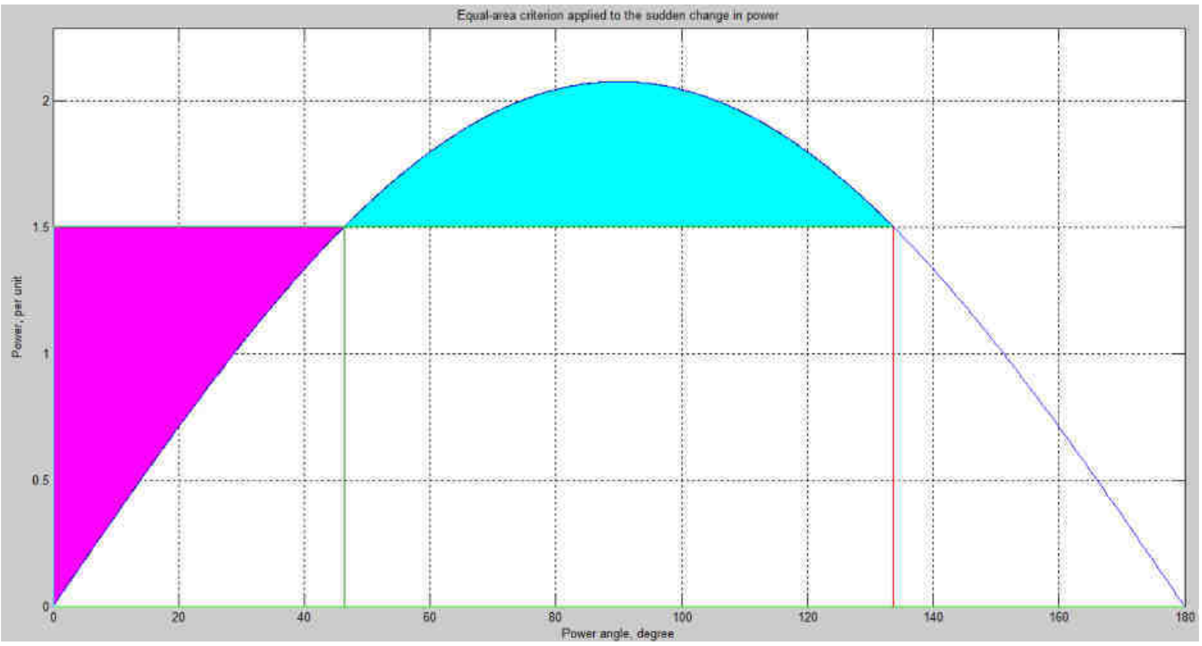
Initial power angle =0.000degrees

Sudden additional power =1.505p.u.

Total power for critical stability=1.505 p.u.

Maximum angle swing =133.563degrees

Newoperatingangle =46.437 degrees



(B)With non zero initial mechanical power:

p=0.6;e=1.35;v=1.0;x=0.65;

eacpower(p,e,v,x)

<u>Output:-</u>

Initial power =0.600p.u.

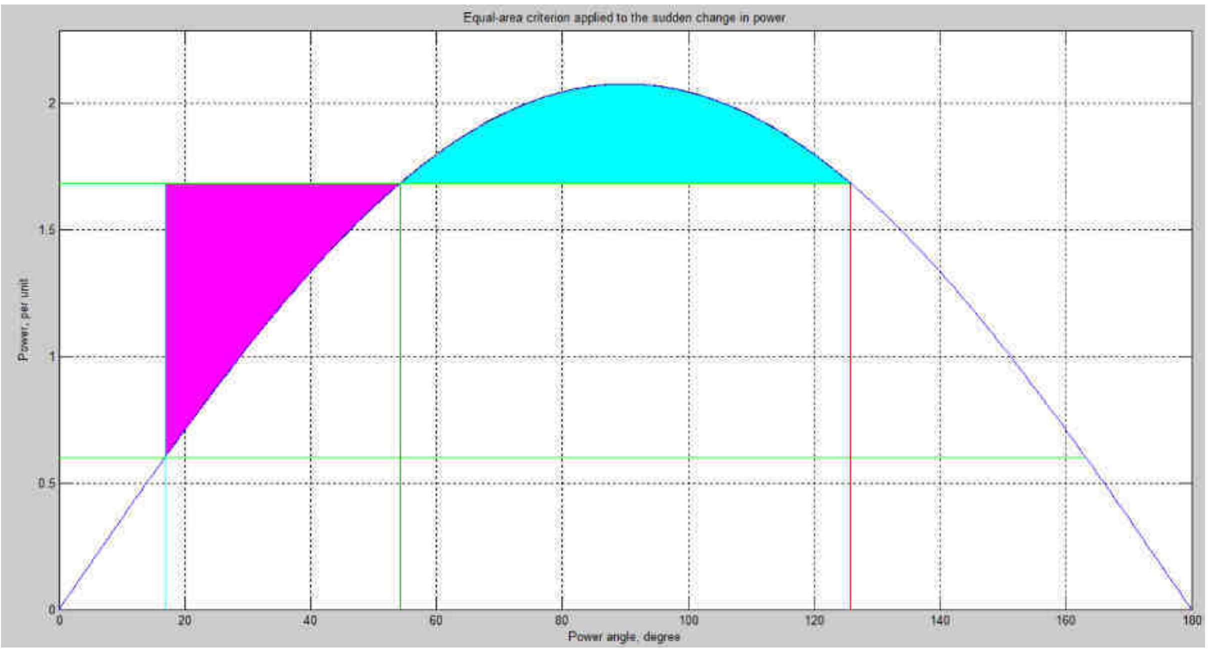
Initial power angle = 16.791 degrees

Sudden additional power =1.084 p.u.

Total power for critical stability =1.684 p.u.

Maximum angle swing =125.840 degrees

New operating angle = 54.160 degrees



CASE2: FAULT ON A SYSTEMHAVINGTWOPARALLEL LINES:

(A)Fault at sending end:

p=1.0;e=1.2;v=1.0;x1=0.522;x2=inf;x3=0.8;

eacfault(p,e,v,x1,x2,x3)

<u>Output:-</u>

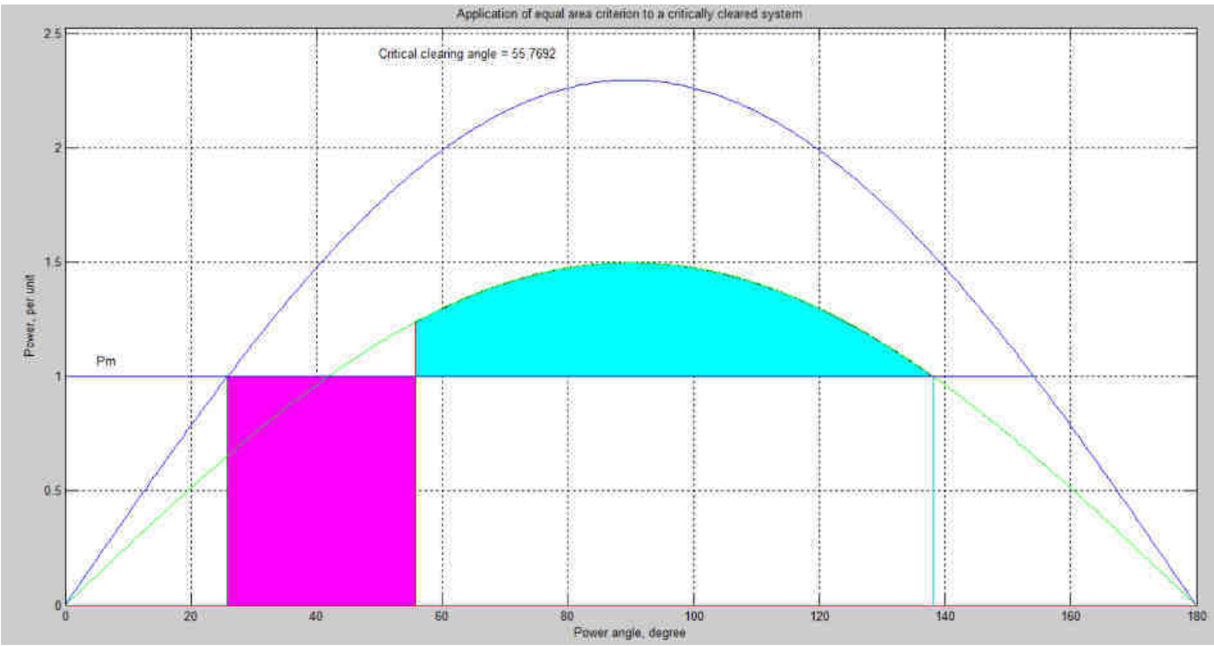
To find tcenter InertiaConstantH,(or0toskip)H=5

Initial power angle =25.785

Maximum angle swing =138.190

Critical clearing angle =55.769

Critical clearingtime=0.167 sec.



(B)Fault at middle of any one of the two lines:

p=1.0;e=1.2;v=1.0;x1=0.71;x2=2.424;x3=1.0;

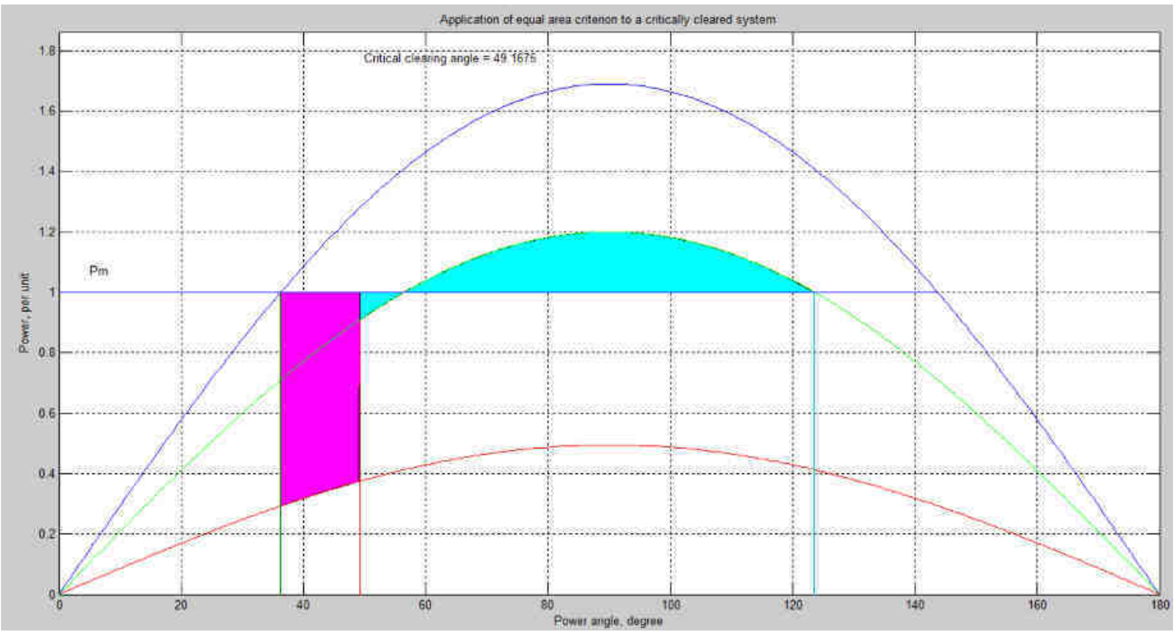
eacfault(p,e,v,x1,x2,x3)

<u>Output:-</u>

Initial power angle =36.275

Maximum angle swing =123.557

Critical clearing angle =49.167



(c)Fault cleared by the isolation of the fault line:

p=0.8;e=1.17;v=1.0;x1=0.65;x2=inf;x3=0.65;

eacfault(p,e,v,x1,x2,x3)

Output:-

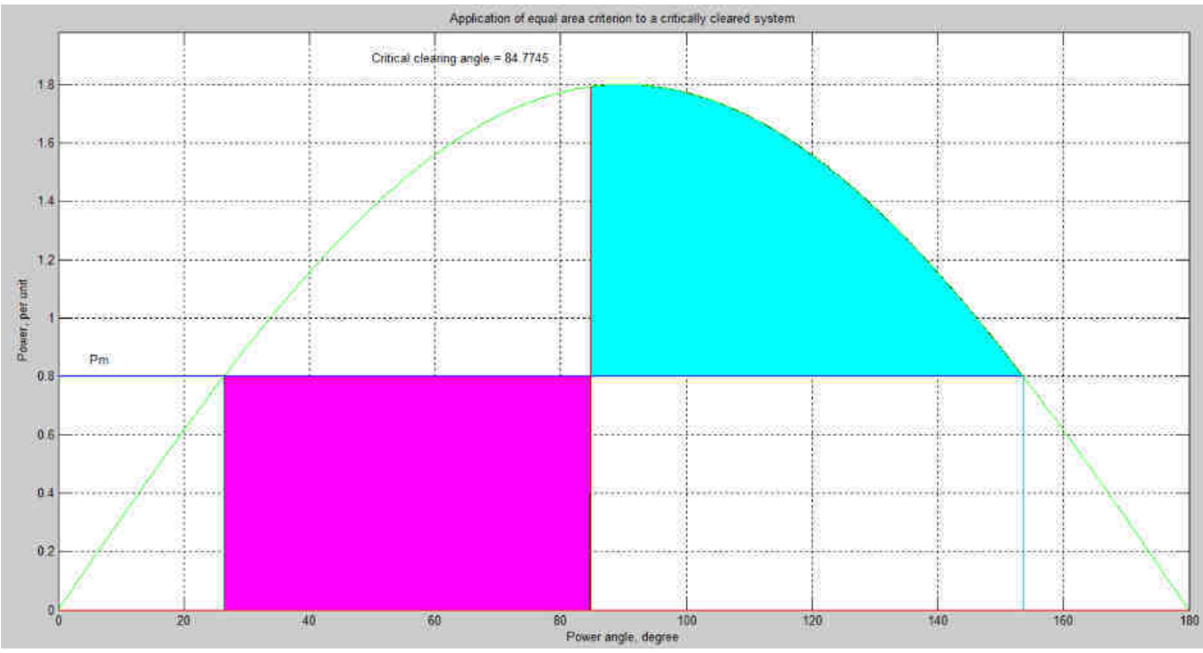
To find tcenter InertiaConstantH,(or0toskip)H=5

Initial power angle =26.388

Maximum angle swing =153.612

Critical clearing angle =84.775

Critical clearingtime=0.260 sec.



CASE3: SUSTAINED FAULTS ON MULTI-MACHINE SYSTEM (tc=0.2,0.41,0.61):

p=0.8;e=1.17;v=1.0;x1=0.65;x2=1.8;x3=0.8;

h=5;f=60;tc=0.2;tf=1;dt=0.01;

swingmeu(p,e,v,x1,x2,x3,h,f,tc,tf,dt)

Output:-

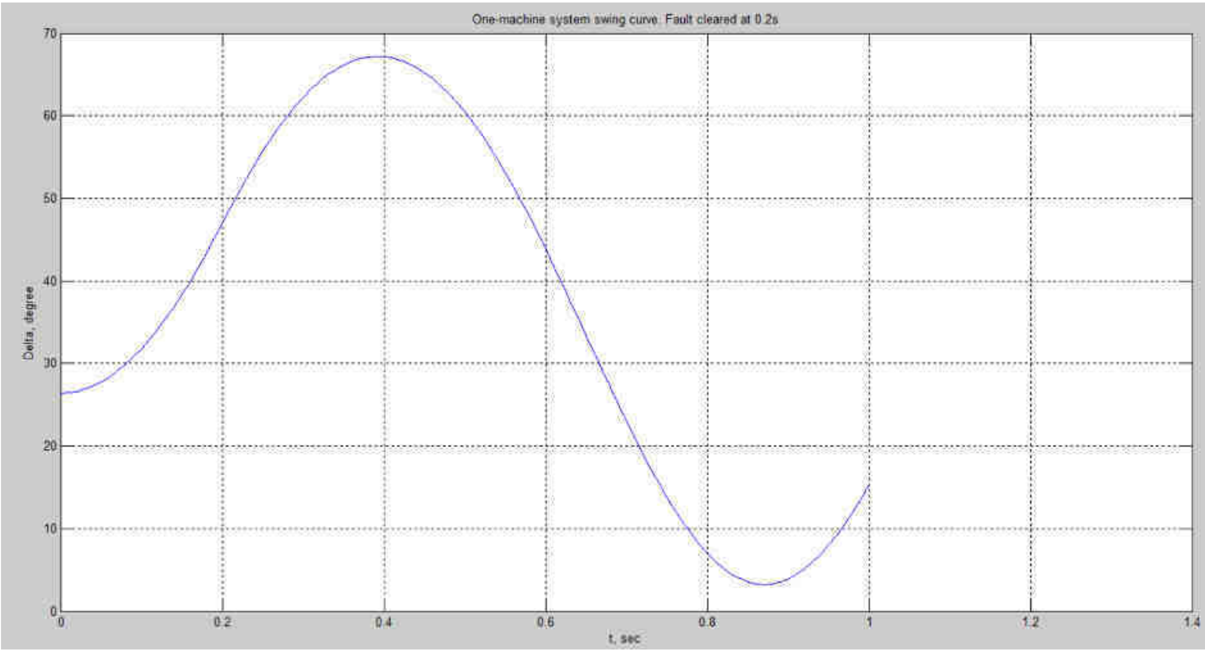
Faultisclearedat0.200Sec.

time	delta	Dws
	degrees	rad/s

0	26.3878	0
0.0100	26.4430	0.1927
0.0200	26.6085	0.3849
0.0300	26.8841	0.5764
0.0400	27.2689	0.7665
0.0500	27.7624	0.9550
0.0600	28.3632	1.1414
0.0700	29.0703	1.3254
0.0800	29.8820	1.5065
0.0900	30.7966	1.6844
0.1000	31.8121	1.8588
0.1100	32.9265	2.0293
0.1200	34.1374	2.1956
0.1300	35.4424	2.3575
0.1400	36.8389	2.5146
0.1500	38.3240	2.6669
0.1600	39.8948	2.8140
0.1700	41.5485	2.9558
0.1800	43.2819	3.0922
0.1900	45.0918	3.2230
0.2000	46.9752	3.3483
0.2100	48.8646	3.2407
0.2200	50.6888	3.1213
0.2300	52.4413	2.9909
0.2400	54.1162	2.8505
0.2500	55.7078	2.7009
0.2600	57.2112	2.5429
0.2700	58.6218	2.3772
0.2800	59.9354	2.2048
0.2900	61.1483	2.0262
0.3000	62.2573	1.8422
0.3100	63.2594	1.6535
0.3200	64.1522	1.4607
0.3300	64.9334	1.2644

0.3400	65.6011	1.0651
0.3500	66.1540	0.8634
0.3600	66.5906	0.6597
0.3700	66.9100	0.4547
0.3800	67.1116	0.2486
0.3900	67.1950	0.0420
0.4000	67.1598	-0.1647
0.4100	67.0062	-0.3711
0.4200	66.7346	-0.5766
0.4300	66.3455	-0.7809
0.4400	65.8398	-0.9835
0.4500	65.2186	-1.1838
0.4600	64.4833	-1.3814
0.4700	63.6357	-1.5757
0.4800	62.6777	-1.7662
0.4900	61.6119	-1.9522
0.5000	60.4408	-2.1330
0.5100	59.1677	-2.3081
0.5200	57.7960	-2.4766
0.5300	56.3298	-2.6378
0.5400	54.7734	-2.7909
0.5500	53.1317	-2.9352
0.5600	51.4100	-3.0698
0.5700	49.6141	-3.1937
0.5800	47.7503	-3.3063
0.5900	45.8254	-3.4066
0.6000	43.8467	-3.4938
0.6100	41.8219	-3.5671
0.6200	39.7592	-3.6257
0.6300	37.6672	-3.6689
0.6400	35.5550	-3.6961
0.6500	33.4318	-3.7067
0.6600	31.3074	-3.7003
0.6700	29.1917	-3.6763

0.6800	27.0946	-3.6347	0.8500	3.5462	-0.5581
0.6900	25.0265	-3.5753	0.8600	3.3031	-0.2891
0.7000	22.9977	-3.4979	0.8700	3.2148	-0.0184
0.7100	21.0182	-3.4028	0.8800	3.2817	0.2523
0.7200	19.0983	-3.2901	0.8900	3.5037	0.5216
0.7300	17.2479	-3.1603	0.9000	3.8793	0.7881
0.7400	15.4768	-3.0138	0.9100	4.4065	1.0502
0.7500	13.7942	-2.8513	0.9200	5.0825	1.3066
0.7600	12.2093	-2.6735	0.9300	5.9035	1.5557
0.7700	10.7304	-2.4813	0.9400	6.8651	1.7963
0.7800	9.3657	-2.2756	0.9500	7.9618	2.0271
0.7900	8.1226	-2.0576	0.9600	9.1878	2.2468
0.8000	7.0078	-1.8283	0.9700	10.5363	2.4543
0.8100	6.0274	-1.5889	0.9800	12.0000	2.6484
0.8200	5.1868	-1.3409	0.9900	13.5710	2.8283
0.8300	4.4907	-1.0854	1.0000	15.2408	2.9929
0.8400	3.9428	-0.8240			



RESULT:-

Thus Transient stability analysis of a single machine system connected to infinite bus is determined using Equal Area Criteria using MATLAB.

8. Fault Studies Using Z_{bus} Matrix

AIM:-

ToConductshortcircuitanalysisforgivenpowersystemusingMATLABforLG, LL, LLGand3Φfaults.

APPARATUS:-

Personal computer

MATLAB Software

Powersystemtoolbox

PROCEDURE:-

1. Click on MATLAB icon, then the MATLAB window will open.
2. In the toolbar from file choose a blank M-File then the file will open.
3. Enter the program and click on the run option.
4. The output (or) result will be display in main MATLAB window.
5. Enter the fault bus number 3 and Zf=j*0.1 and continue for the remaining buses and faults.

PROGRAM:-

```
zdata0=[01 0 0.40
0 2 0 0.10
1 2 0 0.30
1 3 0 0.35
2 3 0 0.7125];
zdata1=[01 0 0.25
0 2 0 0.25
1 2 0 0.125
1 3 0 0.15
2 3 0 0.25];
zdata2 = zdata1;
zbus1= zbuild(zdata1)
zbus2 = zbus1
zbus0=zbuild(zdata0)
symfault(zdata1,zbus1)
```

lgfault(zdata0,zbus0,zdata1,zbus1,zdata2,zbus2)

llfault(zdata1,zbus1,zdata2,zbus2)

dlgfault(zdata0,zbus0,zdata1,zbus1,zdata2,zbus2)

Output:-

zbus1=

0 +0.1450i	0 +0.1050i	0 + 0.1300i
0 +0.1050i	0 +0.1450i	0 + 0.1200i
0 +0.1300i	0 +0.1200i	0 + 0.2200i

zbus2=

0 +0.1450i	0 +0.1050i	0 + 0.1300i
0 +0.1050i	0 +0.1450i	0 + 0.1200i
0 +0.1300i	0 +0.1200i	0 + 0.2200i

zbus0=

0 +0.1820i	0 +0.0545i	0 + 0.1400i
0 +0.0545i	0 +0.0864i	0 + 0.0650i
0 +0.1400i	0 +0.0650i	0 + 0.3500i

Enter Faulted BusNo.->3

EnterFaultImpedanceZf=R+j*Xincomplexform(forboltedfaultenter0).Zf=0.1i Balanced three-phase fault at bus No. 3

Total fault current=3.1250perunit Bus

Voltages during fault in per unit

Bus No.	Voltage Magnitude	Angle degrees
1	0.5938	0.0000
2	0.6250	0.0000
3	0.3125	0.0000

Line currentsforfault atbusNo.3

From Bus	To Bus	Current Magnitude	Angle degrees
G	1	1.6250	-90.0000
1	3	1.8750	-90.0000
G	2	1.5000	-90.0000
2	1	0.2500	-90.0000
2	3	1.2500	-90.0000
3	F	3.1250	-90.0000

Another fault location? Enter 'y' or 'n' with in single quote->'n'

Line-to-ground fault analysis

Enter Faulted BusNo.->3

Enter Fault Impedance Zf=R+j*X in complex form(forboltedfaultenter0).Zf=0.1i Single line to-ground fault at bus No. 3

Total fault current = 2.7523 per unit

Bus Voltages during the fault in per unit

Bus No.	-------Voltage Magnitude------- Phase a	Phase b	Phase c
1	0.6330	1.0046	1.0046
2	0.7202	0.9757	0.9757
3	0.2752	1.0647	1.0647

Line currentsforfault atbusNo.3

From Bus	To Bus	-----LineCurrentMagnitude---- Phase a	Phase b	Phase c
1	3	1.6514	0.0000	0.0000
2	1	0.3761	0.1560	0.1560
2	3	1.1009	0.0000	0.0000
3	F	2.7523	0.0000	0.0000

Another fault location? Enter 'y' or 'n' with in single quote->'n'

Line-to-line fault analysis

EnterFaultedBusNo.->3

EnterFaultImpedanceZf=R+j*Xincomplexform(forboltedfaultenter0).Zf=0.1i Line-to-line fault at bus No. 3

Totalfaultcurrent= 3.2075per unit

BusVoltagesduringthefaultinperunit Bus

-------VoltageMagnitude-------			
No.	Phasea	Phase b	Phasec
1	1.0000	0.6720	0.6720
2	1.0000	0.6939	0.6939
3	1.0000	0.5251	0.5251

Line currentsforfaultatbus No.3

From	To	-----LineCurrentMagnitude----		
Bus	Bus	Phase a	Phaseb	Phasec
1	3	0.0000	1.9245	1.9245
2	1	0.0000	0.2566	0.2566
2	3	0.0000	1.2830	1.2830
3	F	0.0000	3.2075	3.2075

Anotherfaultlocation?Enter'y'or 'n'withinsinglequote->'n'

Double line-to-ground fault analysis

EnterFaultedBusNo.->3

EnterFaultImpedanceZf=R+j*Xincomplexform(forboltedfaultenter0).Zf=0.1i Double line-to-ground fault at bus No. 3

Total fault current = 1.9737 per unit

BusVoltagesduringthefaultinperunit

Bus	-------VoltageMagnitude-------		
No.	Phasea	Phase b	Phasec
1	1.0066	0.5088	0.5088
2	0.9638	0.5740	0.5740
3	1.0855	0.1974	0.1974

Line currentsforfault atbusNo.3

From	To	-----LineCurrentMagnitude----		
Bus	Bus	Phase a	Phaseb	Phasec
1	3	0.0000	2.4350	2.4350
2	1	0.1118	0.3682	0.3682
2	3	0.0000	1.6233	1.6233
3	F	0.0000	4.0583	4.0583

Anotherfaultlocation?Enter'y'or'n'withinsinglequote->'n'

RESULT:-

Thus the Fault Current and other parameters were determined for the given power system network for different types of faults and results were compared with the MATLAB results.

9. Reactive Power Control in a Transmission System (Ferranti Effect, Effect of Shunt Inductor)

AIM:

To Simulate the Reactive Power of a Given Transmission Line Under Ferranti Effect And also to Study and Simulate the Effect of Shunt Inductor on the Reactive Power of a Transmission Line.

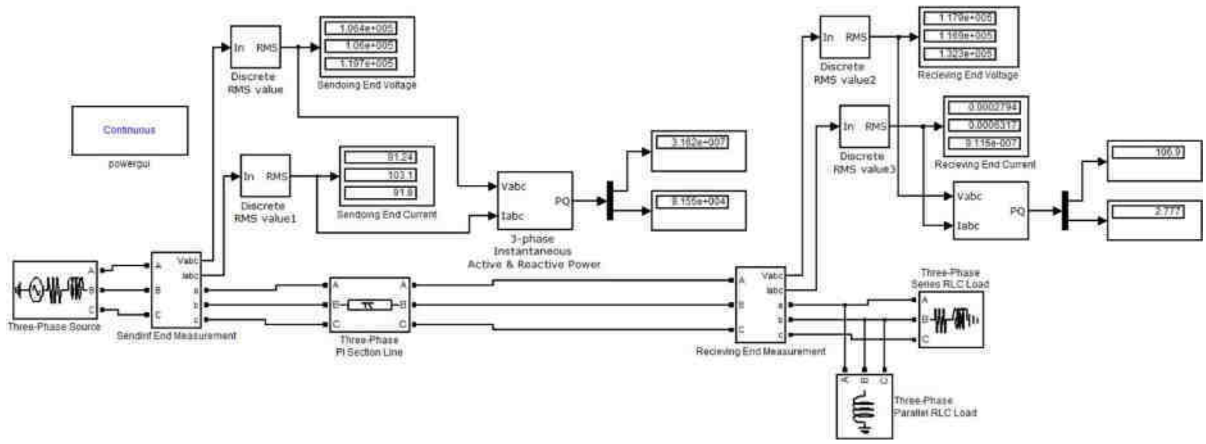
REQUIRED APPARATUS & SOFTWARE USED:

- Personal computer
- MATLAB software

PRECAUTIONS:

Save the simulation file and take the printout of output waveforms before closing the MATLAB simulation file.

CIRCUIT DIAGRAM:



THEORITICAL VALUES FOR THE FERRANTI EFFECT:-

Operating Frequency = 50 Hzs

Transmission Line Length = 400 Kms.

Resistance of the Line = 0.05 Ω/Km.

Inductance of the Line = 1.11 mH/Km.

CapacitanceoftheLine=1.11*10^{-8}F/Km.

Operating Voltage = 110 KV

PROCEDURE:

1) Open the MATLAB software and click on "Simulink library" on the top of the menu bar.
2) Open a new model file and collect the required blocks in Simulink library and make the connections as shown in connection diagram.
3) Initiate the all values as shown in diagram.
4) After arranging the blocks as per the circuit diagram, now click on "RUN" button provided on the top side of the tool bar.
5) Now, double click on "scope" and observe the waveforms carefully on scope.

RESULT:

Thus, The Reactive Power Control of a Transmission Line under Ferranti Effect With and Without Inclusion of Shunt Inductor has been Studied and Designed.

10. Wide Area Control of Two Area Kundur System

AIM:-

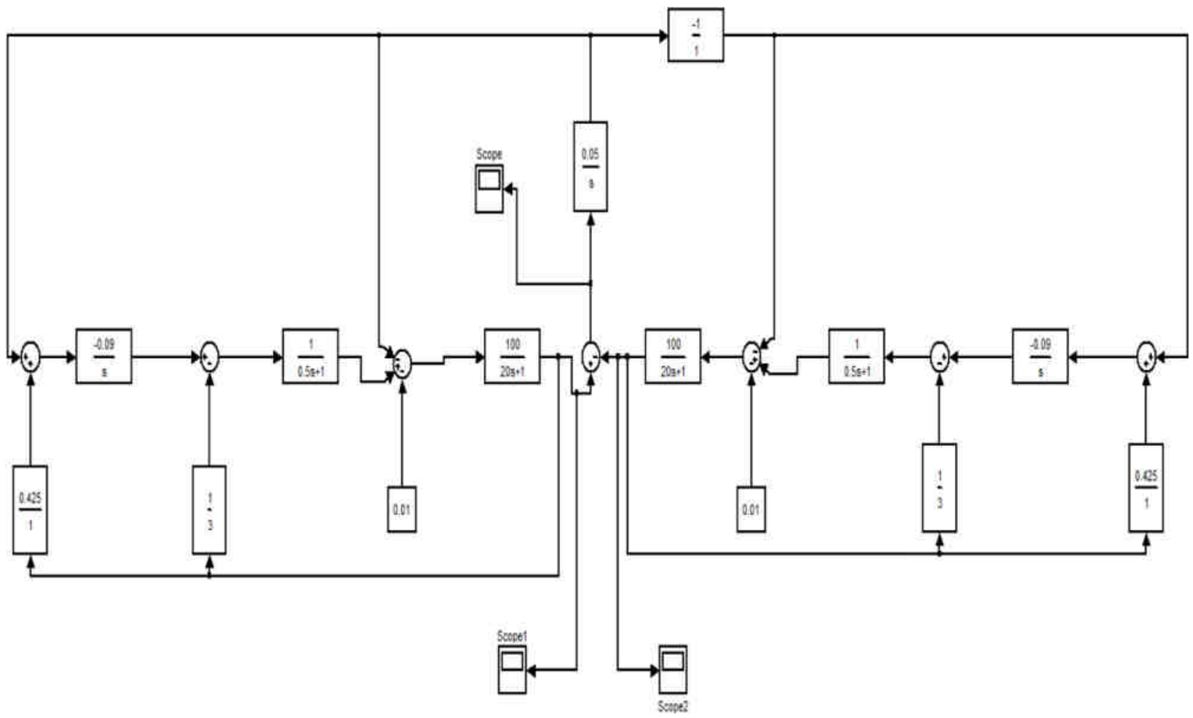
To obtain the step response of two area system with integral control and estimation of Tie line frequency deviation using simulink.

APPARATUS:-

Personal computer

MATLAB Software

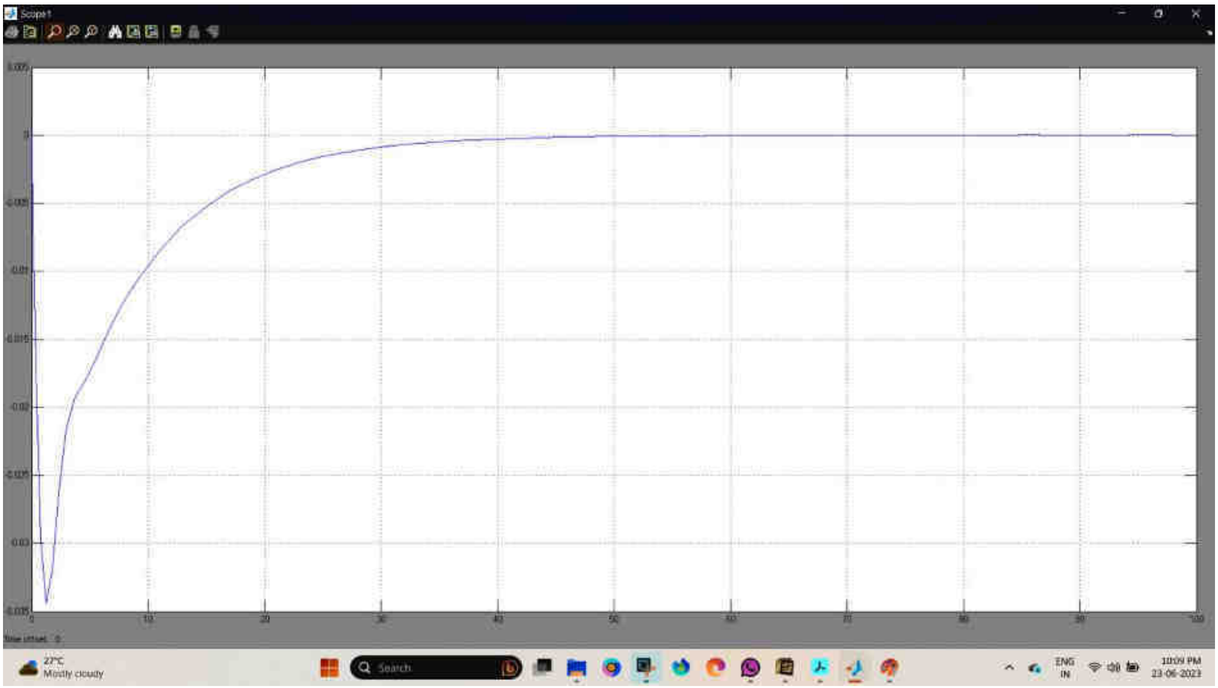
BLOCK DIAGRAM:-



PROCEDURE:-

1. Click on MATLAB icon, then the MATLAB window will open.
2. In the tool bar from file choose a model then the window will open.
3. Click on the library browser on the tool bar then drag the required components.
4. Connect the blocks and click on the run option.
5. Click on scope the result will be displayed.

Output:-



RESULT:-

Therefore, the step response of two area systems with integral control and estimation of tie-line frequency deviation using simulink were obtained.