

**G.H. RAISONI COLLEGE OF ENGINEERING**  
**DEPARTMENT OF ELECTRICAL ENGINEERING**

**COMPUTER AIDED ELECTRICAL ENGINEERING DRAWING ( CAD )**  
**LAB**

**INDEX**

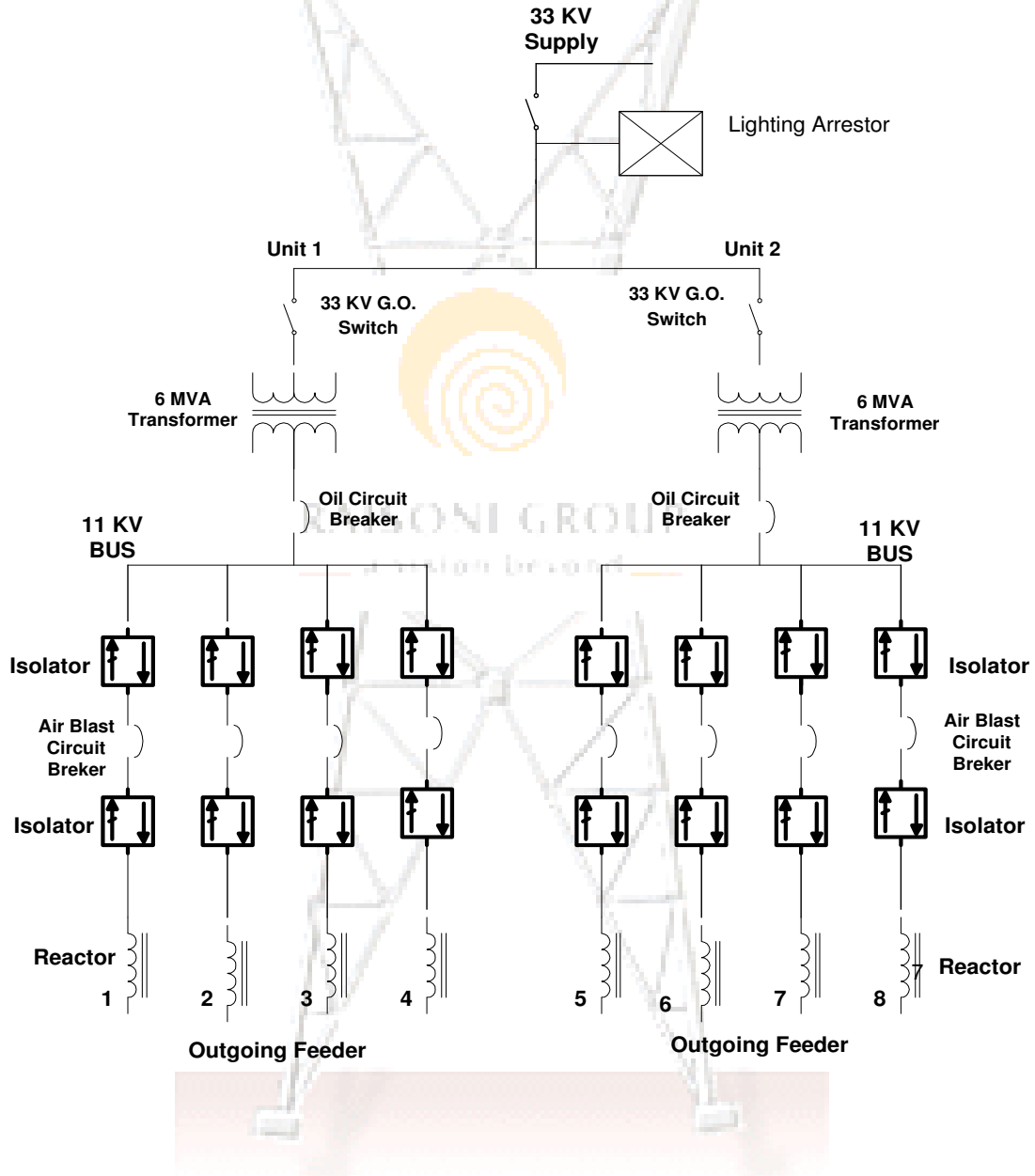
<b>Sr. No.</b>	<b>Name of Experiments</b>	<b>Page No.</b>
1.	To draw a single line diagram of 33 kV / 11 kV substation	2
2.	To draw the connection diagram of Hingna Substation	4
3.	To study the 3 $\emptyset$ balanced & unbalanced system using PSIM Software.	6
4.	To study Integrator & Differentiator using PSIM software using Operational amplifier.	8
5.	To study the speed control of DC motor using PSIM software.	10
6.	To Study Power circuit, Control Circuit and Ladder diagram of PLC	13
7.	To Draw Thermal Power Plant Layout using VISIO	16
8.	To Design a motor using MOTORPRO software	17



### Experiment. 1

Name of Experiment: - To draw single line diagram of 33/11kv substation

Diagram :



33 / 11 KV Single Line Diagram Sub-Station



**Theory :**

In every electrical substation, there are generally various indoor and outdoor switchgear equipments. Each equipment has certain functional equipment. Each & every equipment is either indoor or outdoor, depending upon the voltage rating and local condition generally, indoor equipment are preferred for voltages upto 33kv. However, in heavily polluted areas indoor equipments may be preferred even for higher voltages SF<sub>6</sub> gas insulated substation are preferred in large cities for voltages above 33KV.

The outdoor equipment is installed under the open sky. The indoor switchgear is generally the open sky. The indoor switchgear is generally in form of metal enclosed factory assembled units called metal switchgear.

**Description :**

- 1) Transformer 2) Bus-Bars 3) Insulators 4) Isolators 5) Lightning Arrestor
- 6) CT/PT 7) Reactor 8) Switches 9) Fuses

**Results: Single Line Diagram is drawn using VISIO and different components are Described below**

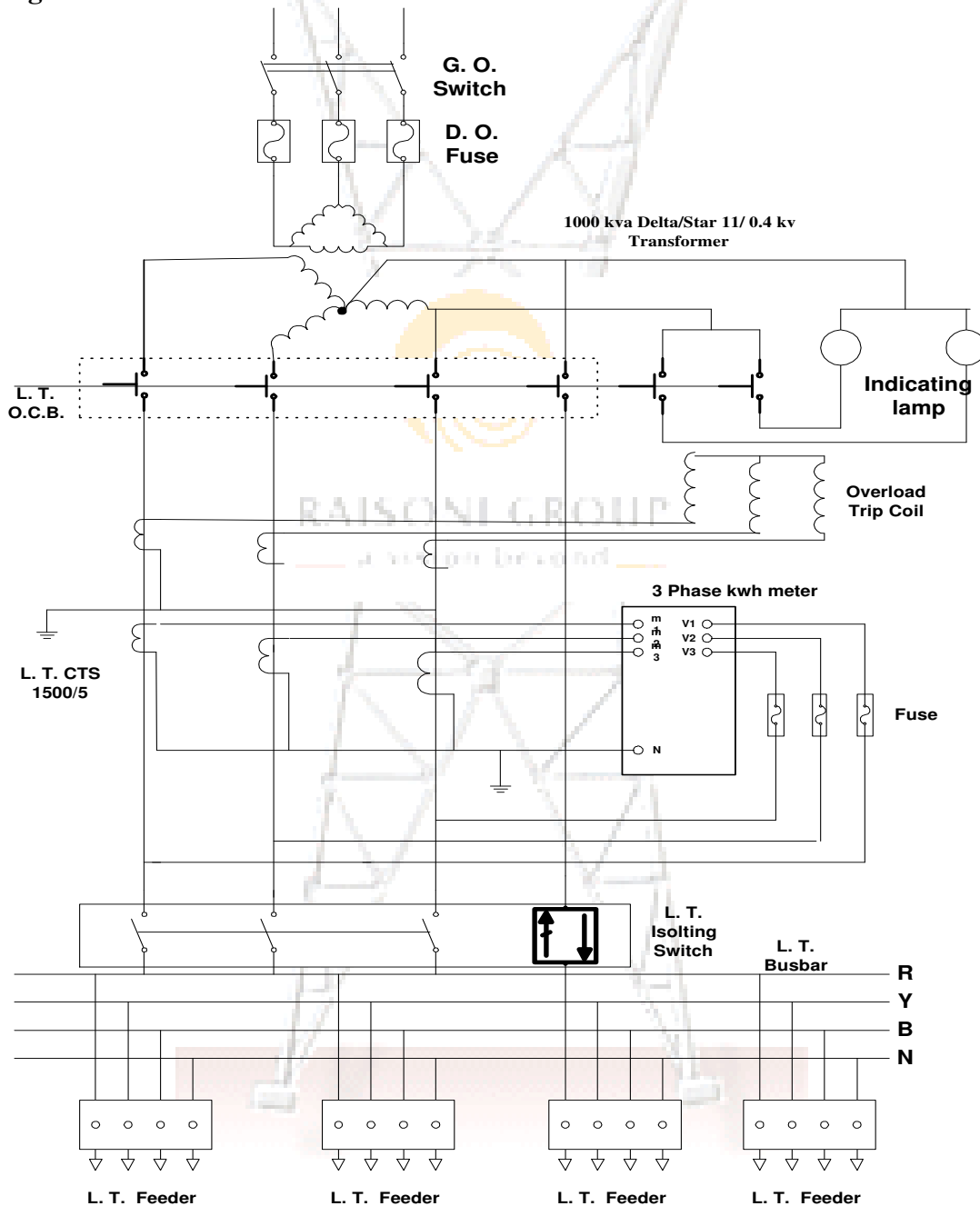
**Viva Questions: -**

- 1) Describe the equipments used in the substations?
- 2) What is the significance of using CT/PT?
- 3) Why tapping cannot be taken on feeder?
- 4) How do you calculate the rating of Lightning Arrestor?

## Experiment 2

**Name of Experiment:** - 11KV/440V substation is to be erected in the city, the capacity of substation is 1000 KVA & Max. Demand is 800 KVA which is to be distributed in 4 circuits. Draw the Connection diagram.

**Diagram :**



**Single line diagram of 11/ 0.4kv Substation**



**Theory: -**

**Gang operated Switch : (G.O.S.) :-** This switch is operated manually in case of fault condition or can be used for maintenance or repairing purpose

**Isolator:-** In sub-station, it is often desired to disconnect a part of system for general maintenance & repair purpose. This is accomplished by an isolating switch.. It is designed to open a circuit under no Load condition

**Feeder: -** A Feeder is a conductor, which connects substation to the area where the power is to be distributed.

**Air blast ckt Breaker: -** It is used in the range from 11KV to 1100 KV. Since it is fast & suitable for repeated operation it is the most popular circuit. Breaker from High Voltage traction system.

**Distributor:-** Tapings are taken from Distributor for the supply to the consumer end. Due to tapings current is not uniform throughout its length.

Describe the Following in Details: -

1) DO Fuse 2) Energy meter 3) Minimum Oil circuit Breaker, etc

**Result: - The 11 KV / 400V substation set up was studied**

**Viva Questions: -**

- 1) What is the difference between Energy meter and Wattmeter?
- 2) What are the types of Circuit breakers?
- 3) Explain the arc quenching phenomena in Air blast Circuit breaker?
- 4) What the components available in VISIO?

### Experiment. 3

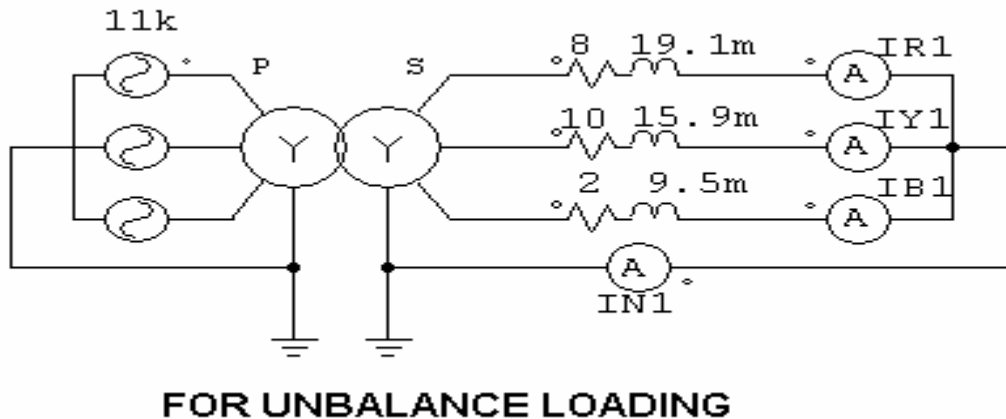
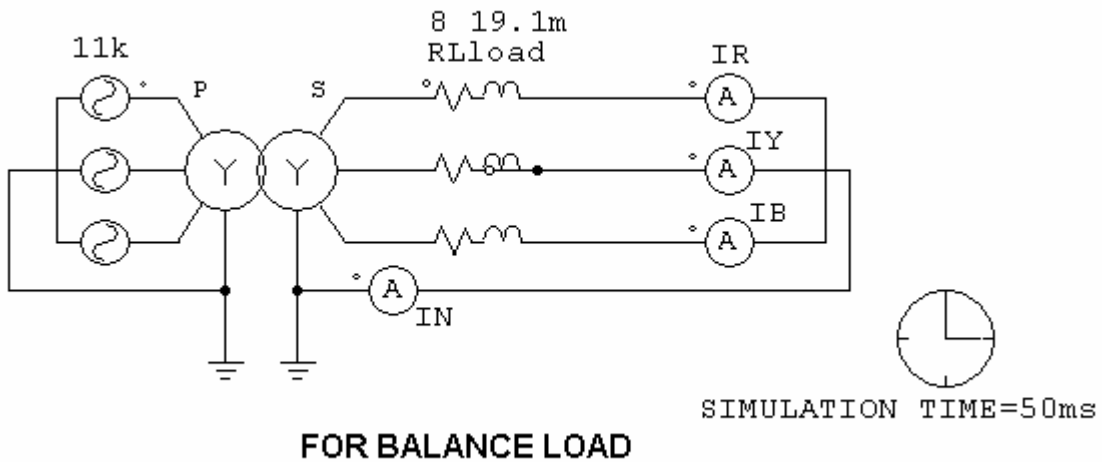
**Name of Experiment:** -To study the 3 Ø balance & unbalance system using PSIM Software.

**Problem :** A balanced star connected load of  $8 + j6 \Omega/\text{Ph}$ . is connected to balance 3 phase 440 V, Supply A 440 V supply is fed from 11KV /440 V 50Hz Y-Y, Transformer.

Case I : Find Line current and Neutral current

CaseII : Calculate Line current & Neutral Current of  $Z_R = 8 + j6$  ,  $Z_Y = 10 + j5$   
And  $Z_B = 2 + j3$

**Diagram :**



**Theory :** In this ckt load is connected to Secondary of Transformer which gives 440 V.A transformer used here is step down transformer as input voltage is 11KV and and output voltage is 440V . Primary and Secondary of Transformer are both

star Connected  $I_L = I_{ph}$   
 $V_L = \sqrt{3} V_{ph}$

**1) Balanced Load: -** A 3 $\phi$  load having same impedance & same power factor in each phase were called the balanced loads. It means that impedances in all the three phases ie.  $Z_1, Z_2, Z_3$  as shown in above fig. Are similar ie.  $Z_1 = Z_2 = Z_3$  and also the current flowing through neutral is equal to zero . This is what we call balanced condition.

**2) Unbalanced Load: -** A 3 $\phi$  load having different impedances and different Power factor is called as Unbalanced load. Ie.  $Z_1 \neq Z_2 \neq Z_3$  & also  $\cos\phi_1 \neq \cos\phi_2 \neq \cos\phi_3$  in this case current & power calculated in each phase will be different &  $I_N = I_R + I_Y + I_B$

**Result :** The balanced & Un-balanced Load by using PSIM Software were studied.

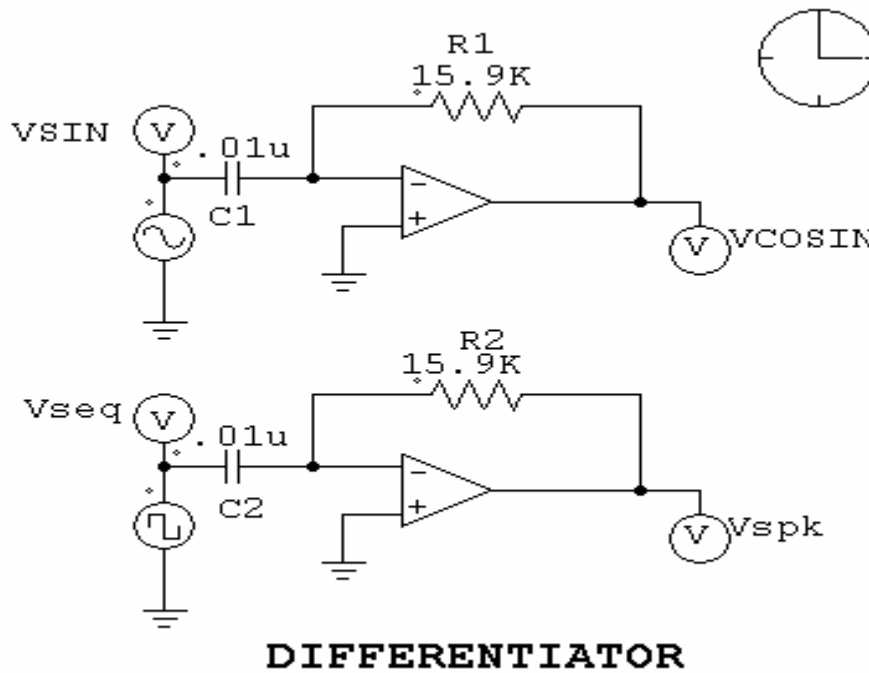
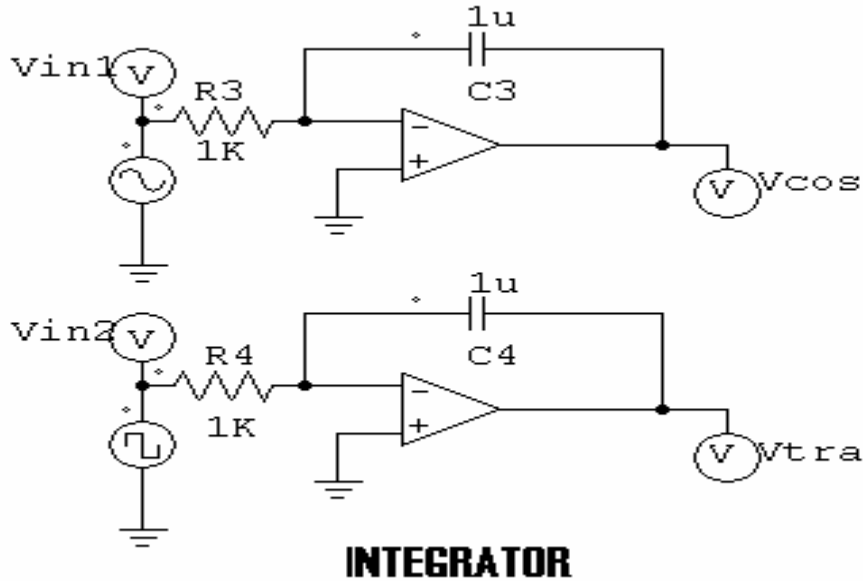
**Viva Questions: -**

- 1) What is Balanced and Unbalanced Load?
- 2) Explain the Torque -Speed Characteristics for balanced and Unbalanced load?
- 3) State the advantages of PSIM software?

### Experiment. 4

**Name of Experiment:** - To study Integrator & Differentiator using PSIM software using Operational amplifier.

**Ckt. Diagram :**



**Theory : Integrator :-** An integrator ckt or integrating amplifier is one in which the output voltage is the integration of the Input voltage. An integrator using operational amplifier is studied. This ckt. is derived from the feedback ckt. of basic inverting configuration of operational amplifiers by replacing feedback resistor by a capacitor. Here the O/p voltage is directly proportional to negative integral of Input voltage and inversely proportional to time constant  $R_1 C_F$

$$V_{out} = \frac{-1}{R_1 C_F} \int_0^t V_{in} dt + C$$

**C - integration time constant. At low frequency the integrator has very high gain.**

**Differentiator: -** The differential amplifier or differentiator Performs mathematical differentiation & output waveform is derivative of the Input waveform.

In this case the o/p voltage is equal to the  $R_F C_1$  times the derivative of the Input voltage  $V_{in}$ .

$$V_o = -R_F C_1 \frac{dv_{in}}{dt}$$

Negative sign indicates a phase shift  $180^\circ$  from Input to Output.

The magnitude of gain increases at a rate of 20 dB/ decade. This makes the ckt. unstable. Also the Input impedance decreases with increase in frequency which makes the Circuit susceptible to high frequency noise.

**Result :** The Integrator & Differentiator circuit are studied using PSIM software

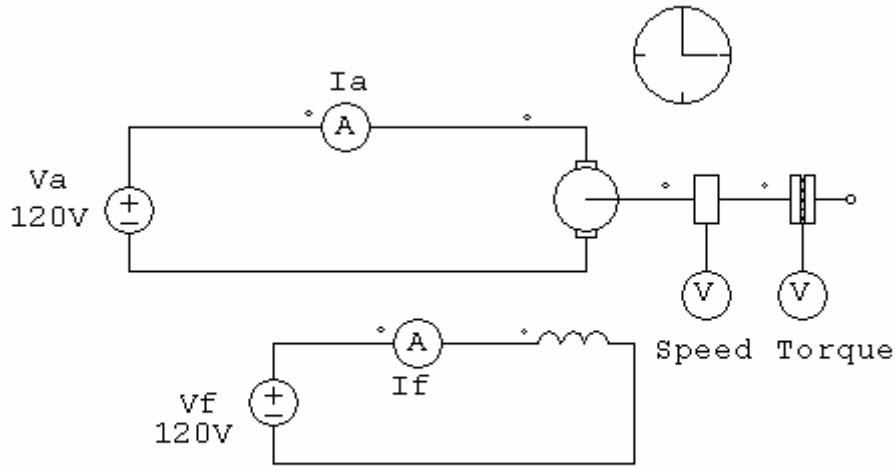
**Viva Questions: -**

- 1) What is the significance of Differentiator and Integrator circuit?
- 2) What differences were observed with different Inputs applied to the Differentiator and Integrator Circuit?
- 3) Explain the Significance of Differentiator and Integrator Circuit?

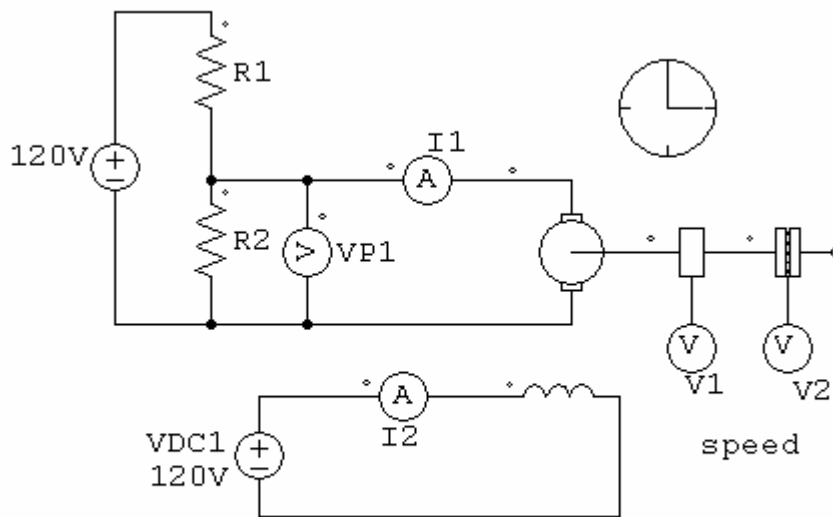
### Experiment. 5

**Name of Experiment:** - To study the speed control of DC motor using PSIM software.

**Ckt. Diagram :**

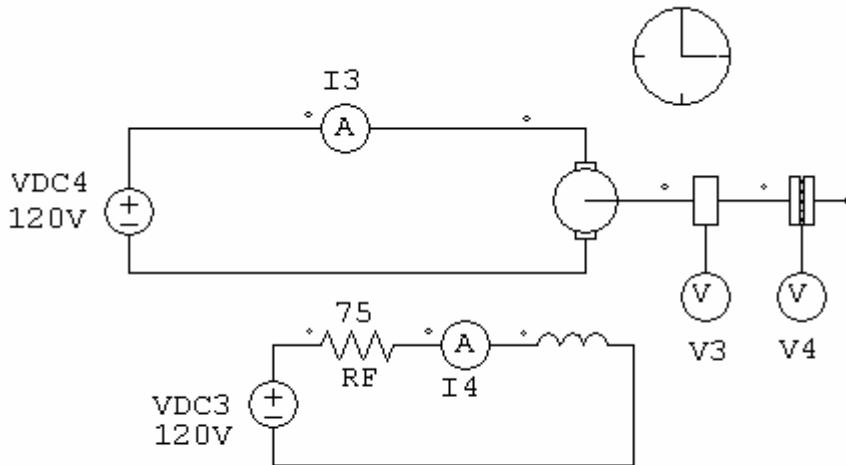


**DC MOTOR WITH CONSTANT SPEED**



**ARMETURE CONTROL OF DC MOTOR**





**FIELD CONTROL OF DC MOTOR**

**Problem :** A 120 v. separately excited DC motor runs at no load speed of 1200 rpm. The armature & shunt resistance are  $0.5\Omega$  &  $75\Omega$  respectively. obtain the speed, torque, armature current & field current using PSIM Software for the following cases.

1. When the motor runs at no load.
2. A resistance of  $0.5\Omega$  is connected in series with armature Windings.
3. A resistance of  $75\Omega$  is connected in series with field winding.

**Theory : PSIM Software**

It is a stimulation package especially for PE & Motor control with post Simulator uses friendly interface & waveform processing PSIM provides a Powerful stimulation environment for Power convertor analysis control loop design and motor Drive system studies.

**Motor Drive Model :**

It consists of machine model and Mechanical load models for Drive system Studies.

**Digital Control Models:** It Provides Discrete elements ,Z-domain transfer function blocks such as Integrator and Differentiator, Digital filter for digital control analysis

**Sim-Coupler :** The Sim- Coupler model provides Interface between PSIM and MATLAB

## Characteristics of DC Shunt Motor

DC motor is same as DC Generator :

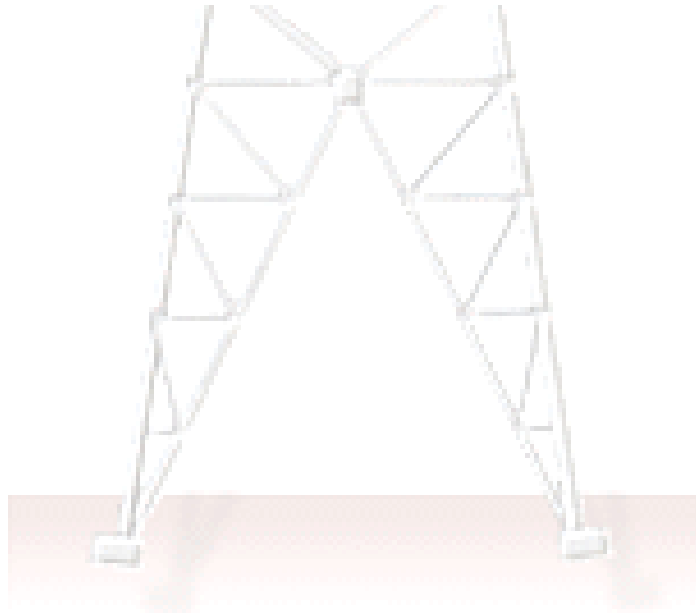
- 1)  **$T_a / I_a$  Characteristics** : Assuming  $\phi$  to be particularly constant we find  $T_a$  is Directly proportional to  $I_a$  thus the characteristics is a Straight line through Origin
- 2)  **$N / I_a$  Characteristics**: Since  $\phi$  is constant  $N$  is directly proportional to  $E_b$  as  $E_b$  Practical constant ,speed will remain constant for all values of load
- 3)  **$N / T_a$  Characteristics** : when Load Torque increases, armature current  $I_a$  increases but speed decreases slightly, Thus with increase in load speed decreases slightly.

**Result** : Thus, speed , Torque , Armature current & Field current are checked using PSIM software..



## Viva Questions: -

- 1) What is Drooping Characteretics
- 2) Why DC shunt motor is constant speed machine
- 3) What are the Different types of Loads available in PSIM software?

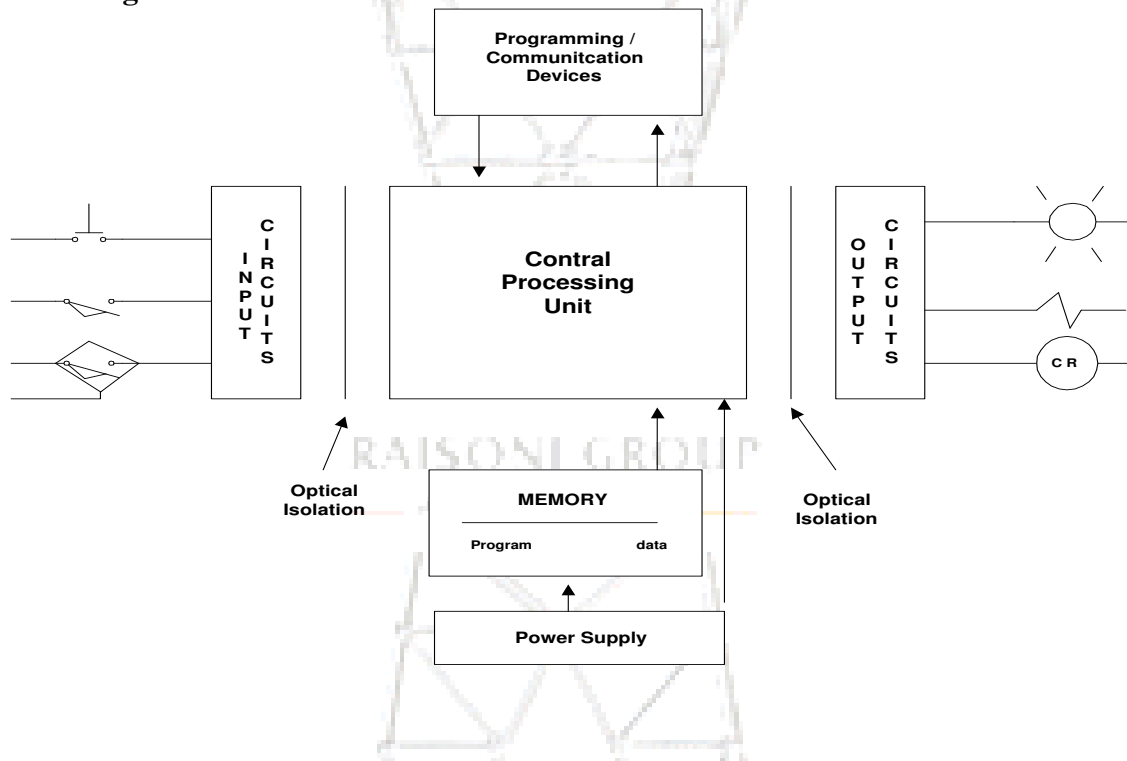


## Experiment. 6

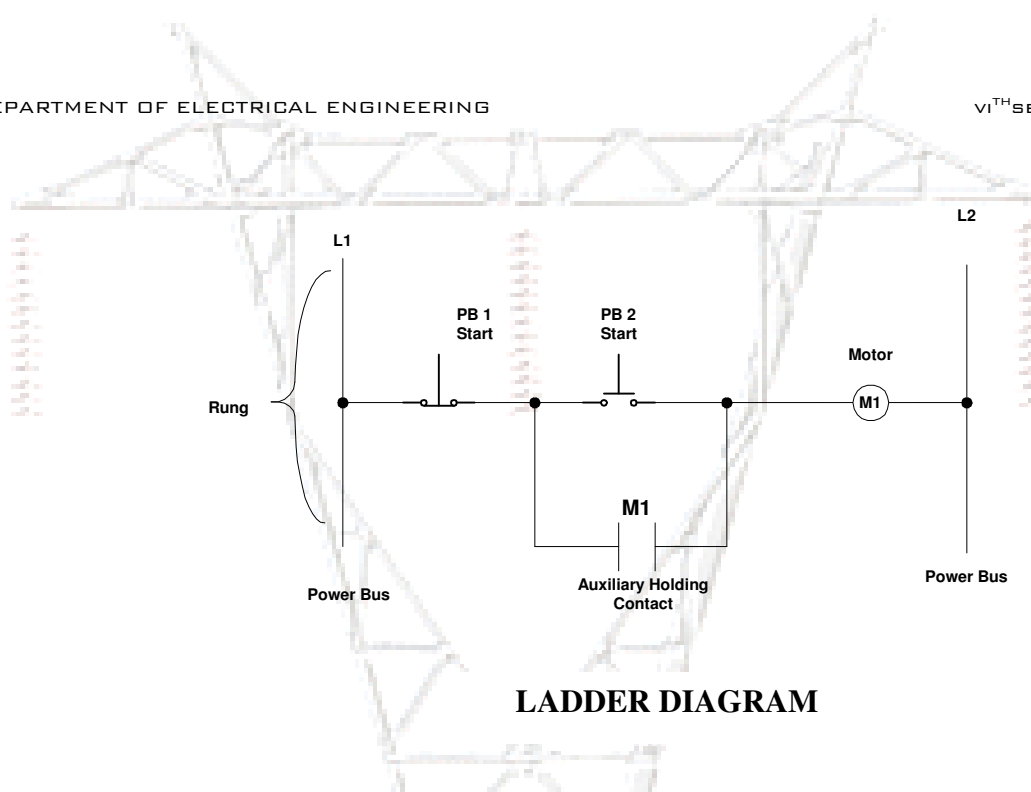
**Aim :** To Study Power circuit ,Control Circuit and Ladder diagram using PLC

**Problems :** A 3 Phase Induction motor is to be started and to be stopped with the help of DOL starter and 2 Push buttons. The motor will start when push button is pressed and motor will stop when stop button is pressed.. Also provide over load and short circuit protection to the motor.

**Ckt. Diagram :**



**PLC BLOCK DIAGRAM**



**LADDER DIAGRAM**

**Theory :** PLC is an Electronic device that control machines and Processes it uses a programmable memory to store Instructions and execute specific functions that includes ON/OFF control ,Timing, Counting ,Sequencing and Arithmetic and data Handling.

### Components Overview :

**Inputs :** The Input terminals on a PLC forms the Interface by which field devices are connected to PLC. Inputs include push buttons, Proximity switches and Photoelectric sensors

**Outputs :** Connected to the output terminals are PLC devices such as solenoid valves, relays, contactors, motor starters ,Indicator lights, valves and alarms. Output circuits operate in a manner similar to Input circuits. Signals from the CPU pass through an isolation barrier before energizing output circuits. PLCs uses a variety of output circuits to energize their output terminals, relays , transistor and traics

**Central Processing Unit (CPU) :** The CPU ,made up of a microprocessor and a memory system, forms the primary component of the PLC .The CPU reads the Input , executes logic as dictated by the application programme, performs calculations, and controls the output accordingly.

**Data , Memory and Addressing :** Memory is a physical space ,data is information is stored in that space .The CPU operates just like a Computer , it manipulates data using binary digits, or bits. A bit is a discrete location within a silicon chip that either has a voltage present ,read as value of 1(ON) or 0 ( OFF).Thus data is a pattern of Electrical charges that represents a numerical value.

**Ladder Diagram :** The figure is ladder representation .Ladder Logic programme evolved from the electrical ladder diagram ,which represent how electrical current flows through the device to complete an electric circuits .These diagram shows electric connections, between electrical devices in an easy –to read graphical format .Each electrical circuit in the diagram is considered a rung. Every rung as two key components: it contains at least one device that is controlled, and it contains conditions that control the device, such as power from the bus or a contact from a field device. A rung is said to have electrical continuity, when current flows uninterruptedly from left to right across the rung.

### Advantages of PLC

- 1) No internal windings
- 2) High Reliability, simple, cheap
- 3) Ability to communicate with computer
- 4) Complete replacement to Hardwired Panel

**Result:** Power Circuit, Control Circuit and Ladder diagram of DOL starter Using PLC is studied.

### Viva Questions: -

- 1) What are the advantages of using PLC
- 2) What are the Programming Devices used to Programme PLC
- 3) Explain the addressing modes in PLC
- 4) What are I/O and O/P Devices

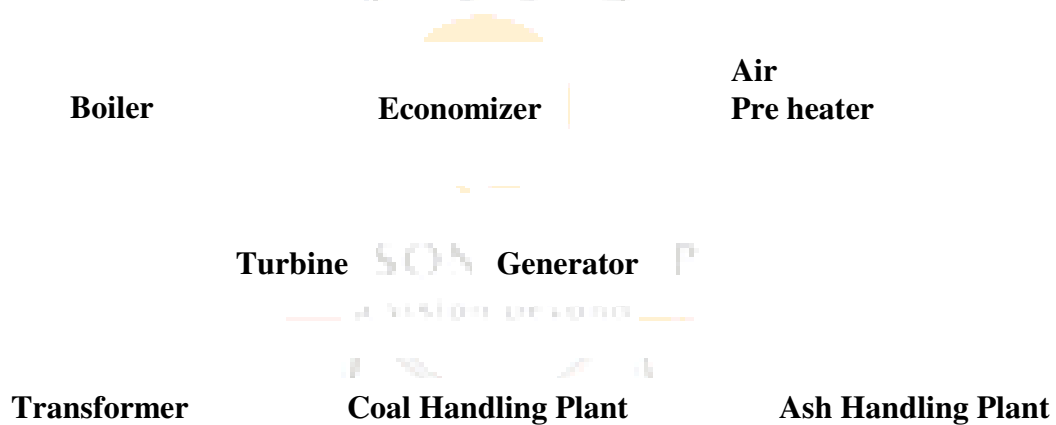
## Experiment. 7

**Aim :** To Draw Thermal Power Plant Layout using VISIO

**Theory :**

- 1) What are the Parameters you while consider when you will Design Thermal Power Plant
- 2) How will you decide Ratings of the Transformer?
- 3) How will you handle the Ash?
- 4) Which types of Turbines are used in the power plants and why?

**Diagram:** Draw using Visio (Use Blocks from Visio Library)  
The main Equipments are shown: Arrange them to Design a Thermal Power Plant



**Result :** Thermal power Plant using Visio was designed

### Viva Questions: -

- 1) Why Geographical location is Important in Deciding where Power Plant should be Located?
- 2) What is Economizer
- 3) What is the use of Boiler
- 4) Explain Ash handling Plant

## Experiment. 8

**AIM :** To Design a motor using MOTORPRO software

**Theory :** MOTORPRO software is used for Design of Switched Reluctance motor, Brush less DC motor and Induction motor. We are Designing Switched Reluctance motor. The Principal of Switched Reluctance motor is The stator EMF gets shifted and the rotor tries to align with the stator mmf creating motion. The advantage is that the rotor and the stator never gets Locked. 8/6 motor is Designed I .e. ( 6-Stator Poles and 4-Rotor Poles.)

### Design Specification:

No of Stator Poles	6
No of rotor poles	4
Stator Outer Radius	61 mm
Stator Inner radius	33 mm
Air gap	0.3 mm
Thickness of stator pole	13 mm
Stator Inner radius	33 mm
Air gap	0.3 mm
Thickness of stator pole	13 mm
Rotor Outer Radius	32.7 mm
Rotor Inner Radius	23 mm
Thickness of rotor pole	15.8 mm
Material	Steel
windings	Concentric
Speed	3000 rpm

**Result :** Using MOTORPRO Switched Reluctance Motor is Designed

**Viva Question:**

- 1) What is the Principal of working of Switched Reluctance Motor
- 2) What are the advantages of Designing the motor in MOTORPRO Software
- 3) What is Finite Element Analysis
- 4) Why Designing is Important



RAISONI GROUP  
— a vision beyond —

