THAPAR POLYTECHNIC COLLEGE

SECOND MID SEMESTER ASSIGNMENT

Department: Electrical Engineering **Semester: 6th**

Subject: Electrical Power-II (5229) **Teacher Name: Nitish Singla**

Q1. Define (i) Prospective Current (ii) Cut-off current (iii) Arcing time (iv) Breaking Capacity
Q2. What is a protective relay? Explain its essential elements with the help of a block diagram.
Q3. Explain the construction and working of Thermal relay.
Q4. Draw the labelled diagram of Induction type Overcurrent relay.
Q5. Explain the Buchhloz Relay protection scheme for protection of transformer.
Q6. Explain the Merz Price protection scheme for protection of alternators.
Q7. Explain the differential protection scheme for protection of feeders.

THAPAR POLYTECHNIC COLLEGE

THIRD MID SEMESTER ASSIGNMENT

Department: Electrical Engineering **Semester: 6th**

Subject: Electrical Power-II **Teacher Name: Nitish Singla**

Q 1- What are the internal and external causes of over-voltages.
Q 2- What is lightning arrestor? What is the necessity of using lightning arrestor?
Q 3- Explain Rod Gap arrestor with the help of suitable diagram.
Q 4- What is tariff? What are its main objectives?
Q 5- Explain: (a) Block rate tariff (b) Two-part tariff (c) Block rate tariff with minimum charges.

Thapar Polytechnic College, Patiala

Students' Progressive Assessment (Theory) Sheet for Session Jan2020 - May2020

Seminar Topics

Branch: Electrical Engg.
Semester: 6th

Subject: Electrical Power-II
Code: 5229

S.No	Name of the student	Roll No.	Seminar Topic
1.	Abhishek	2017/81	Faults in Overhead System
2.	Akash Kumar	2017/82	Faults in Underground Cables
3.	Akshdeep Singh	2017/83	Blavier's test
4.	Amritpal Singh	2017/84	Murray Loop Test
5.	Ankush Pandey	2017/86	Varley Loop Test
6.	Ashish Jindal	2017/87	Switchgear and its purpose
7.	Balwinder Singh	2017/88	Switch, Isolator & Circuit breaker
8.	Bikram Singh	2017/89	Operating Principle of Circuit breaker
9.	Bobby Sharma	2017/90	Arc Phenomenon in C.B.
10.	Damanpreet Singh	2017/91	Principle of Arc extinction
11.	Deepak Gupta	2017/92	Methods of Arc extinction
12.	Deepak Ram	2017/93	Bulk oil circuit breaker
13.	Deepak Singh	2017/94	Plain break oil circuit breaker
14.	Dishant Joshi	2017/95	Self-generated pressure oil circuit breaker
15.	Gagandeep Sharma	2017/96	Externally generated pressure oil circuit breaker
16.	Gaurav Garg	2017/97	Minimum oil circuit breaker
17.	Gautam	2017/98	Cross blast Air blast circuit breaker
18.	Gunjot Singh	2017/99	Axial blast Air blast circuit breaker
19.	Gurpreet Singh	2017/100	SF_6 and its properties

20.	Harinderpal Singh	2017/101	Vaccum Circuit breaker
21.	Harsh Thakur	2017/103	SF_6 Circuit breaker
22.	Harwinder Singh	2017/104	Bus bar arrangements
23.	Jagjeet Singh	2017/105	Substation equipments
24.	Japkirat Singh	2017/106	MCB and its working
25.	Jivesh Bhambri	2017/107	ELCB and its working
26.	Madhur Jain	2017/109	Features of good protective gear
27.	Manpreet Singh	2017/111	Fuse and its materials
28.	Manpreet Singh	2017/112	Low voltage fuses
29.	Mukul Rahela	2017/113	High voltage fuses
30.	Navdeep Singh	2017/114	Relay and its elements
31.	Parvesh Noria	2017/115	Thermal Relay and its working
32.	Pooja Rani	2017/116	Electromagnetic attraction type relay
33.	Prabhjot Singh	2017/117	Induction type over current relay
34.	Prabhsimran Singh	2017/118	Induction type reverse power relay
35.	Prince Goyal	2017/119	Directional over-current relay
36.	Prince Thakur	2017/120	Distance type impedance relay
37.	Rajnish Pushkar	2017/121	Current balance differential relay
38.	Rajwinder Singh	2017/122	Earthing and its purpose
39.	Ram Kumar	2017/123	System Earthing
40.	Ramandeep Singh	2017/124	Equipment Earthing
41.	Rekha Rani	2017/125	Types of faults in alternators
42.	Rishab	2017/126	Merz price protection of alternator
43.	Sahil	2017/127	Balanced earth fault protection
44.	Sahil Dhall	2017/128	Buccholz relay protection

45.	Sakshi Sharma	2017/129	Earth fault or leakage protection
46.	Sanskar Sagar	2017/130	Combined leakage and over load protection
47.	Simarpreet Kaur	2017/135	Merz price protection of transformer
48.	Shiv Kumar	2017/131	Bus bar protection
49.	Shivreet Singh	2017/132	Time graded protection for radial feeders
50.	Shobit Kumar	2017/133	Time graded protection for parallel feeders
51.	Shubhdeep Singh	2017/134	Ring mains protection
52.	Snehdeep Sharma	2017/136	Differential protection
53.	SonuGarg	2017/137	Distance protection
54.	Taranbir Singh	2017/138	Internal causes of over-voltages
55.	TusharGautam	2017/139	External causes of over-voltages
56.	Vikas Kumar	2017/140	Protection against over-voltages
57.	Vishal Kumar Bawa	2017/141	Lightning arrestor and its properties
58.	Gautam	2018/147	Rod gap arrestor
59.	Inderjeet Singh	2018/148	Horn gap arrestor
60.	Komalpreet Singh	2018/149	Thyrite arrestor
61.	Labh Singh	2018/150	Valve type arrestor
62.	Narinder Kumar	2018/152	Important terms of economic generation
63.	Sachin	2018/153	Tariff and its objectives
64.	Sandeep Singh	2018/154	Simple, Flat rate tariff
65.	Simranjit Singh	2018/155	Block rate, two-part tariff
66.	Vikas Kumar	2018/156	Power factor, block rate with minimum charge tariff
67.	Gurwinder Singh	2017/577	Power line carrier communication (PLCC)

YouTube Links

- https://youtu.be/fLVzvMTgGDY
- https://youtu.be/cunddFiQzrk
- https://youtu.be/jwuEZMpTS3Q
- https://youtu.be/dPlnm2zoirA

11. ELECTROMAGNETIC ATTRACTION TYPE RELAYS

Electromagnetic attraction type relays are operated by virtue of an armature being attracted towards the poles of an electromagnet.

These relays may be actuated by d.c. or a.c. quantities.

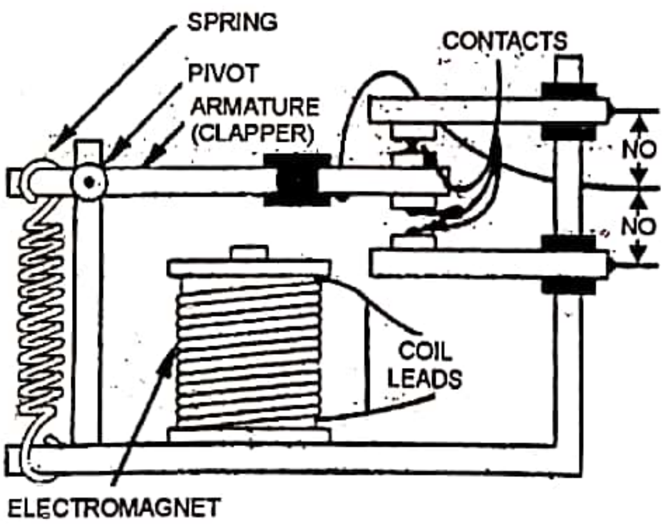
Construction

The schematic diagram of an electromagnetic attraction type relay is shown in fig. 11. It consists of a magnet which carries a relay coil having number of tappings. The armature is held by the spring attached to it. The armature has spring loaded moving contact which bridges the trip coil circuit.

Working

Under normal conditions, the current flowing through the relay coil is such that spring tension (F_s) is more than the attractive force of the electromagnet F_e (*i.e.* $F_s > F_e$). Therefore, armature is held in the open position (terminal *B* and *C*). However, when fault occurs, current flowing through the relay coil increases. This increases the attractive force of the electromagnet. At the instant when $F_e > F_s$ the armature is tilted down wards and the moving contact bridges the fixed contacts. This closes the trip coil circuit.

The current setting can be adjusted by changing the number of turn of relay coil (by changing the tapping). The larger number of turns are introduced in the operating coil, the smaller is the value of actuating current. The time setting can be adjusted by changing the tension of spring by a screw.



(a)

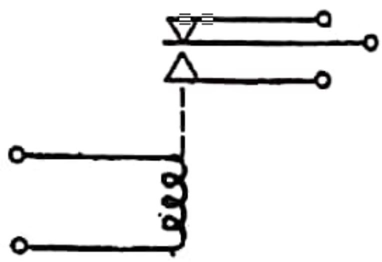

(b)

Fig. 11

Terminal *AC* act as normally closed (*NC*) terminals. These two terminals can also be used for the operation of another circuit.

12. INDUCTION RELAYS

The basic principle of operation of these relays is electromagnetic induction. These relays are only actuated by a.c. An induction relay essentially consists of a pivoted aluminum disc placed in between two alternating fields of the same frequency but displaced from each other by some angle (see fig. 12). A torque is produced in the disc by the interaction of the two fields. Such relays may be over current, reverse power or directional over-current relays as discussed in the coming articles.

3. Plug-setting multiplier (PSM)

The ratio of fault current in relay coil to the value of pick- up current is known as plug-setting multiplier (PSM).

$$PSM = \frac{\text{Fault current in relay coil}}{\text{Pick-up current}}$$

$$= \frac{\text{Fault current in relay coil}}{\text{Rated secondary current of } CT \times \text{Current setting}}$$

For instance, if a relay is set at 150% and it is connected to the system through a CT of ratio 400/5 A, then for a fault current of 1800 A, the plug-setting multiplier (PSM) in calculated as under:

Pick-up current = Rated secondary current of CT × Current setting

$$= 5 \times 1.5 = 7.5 \text{ A}$$

$$\text{Fault current of relay coil} = \frac{5}{400} \times 1800 = 22.5 \text{ A}$$

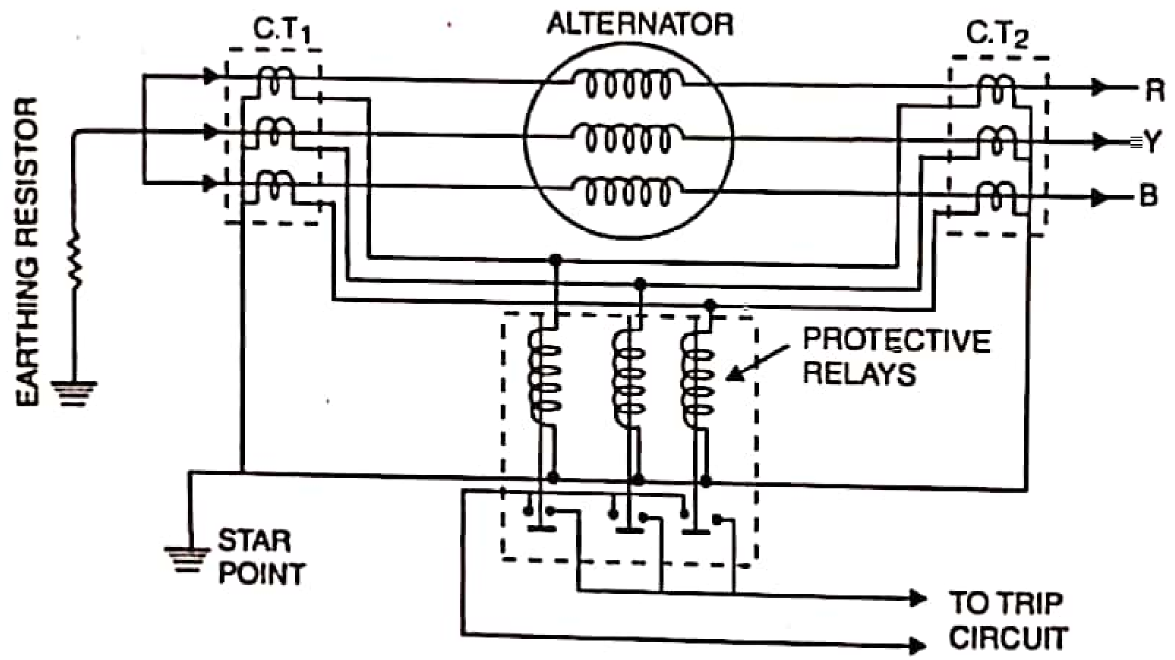
$$\therefore \quad PSM = \frac{22}{7.5} = 3$$

2. MERZ PRICE PROTECTION OF ALTERNATORS

This is the most common form of protection scheme employed for stator winding faults. It operates on the principle of differential circulating current system.

Schematic Arrangement

The schematic arrangement of *Merz Price Protection System* for the protection against internal faults of a 3-phase alternator is shown in fig. 3. Identical current transformer sets CT_1 and CT_2 are placed on either side of each phase of the stator winding. The secondaries of each set of current transformers are connected in star. The star points and the corresponding terminals of both the sets of *CTs* are connected across the mid points of the connected wires and star point.

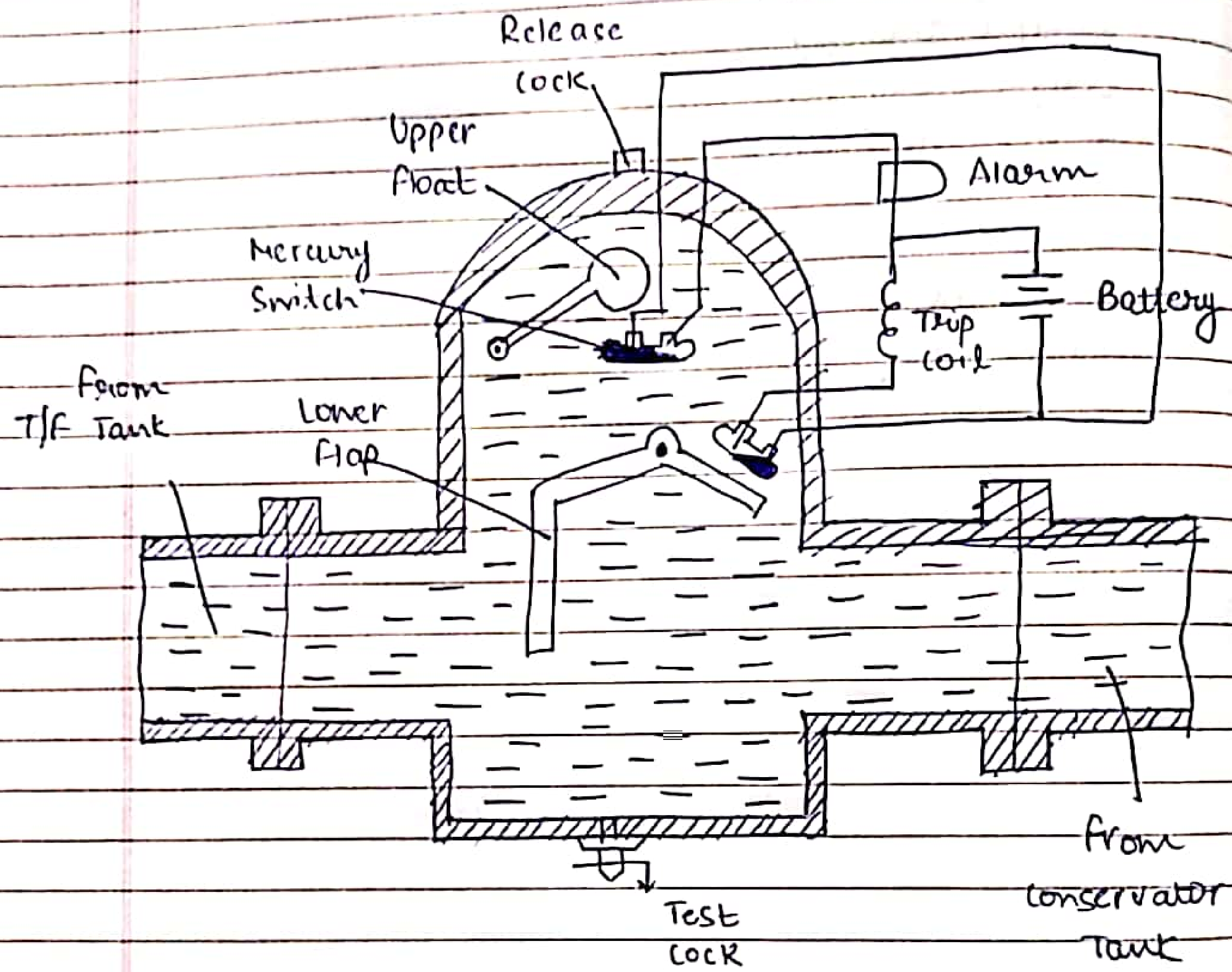


MERZ PRICE PROTECTION ON ATERNATOR

Fig. 3

Operation

Under normal operating conditions, current at both the ends of each winding are equal. So equal e.m.fs are induced in the secondaries of current transformers and hence no current flows through the protective relays. However, when fault occurs in the stator winding (due to insulation failure), different current flows at the two ends of the stator winding. This results in difference in induced *e.m.fs* in secondaries of *CTs* placed on two ends and causes a flow of current in the protective relay which closes the trip coil circuit.



Release
cock
Upper
Float
Alarm
Mercury
Switch
Battery
Trip
coil
From
T/F Tank
Lower
Flap
Test
cock
From
conservator
Tank

23. EARTHING

The process of connecting metallic bodies of all the electrical apparatus and equipment to the huge mass of earth by a wire of negligible resistance is called **earthing.**

When a body is earthed, it is basically connected to the huge mass of earth by a wire having negligible resistance. Thus, the body attains zero potential of the earth. This ensures that whenever a live conductor comes in contact with the outer body, the charge is released to the earth immediately.

24. PURPOSE OF EARTHING

The basic purpose of earthing is to protect the human body (operator) from electric shock.

To illustrate the purpose of earthing consider an electrical circuit shown in fig. 25 where an electrical appliance of resistance R is connected to the supply through a fuse and a switch. When the operator touches the metallic body of the apparatus (see fig. 25 (*a*)) having perfect insulation. The equivalent circuit is shown in fig. 25 (*b*). Where two parallel paths are formed. Since the insulation resistance R_i is very high as compared to appliance resistance R, whole of the current flows through appliance resistance and no current flows through the operator's body resistance.

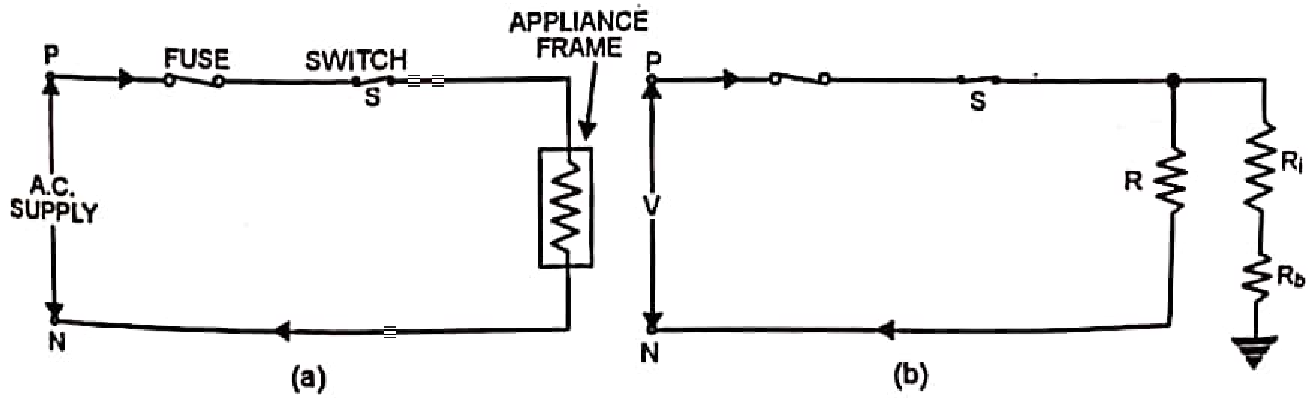


Fig. 25

When earth fault occurs, the live (phase) wire directly comes in contact with the outer body and the insulation resistance is rerduced to zero as shown in fig. 25 (*c*). Now the body resistance comes just in parallel with the appliance resistance. A heavy current flows through the operator's body and he/she gets a severe shock.

1. CAUSES OF OVER-VOLTAGES

The over-voltages may occur in the power system due to

(*i*) Internal Causes

(*ii*) External Causes

2. INTERNAL CAUSES OF OVER-VOLTAGES

The over-voltages may occur in the power system due to internal causes. These are mainly due to the oscillations set up by the sudden changes of circuit conditions or by resonance effects. The prominent internal causes of overvoltages have been discussed below :

(*i*) **Switching surges :** Making or breaking operation of the circuit breaker produces a sudden change in the circuit conditions which put the circuit under transient state. This results in travelling waves being set up in the circuit.

A typical example of this is when as open ended line is switched *ON*, a voltage wave travels along the line and on reaching the far end, it is reflected without change of sign, thereby producing double voltage at the end. The reflected wave travels back to the supply end and gives rise to further reflections. However, because of the losses in the line the wave gradually suppresses and the line ultimately attains the normal voltage.

Hence, the maximum potential attained by the line at the instant of switching can not be more than twice the maximum value of system voltage (V_m).

Similarly, when a line carrying load suddenly opened, a transient voltage is produced. The worst case is when the circuit is interrupted at the peak value of short circuit current. However, under abnormal conditions, a.c. circuit breakers open the circuit only at the instant when current is zero.

(ii) Arcing grounds : The phenomena of arcing grounds is commonly experienced with insulated neutral system. In a 3-phase transmission line, each line has an inherent distribution capacitance effect with respect to earth as shown in fig. 1. When earth fault occurs on one of the phases, the capacitance between the other lines is charged and discharged repeatedly. Such repeated charging and discharging of line to ground capacitance results in repeated arcs between line and ground is called arcing ground.

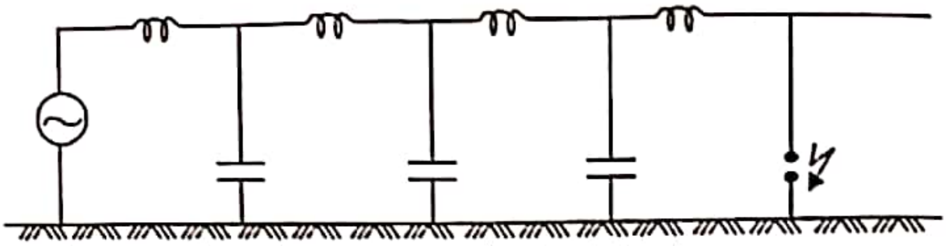


Fig. 1

Arcing ground produce severe voltage oscillations reaching three to four times normal voltage. However, this effect is reduced by connecting neutral to earth by a peterson coil.

(iii) Insulation failure : In a power system the insulation failure may occur between phases or between any phase and earth. The failure of insulation between any phase and earth is very frequent. This reduces the potential at fault point suddenly from maximum to zero and results in a negative voltage wave of very steep front in the form of surge which travels in both the directions.

(iv) Resonance : This condition occurs in the power system only when inductive reactance of the system is equal to the capacitive reactance. Under normal condition at power frequency, the inductive reactance of the system is very large is comparison to that of capacitive reactance. However, under fault conditions at higher frequency waves, the resonance may occur which produces travelling waves. But this condition occurs very rarely in power system.

Thus, it is conclude that the internal causes generally produce voltages of twice the normal value of operating voltage of the system.

3. EXTERNAL CAUSES OF OVER-VOLTAGES

The dangerous over-voltages are mainly caused due to lightning. This is called an external cause of over-voltage. In the high voltage systems, much damage is caused by the lightning inspite of taking all types of protective measures. In this case, voltage may rise to several times to that of normal operating voltage of the power system.

Lightning : *An electrical discharge in the air between clouds, between the separate charge centres in the same cloud or between cloud and earth is called* **lightning.**

As a result of certain atmospheric processes that take place during thunder-storms, positive and negative charges are accumulated on the clouds or on the portion of the clouds. As the amount of these charges increases, the potential gradient between the positively and negatively charged clouds or between the charged clouds and earth increases. At a certain potential gradient (5 to 10 kV/cm), the air breaks down and flash occurs, which is called a lightning stroke. There are two ways in which lightning stoke can effect a line *i.e.*

(*i*) Direct stroke (*ii*) Indirect stroke.

(*i*) Direct stroke : The direct stroke may further be classified as *A*-stroke and *B*-stroke.

PUNJAB STATE
POWER CORPORATION LIMITED
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Ph No : 1912
Email : cn-commercial@pspcl.in
Website: www.pspcl.in
CIN : U40109PB2010SGC033813

ELECTRICITY BILL DS GEN

DATE: 23-11-2019 TIME: 10:56:10

BILL CUM NOTICE NO: 6538919K231056026
SUB. DIV. CODE : 4271 CYCLE: 5 GRP: 2
SUB DIVISION NAME :EAST COMMERCIAL (CIV
DIVISION NAME :
CIRCLE NAME :
CONSUMER NO :P12MF250320P
CONTRACT A/C No :3000037482
NAME:MANMOHAN SINGLA
ADDRESS:PATIALA . NARULA COLONY HEMRAJ SINGLA
PTA

ACD: 1500 METER SECURITY : 0

DUE DATE CASH/ONLINE :09-12-2019
DUE DATE CHEQUE/DD :06-12-2019

COMPLAINT CENTER PHONE NO.:1912
NEAREST CASH COUNTER :0.000

CAT: DS SUB.CAT: GEN PHASE CODE: 1
MTR NO: 225783 IND: TF/C:
METER MPL:1 OVERALL MF: 1
SL : 6.42 CD:
METER LOCATION :INSIDE
METER TYPE :MECHANICAL

READING	PREVIOUS	CURRENT	UNITS
KWH :	75283	75842	559
STATUS :	0	0	
BILL TYPE :	NORMAL	NORMAL	
DATE :	23/09/2019	23-11-2019	

DAYS : 61
CONS : 559 OLD MTR. CONS. :0
TOTAL CONSUMPTION :559

Curr EC	Curr FC	Curr ED	Infr.CESS	OCT/MT
3364	464	581	193	77

METER RENT	SERVICE RENT	MCB RENT
16	0	8

SERVICE CHGS	FCA CHGS	PF SU CHG	COWCES
0	25	0	11

	SOP	ED	OCT/MT/CC
CURRENT	3854	501	88

NET SOP	NET ED	NET OCT/CC/MT	TOTAL
3854	501	88	4443

INFRASTRUCTURE DEVELOPMENT CESS : 193
TOTAL RENTS : 24
TOTAL CHARGES : 4660
ROUNDING PREV : 2 ROUNDING PRES: 0

TOTAL PAYABLE : 4660
LATE PAYMENT CHARGES : 93
PAYMENT AFTER DUE DATE : 4753

SUNDRY DETAILS :

Interest @ 1.5% on unpaid amount 15 days after expiry of due date

LAST 6 CONSUMPTIONS HISTORIES :
H1 : 1172 H2 : 1436 H3 : 803
H4 : 388 H5 : 405 H6 : 524

METER BY PSPCL - USE PSPCL APP
Signature

3000037482000466009L19

Save Electricity and help the Nation

For Permanent Record Please Keep Photocopy of the Bill

5 ਬਿੱਲ ਦੀ ਅਦਾਇਗੀ ਸਬੰਧਤ ਉਪਮੰਡਲ ਵਿਚ ਕਿਸੇ ਵੀ ਕੰਮ ਕਾਜ ਵਾਲੇ ਦਿਨ ਸਵੇਰੇ 9.00 ਵਜੇ ਤੋਂ ਦੁਪਹਿਰ ਬਾਅਦ 3.00 ਵਜੇ ਤੱਕ ਕੀਤੀ ਜਾ ਸਕਦੀ ਹੈ।

6. ਬਿਜਲੀ ਦੇ ਬਿੱਲਾਂ ਸਬੰਧੀ ਸ਼ਿਕਾਇਤ ਲਈ ਸਬੰਧਤ ਸਹਾਇਕ ਇੰਜੀ /ਸ ਕਾ: ਕਾ: ਇੰਜੀ ਨੂੰ ਮਿਲਿਆ ਜਾਵੇ। ਸ਼ਿਕਾਇਤ ਹੱਲ ਨਾ ਹੋਣ ਦੀ ਸੂਰਤ ਵਿੱਚ ਇਸਨੂੰ ਸਬੰਧਤ ਸੀਨੀ: ਕਾਰਜਕਾਰੀ ਇੰਜੀ ਜਾਂ ਨਿਗਰਾਨ ਇੰਜੀ /ਮੁੱਖ ਇੰਜ ਦੇ ਧਿਆਨ ਵਿੱਚ ਲਿਆਂਦਾ ਜਾ ਸਕਦਾ ਹੈ। ਖਪਤਕਾਰ P.S.P.C.L. ਵਲੋਂ ਡਵੀਜਨ /ਸਰਕਲ/ਜੋਨਲ ਪੱਧਰ ਤੇ ਝਗੜਾ ਨਿਪਟਾਊਣ ਲਈ ਗਠਿਤ ਕਮੇਟੀ ਕੋਲ ਵੀ ਬਿਲ ਸਬੰਧੀ ਲਿਖਤੀ ਸ਼ਿਕਾਇਤ ਲੈ ਕੇ ਜਾ ਸਕਦਾ ਹੈ।, ਜੇਕਰ ਫਿਰ ਵੀ ਇਸ ਦਾ ਕੋਈ ਹੱਲ ਨਹੀ ਹੁੰਦਾ ਤਾਂ ਖਪਤਕਾਰ ਸ਼ਿਕਾਇਤ ਨਿਵਾਰਣ ਲਈ ਬਣਾਈ ਫੋਰਮ ਵਿੱਚ ਲਿਖਤੀ ਸ਼ਿਕਾਇਤ ਲੈ ਕੇ ਜਾ ਸਕਦਾ ਹੈ। ਫੋਰਮ ਦੇ ਫੈਸਲੇ ਸਬੰਧੀ ਖਪਤਕਾਰ ਓਬਡਸਮੈਨ ਕੋਲ ਆਪਣੀ ਅਪੀਲ ਕਰ ਸਕਦਾ ਹੈ। ਖਪਤਕਾਰ ਸ਼ਿਕਾਇਤ ਨਿਵਾਰਣ ਫੋਰਮ ਅਤੇ ਓਬਡਸਮੈਨ ਦਾ ਪਤਾ ਹੇਠ ਲਿਖੇ ਅਨੁਸਾਰ ਹੈ।

ਨਿਯਤ ਮਿਤੀ ਤੋਂ 15 ਦਿਨ ਤੱਕ 2% ਸਰਚਾਰਜ ਲੱਗੇਗਾ ਅਤੇ ਇਸ ਤੋਂ ਬਾਅਦ ਖਪਤਕਾਰਾਂ ਨੂੰ ਬਕਾਇਆ ਰਕਮ ਤੇ 1.5% ਪ੍ਰਤੀ ਮਹੀਨਾ ਵਿਆਜ ਦੇਣਾ ਹੋਵੇਗਾ।

Chairman Consumer Grievances Redressal Forum
Patiala - White House ,Rajpura Road , Tel.No. 0175-2215908

S.A.S Nagar- Ombudsman Electricity, Punjab Plot No. A-2,66 KVS/STN, Indl.,Area, Phase-I, S.A.S Nagar(Mohali) Tel.No. 0172-2274576

Ludhiana- 220 KV S/Stn. Opp. Verka Milk Plant, Ferozpur Road,Ludhiana Tel. No. 0161-2971912 Email- secy.cgrfldh@gmail.com

ਪੰਜਾਬ ਸਟੇਟ ਪਾਵਰ ਕਾਰਪੋਰੇਸ਼ਨ ਲਿਮਿਟਡ

Regd. Office: PSPCL Head Office, The Mall, Patiala - 147001

ਬਿਜਲੀ ਦਾ ਬਿੱਲ

Website : www.pspcl.in
CIN : U40109PB2010SGC033813,
E-mail :- ce-commercial@pspcl.in ,Ph. 0175-2214495

ਟੈਰਿਫ (ਬਿਜਲੀ ਦੇ ਰੇਟ 01-06-2019 ਤੋਂ)

ਨੰ. ਸ਼੍ਰੇਣੀ	ਟੈਰਿਫ (ਦਰ ਸੂਚੀ) ਪ੍ਰਤੀ ਮਹੀਨਾ/ਪ੍ਰਤੀ ਯੂਨਿਟ		ਬਿਜਲੀ ਕਰ	ਐਮ ਸੀ ਕਰ	ਇੰਧਨ ਦੇ ਖਰਚੇ ਤੇ ਸਰਚਾਰਜ
1. ਘਰੇਲੂ ਵਰਤੋਂ ਵਾਸਤੇ	0 ਤੋਂ 2 ਕਿਲੋਵਾਟ ਤੱਕ		ਬਿਜਲੀ ਦੇ ਖਰਚੇ + ਪੱਕੇ ਖਰਚੇ ਦਾ 13% (ਸ਼ਹਿਰੀ ਖੇਤਰ), 15% (ਪੇਂਡੂ ਖੇਤਰ)	ਮੌਜੂਦਾ ਹਦਾਇਤਾਂ ਅਨੁਸਾਰ	ਮੌਜੂਦਾ ਹਦਾਇਤਾਂ ਅਨੁਸਾਰ
	ੳ) 0 ਤੋਂ 100 ਯੂਨਿਟਾਂ ਤੱਕ	4.99 ₹			
	ਅ) 101 ਤੋਂ 300 ਯੂਨਿਟਾਂ ਤੱਕ	6.59 ₹			
	ੲ) 300 ਤੋਂ ਉਪਰ ਯੂਨਿਟਾਂ ਤੇ	7.20 ₹			
	2 ਤੋਂ 50 ਕਿਲੋਵਾਟ ਤੱਕ				
	ੳ) 0 ਤੋਂ 100 ਯੂਨਿਟਾਂ ਤੱਕ	4.99 ₹			
	ਅ) 101 ਤੋਂ 300 ਯੂਨਿਟਾਂ ਤੱਕ	6.59 ₹			
	ੲ) 301 ਤੋਂ 500 ਯੂਨਿਟਾਂ ਤੱਕ	7.20 ₹			
	ਸ) 500 ਤੋਂ ਉਪਰ ਯੂਨਿਟਾਂ ਤੇ	7.41 ₹			
	ਪੱਕਾ ਖਰਚਾ ਪ੍ਰਤੀ ਮਹੀਨਾ				
	0 ਤੋਂ 2 ਕਿਲੋਵਾਟ ਤੱਕ	35₹ / ਕਿ:ਵਾ:			
	2 ਤੋਂ ਵੱਧ 7 ਕਿਲੋਵਾਟ ਤੱਕ	45₹ / ਕਿ:ਵਾ:			
	7 ਤੋਂ ਵੱਧ 50 ਕਿਲੋਵਾਟ ਤੱਕ	50₹ / ਕਿ:ਵਾ:		ਆਈ.ਡੀ.ਐਫ.	ਗਊ ਸੈੱਸ
2. ਵਪਾਰਿਕ ਵਰਤੋਂ ਲਈ	ੳ) ਪਹਿਲੇ 100ਯੂਨਿਟਾਂ ਤੱਕ	6.91 ₹		ਬਿਜਲੀ ਦੇ ਖਰਚੇ + ਪੱਕੇ ਖਰਚੇ ਦਾ 5%	ਮੌਜੂਦਾ ਹਦਾਇਤਾਂ ਅਨੁਸਾਰ --
	ਅ) ਅਗਲੇ 400 ਯੂਨਿਟ ਤੱਕ	7.17 ₹			
	ੲ) ਬਾਕੀ ਬਚਦੇ ਯੂਨਿਟਾਂ ਤੇ	7.20 ₹			
	ਪੱਕਾ ਖਰਚਾ				
	0 ਤੋਂ 7 ਕਿਲੋਵਾਟ ਤੱਕ	45 ₹ / ਕਿ:ਵਾ:			
	[illegible]	[illegible]			

Electricity Bill

SL :- Sanctioned load
EC :- Energy charges
FC :- Fixed charges
ED :- Electricity Duty
SOP :- Sale of Power (Total charges)
FCA :- Fuel cost Adjustment

Bill Calculations

Reading	Previous	Current	Units
KWh	75283	75842	559

Days :- 61

SL :- 6.42

Range :- 2 - 50 KW

		Rs/Unit
0 - 100 units	—	4.99
100 - 300 "	—	6.59
300 - 500 "	—	7.20
501 and above	—	7.41

Now, billing period cycle is 2 months

SLAB	UNITS	RATE	TOTAL PRICE
0 - 100	100 X 2 = 200	4.99	998
101 – 300	359	6.59	2365.81
	559		3363.81

EC = Rs 3363.81 ≃ 3364.00

To calculate fixed charges :-

80% of S.L. (i.e. 6.42) = 5.136

Rate = Rs45 / kW

Billing Period = 61 days

$$FC = \frac{5.136 \times 45 \times 61 \times 12}{365} = 463.506$$

$FC \simeq 464$ Rs

Total Energy Charges = 3364 + 464 = Rs 3828

Taxes :- 3828 + 25 (FCA) = 3853

Electricity Duty :- 13 % of Total Charges

$$3853 \times \frac{13}{100} = 500.89 \simeq 501$$

OCT/MT = 2% of SOP = $3853 \times \frac{2}{100}$ = 177.06

Infra. Dev. Cess :- 5% of SOP =

$$\frac{5}{100} \times 3853 = 192.65 \simeq 193$$

Cow cess :- 0.020/ Unit = 0.02 × 559 = 11.18

Rents :- Meter Rent :- 16
MCB Rent :- 8

Total = 24

classmate

Date
Page

Total Payable charges :- SOP + ED + OCT/MT + ID Cess + Con Cess + Rents

= 3853 + 501 + 77 + 193 + 11 + 24

= Rs 4659 ≃ 4660

Late payment charges :- 2% of Total payable

$\frac{2}{100} \times 4660 = 93.2$ Rs

Payable after due date = 4660
93
Rs 4753

Sol. 1 Maxi^n Demand = 15000 kW

Energy consumed / year = 5×10^6 kWh

1) 2-Part Tariff

Fixed Charges = $\text{Rs. } \frac{1000 \times 15000}{2}$ = Rs 150×10^5

Running charges = $\text{Rs. } \frac{40}{100} \times 5 \times 10^6$

= Rs 2×10^6 = Rs 20×10^5

Annual cost = Rs $(150 + 20) \times 10^5$

= Rs 170×10^5

Sol.-3 Avg load = 200 kW

$$\text{Maxim load in kVA} = \frac{\text{Load in kW}}{\text{power factor}} = \frac{200}{0.8} = 250$$

Energy consumed/year = Avg load × No of working hrs/year

$$= 200 \times (16 \times 300) = 960000 \text{ kWh}$$

$$\text{Annual payment} = \text{Rs } \frac{40}{100} \times 960000 + 800 \times 250$$

$$= \text{Rs } 584000$$

Date ______
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Solⁿ 4) Max. demand = 10 kW

Two-part tariff = Rs 1200/kW + Rs 1.50/unit

Flat-Rate tariff = Rs 3.00 per unit

Let x kWh be energy consumed

M.D. = 10 kW

As per 2-part tariff :-

$$Rs\,(1200 \times 10 + 1.50 \times x)$$
$$= (12000 + 1.5x) \quad \text{— (1)}$$

As per flat Rate tariff :-

$$Rs\,(3.00 \times x) = 3.00x \quad \text{— (2)}$$

Equating both equations (1) & (2)

$$12000 + 1.5x = 3x$$
$$12000 = 1.5x$$
$$x = \frac{12000}{1.5} = 8000 \text{ kWh}$$

$$\frac{250}{0.8} = 312.5$$

$10 \times 300 = 3000$

Example 8 : *A consumer takes a steady load of 250 kW at a power factor of 0.8 lagging for 10 hours per day and 300 days per annum. Estimate his annual payment under each of the following tariffs :*

(i) Rs. 1.50 per kWh + Rs. 1000 per kVA per annum.

(ii) Rs. 1.50 per kWh + Rs. 1000 per kW per annum + 50 paise per kVARh.

(Punjab/Haryana Board)

$= 250 \times 3000$

$= 750000$

$(1.5 \times 750000 +$

$1000 \times 312.5)$

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$250 \times \tan\phi$

$\times 3000$

$\tan\cos^{-1}(0.8)$

$= 0.75$

Example 8 : *A consumer takes a steady load of 250 kW at a power factor of 0.8 lagging for 10 hours per day and 300 days per annum. Estimate his annual payment under each of the following tariffs :*

(i) Rs. 1.50 per kWh + Rs. 1000 per kVA per annum.

(ii) Rs. 1.50 per kWh + Rs. 1000 per kW per annum + 50 paise per kVARh.

(*Punjab/Haryana Board*)

$250 \times 0.75 \times 3000$

$= 562500$

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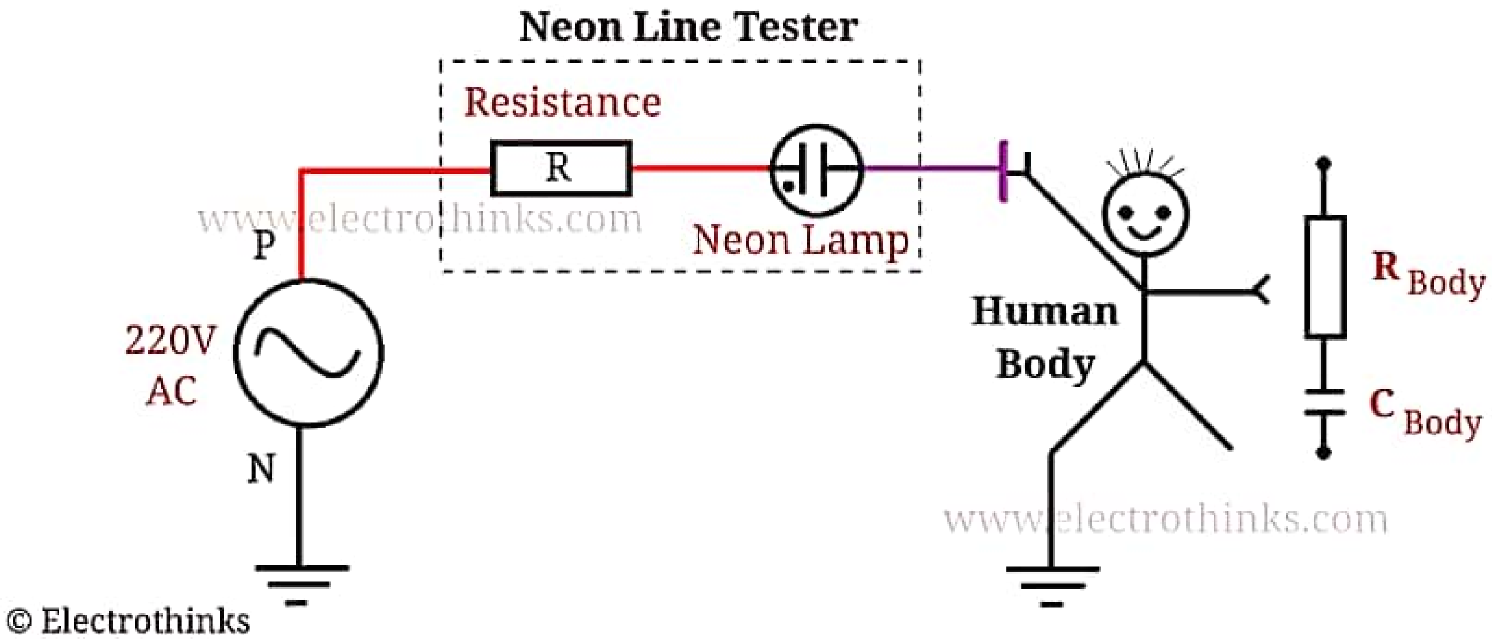
Name	Photo	Short circuit	Over load	Earth fault
RCBO		✓	✓	✓
RCCB		✗	✗	✓
CB		✓	✓	✗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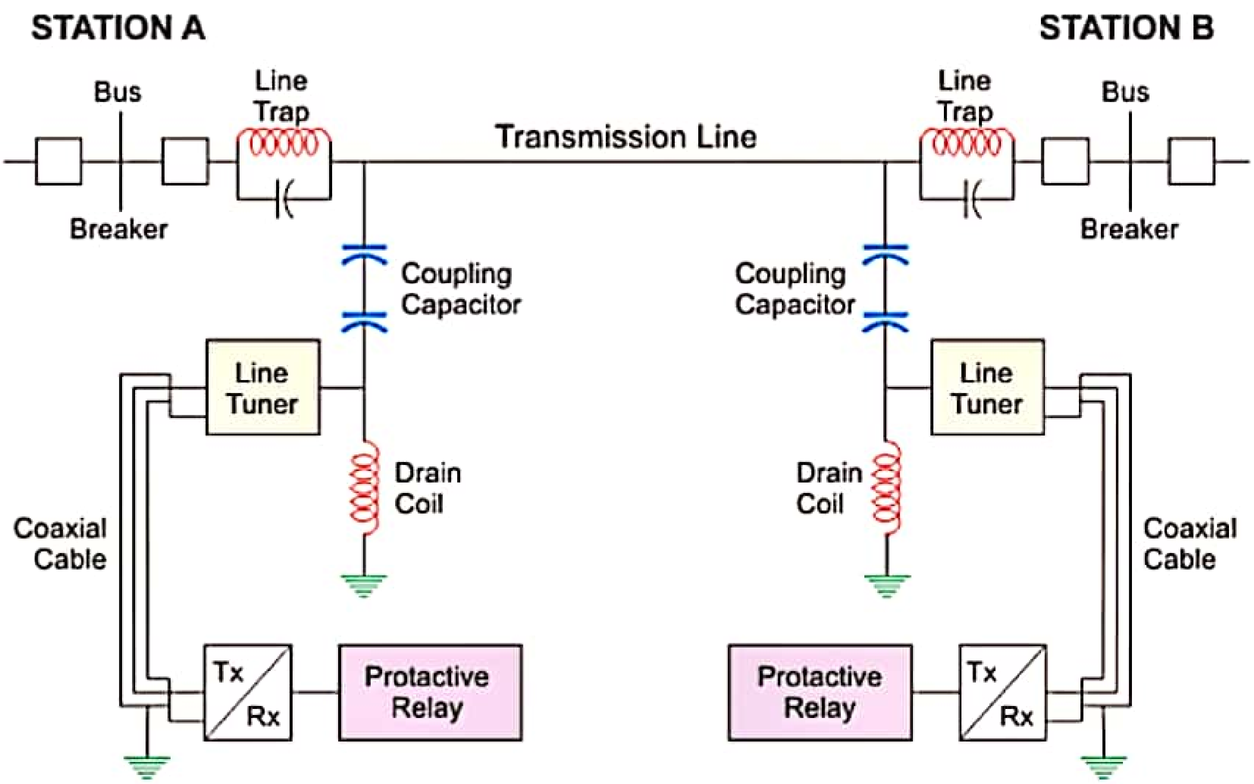
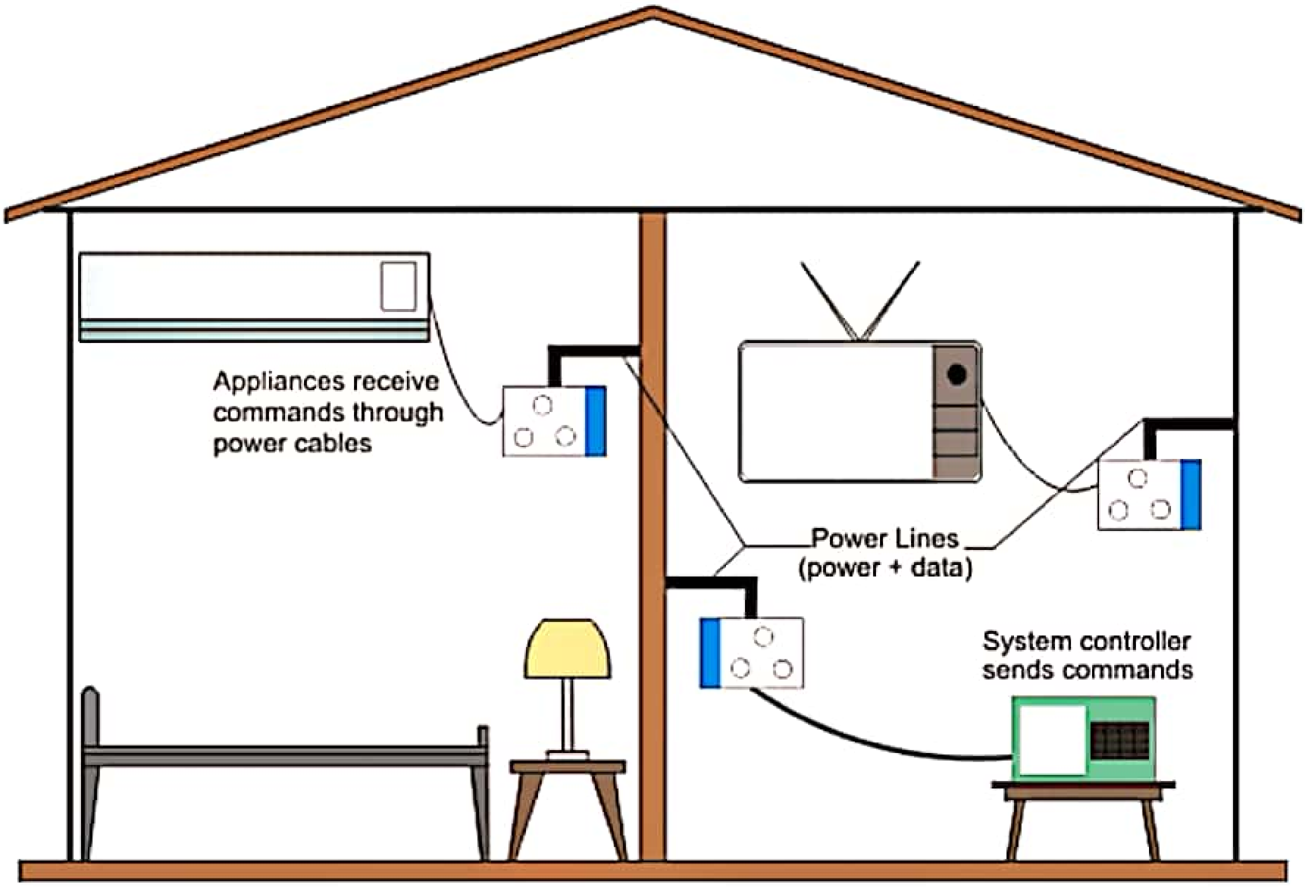


Diagram of PLCC Network



Home Automation Using Power Lines