TWO MARK QUESTIONS WITH ANSWERS
UNIT – 1: INTRODUCTION TO POWER QUALITY

1. Define power quality .

Power quality has been defined as the parameters of the voltage that affect the customers supersensitive equipment.

2. What are the commonly used terms that describe the parameters of electrical power that describe or measure power quality.

Sag, swell, interruption, transients, harmonics, waveform distortion, over voltages,
under voltages, voltage imbalance, power frequency variations, etc.

3. What is the most common power quality problem.

Voltage sags are considered the most common power quality problem.. These can be caused by the utility or by customer loads. When sourced from the utility , they are most commonly caused by faults on the distribution system. These sags will be from 3 to 30 cycles and can be single or three phase. Depending on the design of the distribution system, a ground fault on 1 phase can cause a simultaneous swell on another phase.

4. What is the second most common power quality problem.

Power quality problems are related to grounding , ground bonds and neutral to ground voltages, ground loops, ground current or ground associated issues.

5. **What type of equipment is affected by power quality issues.**

All electrically operated or connected equipment is affected by power quality.

6. What are the types of power quality solutions available on the market today.

There are hundreds of manufacturers making thousands of different power quality solutions today. The categories of these solutions are :

Utility based solutions for the substation level.

User based solution for whole facility protection.

User load level solutions for specific loads

7. How can power quality problems be detected.

A piece of equipment misoperates at the same time of day.

Circuit breakers trip without being overloaded.

Equipment fails during a thunderstorm.

Automated systems stop for no apparent reason.

8. What are harmonics.

Harmonics are distortions in the AC waveform. These distortions are caused by loads on the electrical system that use the electrical power at a different frequency than the fundamental 50 or 60 Hz.

9. How do harmonics affect the electrical system.

In general harmonics cause magnetic portions of the electrical system to overheat.

Such as transformers, line reactors, magnetic relays and power factor capacitors.

10. **How do harmonics affect the load.**

The affect of harmonics on loads varies a great deal and is dependent on the load

itself. Most loads are not affected by moderate levels of harmonics . Exceptions to this are loads that perform electrical measurements in the frequency domain of the harmonics.

11. How do you measure power quality?

It requires power quality measurement equipment to measure , record and diagonos harmonic problems. Power quality instruments offer a service of characterizing all aspects of power quality and determining if it is acceptable to the load.

12. Why is power conditioning needed?

Effective power conditioning will prevent the erosion of your equipment and by filtering out these harmful properties will substantially enhance its reliability.

13. What types of equipment are affected by power line noise?

Any equipment based on semiconductor technology can be affected which includes all computers , telecommunications PBXs and key systems, automated manufacturing and design systems, computerized medical equipment and point of sale terminals.

14. Why are these transients or noise on the power line causing problems now?

Advances in digital logic technology have produced smaller and more sophisticated devices. This new generation of micro-circuitry is extremely dense and substantially more susceptible and transient damage.

15. What represent quality of power?

This term covers technical aspects as well as non-technical aspects like the interaction between the customer and the network operator. Eg. The speed with which the network operator reacts to complaints, etc.

16. What are the power quality issues?

Power frequency disturbances, power system transients, grounding and bonding, electromagnetic interference , power system harmonics, electrostatic discharge, power factor.

17. Classify power quality events in short duration events.

Sag
Swell
Interruption.

18. Mention the types of sag.

Instantaneous sag.
Momentary sag
Temporary sag.

19. Mention the types of swell .

Instantaneous swell
Momentary swell

Temporary swell.

20. List the types of interruption.

Sustained interruption
Momentary interruption
Temporary interruption.

Part-B

1. a) What are the major power quality issues? Explain in detail.
   b) Define power quality. Explain the reasons for increased concern in power quality.
2. Explain the various types of power quality disturbances and impacts of power quality.
3. a) Discuss the following characteristics of power quality events
   1) short duration variations 2) long duration variations
   b) Discuss in detail about sags and swells.
4. Explain the following related with power quality
   a. Voltage imbalance b. Under voltage c. Over voltage d. Frequency variation
5. Define Waveform distortion. Explain the waveform distortion categories.
6. What are harmonics? Explain harmonic distortion with relevant waveforms.
7. Explain the following:
   i) Total harmonic distortion
   ii) Total demand distortion
8. Write the various IEEE and IEC power quality standards.
9. Explain the following event based disturbances:
   1 Dip 2 Swell 3 Transients
10. Discuss about the CBEMA curve.

UNIT – 2: VOLTAGE SAGS AND INTERRUPTIONS

1.What is voltage sag?

A sag or dip is a decrease in RMS voltage or current at the power frequency for durations from 0.5 cycles to 1 minute, reported as the remaining voltage. Typical values are between 0.1 pu and 0.9 pu.

2. When sag leads to interruption.

Voltage sag is a reduction in voltage for a short time. The voltage reduction magnitude is between 10 % to 90% of the normal root mean square (RMS) voltage at 50 Hz. An interruption is a complete loss of voltage or a drop to less than 10 % of nominal voltage in one or more phases.

3. What are the causes of sag?

Voltage sags are usually associated with voltage sag.

Equipment sensitive to both the magnitude and duration of voltage sag.

Equipment sensitive to have characteristics other than magnitude and duration.

4. What are the three levels of possible solutions to voltage sag and momentary interruption problems?

Power System Design

Equipment design

Power conditioning equipment.

5. List some industry standards associated with voltage sags.

*SEMI F47-0200 8CBEMA curve

6. What are the sources of sags and interruption?

A sudden increase in load results in a corresponding sudden drop in voltage. Any sudden increase in load, if large enough will cause a voltage sag in motors, faults, switching, recloser operations.

7. Give some economic impacts due to sag.

Process outages

Damaged products

Lost time for restarting.

8. What is the importance of estimating sag performance?

It is important to understand the expected voltage sag performance of the supply system so that facilities can be designed and equipment specifications developed to assure the optimum operation of production facilities.

9. What are the various factors affecting the sag magnitude due to faults at a certain point in the system.

Distance to the fault
Fault impedance
Type of fault
Pre-sag voltage level
System configuration
System impedance
Transformer connections.

10. Name the different motor starting methods.

Resistance and reactance starters
Autotransformer starters
Star-Delta starters

11. What are the causes for voltage sags due to transformer energizing?

Normal system operation, which includes manual energizing of a transformer.

Reclosing actions.

12. How voltage sag can be mitigated.

Voltage sag can be mitigated by voltage and power injections into the distribution system using power electronics based devices which are also known as custom power devices.

13. Name the three levels of possible solutions to voltage sag and momentary interruption problems.

Equipment Design * Power conditioning equipment
Power system design

14. Name any four types of sag mitigation devices.

Dynamic Voltage Restorer(DVR)
Active Series Compensators
Distribution Static Compensator(DSTATCOM)
Solid State Transfer Switches(SSTS)

15. Define Dynamic Voltage Restorer (DVR).

A DVR is a power electronic switching device consisting of either GTO or IGBT , a capacitor bank as an energy storage device and injection transformers. It is connected in series between a distributed system and a load.

16. What is the important role of a DVR?

The basic idea of a DVR is to inject a controlled voltage generated generated by a forced commuted converter in series to the bus voltage by means of an injecting transformer.

17. Define active series compensation devices.

A device that can boost the voltage by injecting a voltage in series with the remaining voltage during a voltage sag condition.

18. What is the need of DSTATCOM?

It allows effective control of active and reactive power exchanges between the DSTATCOM and the ac system.

19. What is the main function of DSTATCOM?

Voltage regulation and compensation of reactive power

Correction of power factor

Elimination of current harmonics.

20. What is the role of SSTS?

Can be used very effectively to protect sensitive loads against voltage sags, swells and other electrical disturbance.

It ensures continuous high quality power supply to sensitive loads by transferring ,

within a time of milliseconds , the load from a faulted bus to a healthy one.

Part-B

1. Discuss the sources of sags and interruptions.
2. Discuss in detail about the sag performance evaluation indices.
3. What is the need of estimating sag performance? Explain the different methods of estimating voltage sag performance.

4. Explain the sag performance evaluation methods.
5. Explain the various causes and effects of voltage sags.
6. Explain the following causes of sags:
    1. Voltage sags due to motor sag.
    2. Voltage sag due to line to ground fault
    3. Voltage sag due to transformer energizing
7. What are the various voltage sag mitigation techniques?
8. Explain the principle of DVR operation used for sag mitigation.
9. Discuss in detail about active series compensator.
10. Explain the operation of distributed static compensator (DSTATCOM) used for sag mitigation.
11. Explain the solid state transfer switch with the transfer operation.
12. Explain the procedure for estimating the voltage sag indices.
13. Mention the standards associated with the voltage sag.
14. Explain the system adapted to estimate the severity of the sag occurred due to various sources.
15. Explain the following sag mitigation techniques.
    a) Static UPS with minimal energy storage.
    b) Backup storage energy supply.
    c) Flywheel with UPS system.
16. Discuss about estimating the cost of voltage sag events.
17. Explain about voltage magnitude events due to reclosing.
18. Discuss about monitoring of short interruptions.
19. Explain about the influence of interruption on equipments.
20. Discuss about causes of long interruptions.
21. Explain about devices used for voltage regulation.

UNIT – 3: OVERVOLTAGE TRANSIENTS

1. Define transient over voltages.

A transient over voltage can be defined as the response of an electrical network to a sudden change in network conditions, either intended or accidental, (e.g. a switching operation or a fault) or network stimuli (e.g. lightning strike).

2. What are the' types of transient overvoltages?

1) Impulsive 2) Oscillatory

3. Define impulsive transients. Give example for impulsive transient over voltages .

An impulsive transient is a sudden, non-power frequency change in the steady state condition of the voltage and/or current waveforms that is essentially in one direction, either positive or negative, with respect to those waveforms.

The most common cause of this type of transient is lightning.

4. Give examples for oscillatory transient over voltages.

Switching operation within the distribution network are a major cause of oscillatory transients transient over voltages. Such operations include

(a) Switching of utility capacitor banks,

(b) Switching of circuit breakers to clear network faults, and

(c) Switching of distribution feeders to rearrange the network for maintenance or construction

5. What is the effect of capacitor switching transients on network?

Transients of this magnitude and duration are usually not a problem on the utility system, but they can produce problems at a user facility.

Severe over voltages can appear on user facility capacitors through a phenomenon known as voltage magnification

6. What are the causes of voltage magnification on network?

The voltage magnification will not result in capacitor damage. The problem that usually occurs is the failure or mis-operation of sensitive loads in the facility where the low voltage capacitors are installed.

7. Define voltage magnification phenomena?

The highest transient voltages occur at the low voltage capacitor bank when the characteristic frequency of the switching transient is nearly equal to the resonant frequency of the low voltage system and when the switched capacitor is ten or more times the size of the low- voltage capacitor

8. Mention the two important concerns for capacitor bank switching transients.

Voltage transients at the capacitor bank substation and neighboring substations Power quality impact on sensitive customer loads due to variations in voltage when energizing capacitor banks

9. Give the various aspects of equipment specific design and protection issues for the capacitor switching transients.

Phase-to-ground and phase-to-phase insulation switching withstand to voltage stresses

Controlled closing for circuit breakers (pre-insertion resistors/reactors or synchronous switching)

Capacitor bank and substation Circuit breakers ANSVIEEE C37 requirements ./ Current limiting reactor requirements

10. What specify the IEEE standard for shunt power capacitors causing transient overvoltages?

The IEEE Standard for Shunt Power Capacitors, ANSI/IEEE Std. 18-1992, specifies

that capacitors "may reasonably be expected to withstand" transient overvoltages from 205% to

354% of rated peak voltage, depending on the number of times a year the overvoltage occurs.

11.What are the various Causes of overvoltages?

Overvoltages, i.e. brief voltage peaks (transients, surges, spikes), can be attributed to the following main causes:

1.Atmospheric discharges, i.e. lightning (LEMP - Lightning Electro-Magnetic Pulse)

2.Switching operations in the public grid and low-voltage mains

3.Electrostatic Discharges (ESD)

4.Ferroresonance

12.Give tile basic principles of overvoltage protection of load equipments.

Limit the voltage across sensitive

insulation. Divert the surge current away

from the load. Block the surge current entering into the load. Bonding of equipment with ground

13.What is the need of surge arrestors?

A surge arrester is a protective device for limiting surge voltages on equipment by discharging or bypassing surge current.
Surge arresters allow only minimal flow of the 50Hz/60Hz power current to ground.

14.Differentiate between transient voltage surge suppressors (TVSS) and surge arrestors. Arresters and TVSS devices protect equipment from transient overvoltages by limiting the maximum voltage, and the terms are sometimes used interchangeably. However, TVSSs are generally associated with devices used at the load equipment.
A TVSS will sometimes have more surge-limiting elements than an arrester.

15.Mention the types of surge arrestors

Metal-oxide varistor type
Gapped silicon - carbide type

16.What is metal-oxide surge-arrester?

A metal-oxide surge-arrester (MOSA) utilizing zinc-oxide block provides the best performance, as surge voltage conduction starts and stops promptly at a precise voltage level, thereby improving system protection

17.Give any two advantages of metal-oxide arresters over conventional silicon carbide distribution class arresters.

Improved Surge Duty Capability
Improved Temporary Overvoltage Capability

18. **What is the need of Transmission Line Arresters?** '.

Transmission Line Surge Arresters conduct lightning surges around the protected insulator so that a lightning flashover is not created.

They are designed to be installed functionally in parallel with the line insulator. The arrester conducts the lightning surges around the protected insulator so that a subsequent 50Hz /

60 Hz fault on the circuit is not created.

19.Mention the Benefits of Transmission Line Surge Arresters

Lowers initial cost of new or transmission line upgrades by making construction more compact and transmitting more energy in the same right of way.

Reduces the height of transmission lines by eliminating shield wire

Improves outage statistics by eliminating back flashover from the tower ground lead to the phase conductor

20.What is the role of surge arrestor on shielded and unshielded transmission line?

On shielded transmission lines or under-built distribution circuits, the arrester prevents tower to phase insulator back-flashovers during a lightning strike.

On unshielded sub transmission or distribution circuits, the arrester prevents phase-to-ground flashover.

21.What is the need of low pass filter in transient protection?

This LC combination provides a low impedance path to ground for selected resonant frequencies.

Low-pass filters employ pi principle to achieve better protection even for high- frequency transients.

22.What is tire need of Shunt protectors or surge reduction filters?

o An in-line filter specifically designed to reduce the rate of voltage rise (dv/dt) of the pre- clamped waveform.

o It gives some series impedance between input and output terminals. This type of product is highly recommended for the protection of sensitive electronic equipment

23. What is the application of Power Conditioners in transient protection?

Low-impedance power conditioners are used primarily to interface with the switch- mode power supplies found in electronic equipment. Low-impedance power conditioners differ from isolation transformers in that these conditioners have much lower impedance and have a

filter as part of their design

1. When on the device to position the power conditioners to avoid voltage swells.

24. Differentiate between TVSS, Filter and Data/signal protection devices.

Transient: focus on limiting high-voltage spikes to an acceptable level.

Filtering: protect against low-energy transients and high frequency noise and finally Data/signal protection devices: Products that guard sensitive instrumentation against what we refer to as 'back door' transients and noise

25. Define lightning phenomena.

Lightning is an electrical discharge in the air between clouds, between different charge centre within the same cloud, or between cloud and earth (or earthed object).

Even though more discharges occur between or within clouds, there are enough strokes that terminate on the earth to cause problems to power systems and sensitive electronic equipment

Part-B

1. What are transient over voltages? Explain the different types of transient over voltages.
2. Explain the problems associated with ferro-resonance.
3. What are the different sources of transient over voltages? Discuss the capacitor switching.
4. Define lightning. Discuss the lightning over voltages and the problems associated with it.
5. Explain the mechanism of lightning.
6. Explain the phenomena of ferro-resonance.
7. Draw the standardized waveform of the lightning induced voltage. Discuss about the wave shape of the lightning current.
8. Explain about the underground cable system protection.
9. Explain in detail about the protection of transformers.
10. Explain the use of PSCAD in analyzing the power quality.

11. What are the advantages of computer analysis tools? Discuss about PSCAD and EMTP for transient studies.
12. Discuss about the models and examples available in PSCAD/EMTDC.

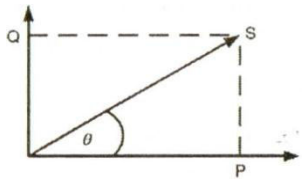
UNIT – 4

HARMONICS

1. What are the important concepts to bear in mind to understand power system harmonics?

There are two important concepts to bear in mind with regard to power system harmonics. The first is the nature of harmonic current producing loads (nonlinear loads) and the second is the way in which harmonic currents flow and how the resulting harmonic voltages develop.

2. Draw the relationship between between P, Q, S in sinusoidal condition.



3. What is the reason for existence of harmonic distortion?

Harmonics distortion exists due to the nonlinear characteristics of the devices and loads on the power system .

These devices act as current sources that inject harmonic currents into the power system.

4. Differentiate between linear loads and non-linear loads.

Linear load: Any load that draws current at supply fundamental frequency only is a linear load. The current drawn does not contain any harmonics (multiples of the supply frequency). Motors, resistors, inductors and capacitors are all linear loads.

Non Linear load: Any load that draws harmonic currents from the supply is a nonlinear load. The current waveform of such non-linear loads, is discontinuous and non sinusoidal because of the presence of harmonics.

5. What is voltage and current distortion?

Voltage distortion is any deviation from the nominal sine waveform of the AC line voltage .

Current distortion is any deviation from the nominal sine waveform of the AC line current.

6. Mention the commonly used indices used for measuring harmonic component of waveform.

The two most commonly used indices for measuring the ham10nic content of the waveform are the total harmonic distortion (THD) and total demand distortion (TDD).

1. If a generator produces a non-ideal sinusoidal waveform, the voltage waveform will contain a certain amount of harmonics

2. In motors, decreased efficiency, excessive heating, and vibration are symptoms of harmonic voltage distortion.

7. Mention at least two causes of harmonics made on distribution systems.

In the distribution system, transformers are capable of producing harmonics due to magnetic core saturation. This is more prevalent at a lighter loading of the transformer

Large load currents in the neutral wires of a 3 phase system. Theoretically the neutral current can be up to the sum of all 3 phases therefore causing overheating of the neutral wires. Since only the phase wires are protected by circuit breakers of fuses, this can result in a potential fire hazard.

8. What is harmonic index? State its significant.

The power quality industry has developed certain index values that help us assess the quality of service as it relates to distortion caused by the presence of harmonics. harmonic indices, serve as a useful metric of system performance. The two most commonly used indices under harmonic studies are

(a) Total harmonic distortion (TI-ID) (b) Total demand distortion (TDD)

9. Mention the problems created by harmonics.

A large load current flows in the neutral Wires of a 3 phase system Theoretically the neutral current can be up to the sum of all 3 phases therefore causing overheating of the neutral wires.

Poor power factor conditions that result in monthly utility penalty fees for major users (factories, manufacturing, and industrial) with a power factor less than 0.9.

10. Mention the harmonic effects on devices and loads Insulation stress (voltage effect)

Thermal stress (current effect)

Load ruptures (abnormal operation)

11. **What is the effect on transformer due to Harmonics?**

The primary effect of power system harmonics on transformers is the additional heat generated by the losses caused by the harmonic contents generated by the load current

12. **Mention he harmonic sources from commercial loads.**

Single phase loads such as Switch mode power supplies, fluorescent lighting and UPS

Systems Three phase loads such as high voltage AC drives system

13. **Mention the harmonic sources from industrial loads .**

Three phase converter with Adjustable speed drives (DC drives and

AC drives) Arcing Devices (Arc furnaces, weiders, Discharge lamps

etc)

Saturable devices (transformer, electromagnetic devices etc with steel core)

15. What is the advantage of three phase converter?

Three-phase electronic power converters do not generate third-harmonic currents mainly when compared with single-phase converters. This is a great advantage because the third harmonic current is the largest component of harmonics shown in harmonics spectrum

16. What is the disadvantage of 12 pulse drive?

The disadvantages of the l2-pulse drive are that there is more cost in control design and an extra transformer is usually required

17. State the different typesinverters Variable voltage inverter (VVI) Current source inverter (CSI)
Pulse width modulated (PWM)

18. What is Variable Voltage Inverter?

The variable voltage inverter (VVI), or square-wave six-step voltage source inverter (VSI), receives DC power from an adjustable voltage source (either from thyristor converter or DC-DC converter fed by Diode Bridge) and adjusts the frequency and voltage.

19. What is current Source inverter?

The current source inverter (CSI) receives DC power from an adjustable current source and adjusts the frequency and current.

20. What is the need of locating harmonic sources?

When harmonic problems are caused by excessive voltage distortion on the supply system, it is important to locate the sources of harmonics in order to develop a solution to the problem.

Part-B

1. Explain briefly about fundamentals of harmonics generation and waveform distortion.
2. Explain in detail about the classification of linear and non-linear loads used in harmonic studies.
3. Explain the concept of harmonics and harmonic producing loads.
4. Explain the following
   i) Harmonic distortion
   ii) Current distortion
   iii) Voltage distribution
5. What are the general causes of harmonics in power systems?
6. Explain the following:
   a) Harmonic sources from commercial loads.

b) Harmonic sources from industrial loads.
c) Harmonic sources from residential loads.

7. What is the need for locating the harmonic sources?
8. How will you find the harmonic sources from point of common coupling? Give the identification procedure on the basis of voltage indices.
9. What are the various devices for controlling harmonic distortion?

UNIT – 5

POWER QUALITY MONITORING

1. What is the importance of power quality monitoring?

Power Quality Monitoring is necessary to- detect and classify disturbance at a particular location on the power system. PQ monitoring assists in preventive and predictive maintenance. Problems can be detected before they cause widespread damage by sending automated alerts. PQ Monitoring can be used to determine the need for mitigation equipment.

2.. What are the monitoring objectives*?*

Continuous evaluation of the electric supply system for disturbances and power quality variations.

Document performance of power conditioning equipment, such as static switches, UPS systems,
other ride through technologies, and backup generators.

4. What is proactive monitoring*?*

The traditional approach to power quality monitoring is reactive. We need to know when a problem is going to occur before it happens. Permanent power quality monitoring systems are designed to
help proactively identify conditions and events that may cause problems should be addressed. This is called proactive monitoring.

5.**What are the steps involved in power quality monitoring***?*

Planning for the monitoring

Preparing for the monitoring
Inspecting the site
Monitoring the power
Analyzing, monitoring and inspecting data
Applying corrective solutions

6.**What are the requirements of monitoring for a voltage regulation and unbalance*?***

3 phase voltages
RMS magnitudes
Continuous monitoring with periodic max/min/avg samples

7.**What are the requirements of monitoring for a harmonic distortion?**

Currents for response of equipment
3 phase voltages and currents
Waveform characteristics
128 samples per cycle minimum
Synchronized sampling of all voltages and currents
Configurable sampling characteristics

8. **What are the Characteristics of power quality monitoring equipment***?*

Harmonic Analysis

Harmonic analyses are usually conducted by obtaining and interpreting measurements of waveforms. Equipment normally required to perform a harmonic study consists of a harmonic analyzer, an oscilloscope, and an RMS responding voltmeter and ammeter. Spectrum analysis is usually performed up to the 50th harmonic (3 kHz).

9. **What are the Characteristics of power line monitors?**

Portable, rugged, lightweight
Simple to use, with proper training
Designed for long-term unattended recording

Definition of line disturbance parameters varies between manufacturers

10. **What is the Types of power quality measurement equipment***?*

Hand-held single-phase power quality monitors

Portable three-phase power quality monitors

Harmonic analyzers

Distortion analyzers

Multimeters

11. Mention the factors that should be considered for selecting the instrument.

Number of channels (voltage and/or current)

Temperature specifications of the instrument

Input voltage range (e.g., a to 1000 V)

Ability to measure three-phase voltages

12. **What is the use of oscilloscope***?*

Oscilloscopes with fast sampling rates and automatic triggering function can be very useful for trace of transients.

13. **What is the use of spectrum analyzer***?*

A spectrum analyzer can be used for trace of high frequency harmonics.

14. What is the use of simple single phase hand-held power quality monitor?

Power quality problems like measuring the occurrence of harmonics or checking the voltage level or the power frequency can easily be made by using a simple single phase hand-held power quality monitor.

15. Mention the Instruments used for the analysis of non-sinusoidal voltage and currents*?*

Oscilloscope

Spectrum analyzer

Harmonic analyzer

16. **Mention the basic categories of instruments for harmonic analysis?**

Simple meters

General-purpose spectrum analyzers

Special-purpose power system harmonic analyzers

Digital Harmonics Measuring Equipment

Distortion Analyzers

Data Logger

Part-B

1. Explain power quality monitoring.
2. Discuss in detail about power quality monitoring sites.
3. Bring out the significance of power quality monitoring.
4. Bring out the characteristics of power quality variations. Write short notes on power quality measurement systems.
5. Explain the harmonic analyzer and disturbance analyzer.
6. Explain in detail about flicker meter and application of expert system for power quality monitoring.
7. Discuss in detail about the instruments used for analyzing non sinusoidal voltage and currents.
8. Explain the modern power quality monitors.
9. Draw the block diagram for advanced power quality monitoring systems and explain the same.