Unit 9 POWER QUALITY

Lead in

Why is it important to monitor power quality?
In what applications is power quality critical?

Task 1

Complete the text with words from the box

Over-load; load; saturation; balanced; sine wave; fluctuations; UPS, thyristor; condensers; converters; disturbances

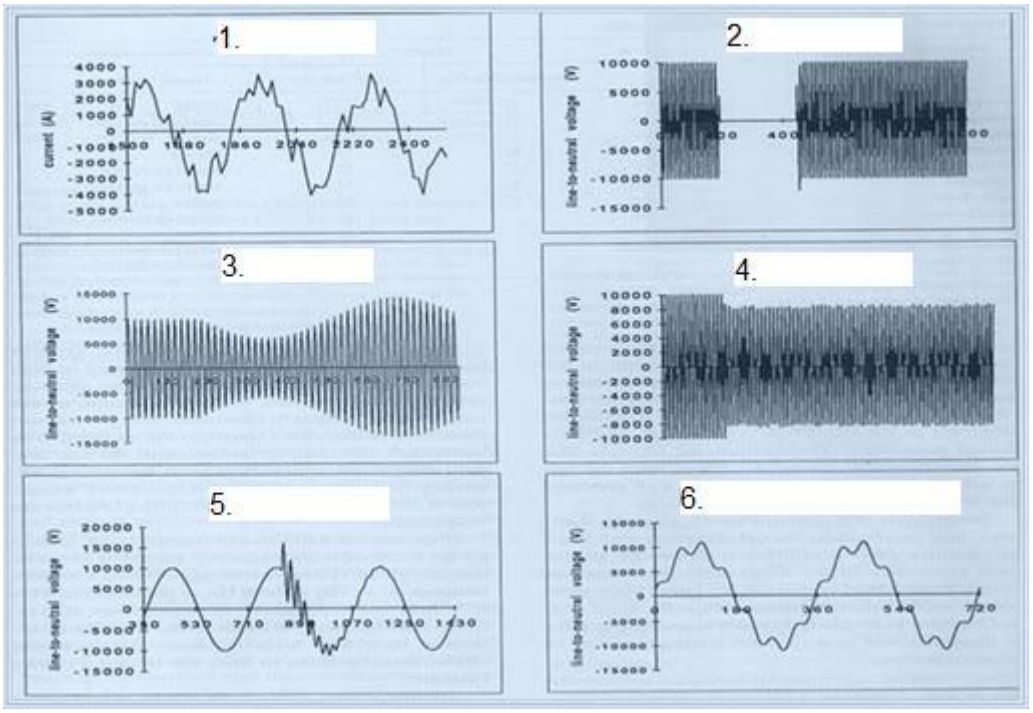
Introduction
It is necessary to prevent the power line disturbances from disrupting the operation of critical loads such as computers used in process control, medical equipments, operation theatre, large computer centre, R & D laboratories and the like.

The voltage supplied by the a.c. main should ideally be perfect 1. _____ without any harmonics and voltage 2. _____.
The voltages in a three phase system should be 3. _____, with each phase displaced by 120 degrees with respect to the others.
However, this does not happen in real practice due to the presence of 4. _____ such as over-voltage, under-voltage, voltage spikes, chopped voltage waveform, harmonics and electromagnetic interference.
The over-voltages (Swell) may be caused by sudden decrease in 5. _____ or unbalance caused due to faults in the supply system.
Under-voltage (Sag) may be caused by 6. _____ conditions such as starting of big induction motors and compressors or due to power line faults.
Spikes of voltages may be caused by switching- in and switching-out of power factor correction 7. _____ or big motors and welding sets working in the vicinity.
The chopped voltages may be due to a.c. to d.c. line commutated 8. _____ converters.
The voltage harmonics may be caused by variety of sources such as thyristor converters, magnetic 9. _____ of power system transformers etc.
Electromagnetic interference (EMI) is produced due to rapid switching of voltages and currents in power 10. _____. In case of critical applications, where shut down due to the above disturbances is not acceptable, the back-up of the a.c. main is provided by means of 11. _____. The power conditioners provide an effective way of suppressing some or all of the electrical disturbances other than the power outages and frequency deviations.

Task 2

Label the wave shapes of typical disturbances

a. brownout
b. sag and swell
c. switching transient
d. power interruption
e. random distortion
f. 7th harmonic distortion, 14% THD



Task 3

Listening

1. Answer the questions

1. What are harmonics?
2. What are the effects of harmonic distortions?
3. How can you reduce harmonics in your system?

2. Fill in the gaps

1. Every system is capable of receiving and creating some harmonic _____
2. Systems with shared _____ like a cubical farm or a classroom converted into a computer lab become _____ to fire from overheating of conductors.
3. In addition _____ banks are more likely to fail in the presence of harmonics.
4. Active harmonic filters continuously _____the nonlinear load and filter as necessary.
5.Harmonic mitigating transformers and _____ transformers can be used to cancel the harmonic currents.

Task 4

Match the titles with the paragraphs

a. Equipment fails because an undervoltage circuit trips
b. A quick-acting relay shuts the system down, typically in the EMO circuit.
c. Equipment fails because there isn't enough voltage.
d. A reset circuit may incorrectly trip at the end of the voltage sag.
e. Equipment fails because an unbalance relay trips.

Why does equipment fail when there are voltage sags on ac power systems? There is one obvious way, and four not-so-obvious ways.

1. _____This is the obvious way -- if there is not enough voltage on the ac power system to provide the energy that the equipment needs, it is going to fail. Actually, the problem is slightly more subtle. In a typical sensitive load, the ac voltage is rectified and converted to pulsed dc. With a bridge rectifier, the pulsing will typically be either twice the power line frequency (for single-phase loads) or six times the power line frequency (for three-phase loads). This pulsing DC is stored in a filter capacitor, which in turn supplies smooth DC as raw material for the rest of the power supply: regulators, etc.
If the DC supplied by the filter capacitor drops below some critical level, the regulators will not be able to deliver their designed voltage, and the system will fail. Note that the filter capacitor always stores energy, so there is always an ability to ride through some sags -- after all, the ac power system delivers zero voltage 100 or 120 times each second! But with a deep enough sag that lasts long enough, the filter capacitor voltage will drop below a critical level.

2. _____ Careful system designers may include a circuit that monitors the ac power system for adequate voltage. But "adequate voltage" may not be well defined, or understood. For example, if the sensitive system is running at half load, it may be able to operate at only 70% ac voltage, even though it may be specified to operate with 90% - 110% ac voltage. So the voltage sags to 70%; the equipment can operate without a problem; but the undervoltage monitor may decide to shut the system down.

3. _____On three-phase systems, voltage sags are often asymmetrical (they affect one or two phases more than the remaining phases). Three-phase motors and transformers can be damaged by sustained voltage unbalance; it can cause the transformer or motor to overheat. So it makes sense to put in an unbalance relay, which is a device that shuts down the system if the voltage unbalance exceeds some, typically a few percent.
But a voltage sag that causes 20-50% unbalance for a second or two is never going to cause a motor or transformer to overheat. It just doesn't last long enough. Still, unbalance relays with inadequate delays can cause the sensitive system to shut down, even for a brief voltage sag.

4. _____The EMO (emergency off) circuit in an industrial load typically consists of a normally-closed switch that can disconnect power to a latched relay coil. If the relay operates quickly enough, it may interpret a brief voltage sag as an operator hitting the EMO switch. The whole system will shut down unnecessarily.

5. _____This is the most subtle problem caused by voltage sags. Many electronic reset circuits are designed to operate at "power up" -- when you first turn on the equipment, these circuits will ensure that the microprocessors all start up properly, the latches are all properly initialized, the displays are in their correct mode, etc. These circuits are difficult to design, because they must operate correctly when power is uncertain.

One common design detects a sudden increase in voltage, which always happens when you turn the equipment on. Unfortunately, it also happens at the end of a voltage sag. If the reset circuit misinterprets the end of a voltage sag, the equipment will operate perfectly during the voltage sag, but will abruptly reset itself when the voltage returns to normal.
To make this problem even more difficult, it is quite common for different parts of a system to have different reset circuits, so it is possible for one part of the system to be reset even when the rest of the system is not. Without a sag generator with a good data acquisition system, this problem is very difficult to detect and solve.

Find words that mean

Prostować _____
Mostek prostownikowy _____
Kondensator filtracyjny _____
ładunek/obciążenie _____
Odbiornik _____
Trójfazowy _____
Przekaźnik _____
Wyłączać się samoczynnie _____

Task 5

What are these?

1. _____

2. _____

3. _____

4. _____