**yarmouk University**

**Hijjawi Faculty of Engineering Technology**

**Department of Electrical power Engineering**

**power Systems ||**

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**1)complex power**: it is a summation between real power and reactive power in the system, Power in an electric circuit is the rate of flow of energy past a given point of the circuit. In (AC) circuits, energy storage elements such as inductors and capacitors may result in periodic reversals of the direction of energy flow. The portion of power that, averaged over a complete cycle of the AC waveform, results in net transfer of energy in one direction is known as active power(sometimes also called real power). The portion of power due to stored energy, which returns to the source in each cycle, is known asreactive power.

**2) Reactive Power**: Also known as (Use-less Power, Watt less Power), Reactive power exists in an AC circuit when the current and voltage are not in phase.

The powers that continuously bounce back and forth between source and load

In electric power transmission and distribution, volt-ampere reactive (var) is a unit by which reactive power is expressed in an AC electric power system.

**3) Power Factor (Pf):** is the ratio between the useful (true) power (kW) to the total (apparent) power (kVA) consumed by an item of ( AC) electrical equipment or a complete electrical installation.

It is a measure of how efficiently electrical power is converted into useful work output.**.**

pf=\cos \theta \,the angle its difference between voltage and currant angle.

**4)** **Power factor correction:** Power factor correction is the term given to a technology that has been used since the turn of the 20th century to restore the power factor to as close to unity as is economically viable. This is normally achieved by the addition of capacitors to the electrical network which compensate for the reactive power demand of the inductive load and thus reduce the burden on the supply. There should be no effect on the operation of the equipment. To reduce losses in the distribution system, and to reduce the electricity bill, power factor correction, usually in the form of capacitors, is added to neutralize as much of the magnetizing current as possible

**5) synchronous generator:** is a generator where the excitation field is provided by a permanent magnet instead of a coil. The term synchronous refers here to the fact that the rotor and magnetic field rotate with the same speed, because the magnetic field is generated through a shaft mounted permanent magnet mechanism and current is induced into the stationary armature

**6) Induction generator**  is a type of alternating current (AC) electrical generator that uses the principles of induction motors to produce power. Induction generators operate by mechanically turning their rotors faster than synchronous speed.

Induction generators are useful in applications such as mini hydro power plants, wind turbines, or in reducing high-pressure.

**7)** **power flow**: In power engineering, the power-flow study, or load-flow study, is a numerical analysis of the flow of electric power in an interconnected system. A power-flow study usually uses simplified notation such as a one-line diagram and per-unit system, and focuses on various aspects of AC power parameters, such as voltages, voltage angles, real power and reactive power. It analyzes the power systems in normal steady-state operation.

**8) power system protection devices: Power-system protection** is a branch of electrical power engineering that deals with the protection of electrical power systems from faults through the isolation of faulted parts from the rest of the electrical network. The objective of a protection scheme is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible still in operation. Thus, protection schemes must apply with very pragmatic and pessimistic approach to clearing system faults. The devices that are used to protect the power systems from faults are called **protection devices**.

Protection systems usually comprise five components:

* Current and voltage transformers to step down the high voltages and currents of the electrical power system to convenient levels for the relays to deal with
* Protective relays to sense the fault and initiate a trip, or disconnection, order;
* Circuit breakers to open/close the system based on relay and autorecloser commands;
* Batteries to provide power in case of power disconnection in the system.

**9) Economic dispatch:** is the short-term determination of the optimal output of a number of electricity generation facilities, to meet the system load**, at the lowest possible cost,** subject to transmission and operational constraints. The Economic Dispatch Problem is solved by specialized computer software which should honor the operational and system constraints of the available resources and corresponding transmission capabilities. In the US Energy Policy Act of 2005 the term is defined as "the operation of generation facilities to produce energy at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities

**10) Optimal power flow: For the planner and operator** fixed generation corresponds to a snapshot only. Planning and operating requirements very often ask for an adjustment of the generated powers according to certain criteria. One of the obvious ones is the minimum of the generating cost. The application of such a criterion immediately assumes variable input powers and bus voltages which have to be determined in such a way that a minimum of the cost of generating these powers is achieved.

**11)power system contingence analysis:**

(CA) is critical in many routine power system and market analyzes to show potential problems with the system. Due to the tremendous and yet increasing amount of data computed by CA, effective visualizations are needed to present the CA results to assist the system operators and engineers to comprehend the static security status of the system in a quick and intuitive manner.

**12)** **Power System Security:**  is defined as the ability of the power system to remain secure without serious consequences to any pre-selected list of credible contingencies. The most common operational problems are transmission equipment overloads and inadequate voltage levels at system buses. The process of detecting, whether the system remains in secure (normal) or insecure (emergency) state, is called power system security assessment.

**13**) Load-frequency control:  is employed to allow an area to first meet its own load demands, then to assist in returning the steady-state frequency of the system, Δf, to zero Load-frequency control operates with a response time of a few seconds to keep system frequency stable.

**14)** **Automatic voltage regulator:** is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

# 15) flexible alternating current transmission system (FACTS) devices: FACTS Devices used To Enhance Power System Performance.

FACTS is defined by the IEEE as "a power electronic based system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability

**16)** **power system stability** is the ability of the system, for a given initial operating condition, to regain a normal state of equilibrium after being subjected to a disturbance.

Stability is a condition of equilibrium between opposing forces; instability results when a disturbance leads to a sustained imbalance between the opposing forces.

**17) compensation devices:** in a power system, devices designed to compensate the network’s reactive parameters (for example, AC transmission-lineparameters) and the reactive power consumed by loads and the system’s components.

**18)** **Unit commitment (UC):** is an optimization problem used to determine the operation schedule of the generating units at every hour interval with varying loads under different constraints and environments. Many algorithms have been invented in the past five decades for optimization of the UC problem, but still researchers are working in this field to find new hybrid algorithms to make the problem more realistic.

## 19) Load Forecasting: Load forecasting is a technique used by power or energy-providing companies to predict the power/energy needed to meet the demand and supply equilibrium. The accuracy of forecasting is of great significance for the operational and managerial loading of a utility company.

**20)** **Supervisory control and data acquisition (SCADA)** is a system for remote monitoring and control that operates with coded signals over communication channels (using typically one communication channel per remote station).

The control system may be combined with a data acquisition system by adding the use of coded signals over communication channels to acquire information about the status of the remote equipment for display or for recording functions.[1] It is a type of industrial control system (ICS*).*

**21)Control center:** The control center is the central nerve system of the power system. It senses the pulse of the power system, adjusts its condition, coordinates its movement, and provides defense against exogenous events

**22)** **corona discharge:**is an electrical discharge brought on by the ionization of a fluid surrounding a conductor that is electrically. Spontaneous corona discharges occur naturally in high-voltage systems unless care is taken to limit the field strength. The corona will occur when the strength (potential gradient) of the electric field around a conductor is high enough to form a conductive region, but not high enough to cause electrical breakdown or arcing to nearby objects. It is often seen as a bluish (or other color) glow in the air adjacent to pointed metal conductors carrying high voltages.

**23)Charging current:** Any two conductors separated by an insulating medium constitutes a condenser or capacitor. In case of overhead transmission lines, two conductors form the two plates of the capacitor and the air between the conductors behaves as dielectric medium. Thus an overhead transmission line can be assumed to have capacitance between the conductors throughout the length of the line. The capacitance is uniformly distributed over the length of the line and may be considered as uniform series of condensers connected between the conductors.

**24)** **A load duration curve** **(LDC):** is used in electric power generation to illustrate the relationship between generating capacity requirements and capacity utilization.

A LDC is similar to a load curve but the demand data is ordered in descending order of magnitude, rather than chronologically. The LDC curve shows the capacity utilization requirements for each increment of load. The height of each slice is a measure of capacity, and the width of each slice is a measure of the utilization rate or capacity factor. The product of the two is a measure of electrical energy (e.g. kilowatt-hours).

**25)** **Power system state estimation:** is defined as the act of estimating the state of the network from the redundant telemetry measurements. Static state estimation refers to the procedure of obtaining the voltage phasors at all of the system buses at a given point in time. This can be achieved by direct means which involve very accurate synchronized phasor measurements of all bus voltages in the system. However, such an approach would be very vulnerable to measurement errors or telemetry failures.

**\* References:**

### 1) https://en.wikipedia.org

**2)** **www.ieee.org**

**3)www.electrical-engineering-portal.com**

**4)** **https://www.techopedia.com**