EE8702 - POWER SYSTEM OPERATION AND CONTROL
UNIT I – PART A - Question with Answers

1, What are the functions of NLDC ?

a) Supervision over the Regional Load Despatch Centers.

b) Scheduling and dispatch of electricity over the inter-regional links in accordance with grid standards specified by the authority and grid code specified by Central Commission in coordination with Regional Load Despatch Centers.

c) Coordination with Regional Load Despatch Centers for achieving maximum economy and efficiency in the operation of National Grid.

d) Monitoring of operations and grid security of the National Grid.

e) Supervision and control over the inter-regional links as may be required for ensuring stability of the power system under its control.

2, What are the roles of RLDC ?

a) Be responsible for optimum scheduling and despatch of electricity within the region, in accordance with the contracts entered into with the licensees or the generating companies operating in the region

b) Monitor grid operations

c) Keep accounts of quantity of electricity transmitted through the regional grid

d) Exercise supervision and control over the inter-State transmission system

3, List out the requirement of good power system ?

The requirement of a good power system are the voltage and frequency must be within the permissible limit .

4, What is the necessity to regulate the voltage in the power system ?

a) The transmission lines and the distribution lines need voltage control at various stages to maintain the voltage at the last consumers premises within the permissible limits.

b) If the voltage of the system deviates from the nominal value, the performance of the device suffers and its life expectancy drops.

5, What is the necessity to regulate the frequency in the power system ?

    a) Most of AC motors run at a speed that are directly related to the frequency

    b) The overall operation of a power system can be much better controlled if the frequency error is kept with in the limit.

    c) When two systems working at different frequencies are to be tied together to make same frequency, frequency converting stations or links are required.

6,What is load curve and Load duration curve ?

The curve drawn between the variations of load on the power station with reference to time is known as load curve. There are three types, Daily load curve, Monthly load curve, Yearly load curve

When the load elements of a load curve are arranged in the order of descending magnitudes ,then the curve obtained is called load duration curve.

7,What is connected load?

The sum of continuous ratings of all the electrical equipments connected to supply systems.

8, What is Average demand?

The average loads or demands on the power station is the average of loads occurring at various events is known as average demand.

Daily average demand = (no of units generated in a day)/ (no of hours in a day = 24 hours)

Monthly average demand = (no of units generated in a month)/ (no of hours in a month = 30* 24 hours)

Yearly average demand = (no of units generated in a year)/ (no of hours in a year = 365*24 hours)

9, What is Load factor?

The ratio of average load to the maximum demand during a certain period of time is known as load factor.

Load factor = (average load)/ (maximum demand)

10. What is Diversity factor?

The ratio of the sum of individual maximum demands of all consumers to the maximum demand of the power station is known as diversity factor.

Diversity factor = (sum of individual maximum demand)/(maximum demand of power station).

11. What is Capacity factor?

It is defined as the ratio of the average load to the rated capacity of the power plant.

Capacity factor = (average demand) /(plant capacity)

This is also defined as the ratio of actual energy produced to the maximum possible energy that could have been produced during a given period.

Capacity factor= (actual energy produced)/ (maximum energy that have been produced)

12. What is Plant use factor?

It is the ratio of the actual energy (units) generated to the product of plant capacity and the number of hours the plant has been actually operated during the period.

Plant use factor = (Total Kwhr Generated) / (Rated capacity of the plant * No of operating hours)

13.What is the major control loops used in large generators?

The major control loops used in large generators are

a) Automatic voltage regulator (AVR)
b) Automatic load frequency control (ALFC).

14,What is the function of load frequency control ?

The function of load frequency control on a Power system is to change the control valve or gate openings of the prime movers as a function of load variation in order to hold system frequency constant.

15.State the basic role of ALFC

The basic role of ALFC is to maintain desired megawatt output of a generator unit and assist in controlling the frequency of the larger interconnection.

16.What is the use of secondary ALFC loop?

The secondary ALFC loop maintains the fine adjustment of the frequency, and also by reset action maintains proper MW interchange with other pool members. This loop is insensitive to rapid load and frequency changes.

17 . Contrast the functions of speed Governor and speed changer in a speed governing system of a turbine generator ?

Speed Governor

      It is pure mechanical speed sensitive device coupled to the hydraulic amplifier which adjust the control valve opening.

Speed changer

      It restore the frequency to nominal value after the operation of the speed governor which has the steady state characteristics.

18, State the conditions to put the alternators in parallel ?

a) The voltage of the incoming alternator must be same as the bus-bar voltage.

b) The frequency of the incoming alternator must be same as the frequency of bus-bar voltage.

c) The phase of incoming alternator voltage must be identical to the phase angle of bus-bar voltage

EE8702 - POWER SYSTEM OPERATION AND CONTROL
UNIT 2– PART A - Question with Answers

1, What is AGC ?

Automatic generation control (AGC) is a centralized online control unit that maintains the overall system frequency and the net tie line load exchange between the power companies in the interconnection.

2)Differentiate static and dynamic response of an ALFC loop ?

Static response of an ALFC loop will inform about frequency accuracy, whereas the dyanamic response of ALFC loop will inform about the stability of the loop.

3) What is meant by control area ?

It is possible to divide an extended power system into subareas in which the generators are tightly coupled together so as to form a coherent group. Such a coherent area is called a control area in which the frequency is assumed to be the same throughout to static as well as dynamic conditions.

4) Define area control error ?

Area Control erroe is a signal which is a function of frequency and tie power deviation. When this signal is used as input signal to the controller, frequency and power deviations are corrected to zero following a step load disturbance.

$$ACE = \Delta Ptie + b.\Delta f \text{ (for multi area system)}$$

$$ACE = \Delta f \text{ (for single area system)}$$

Where

b = Area frequency bias

$\Delta Ptie$ = Change in tie line power

Δf = Change in frequency

5) State Whether changes in AVR loop will be reflected in ALFC loop ?

Control action in the AVR loop affect the magnitude of the generator e.m.f 'E'. As the internal emf determines the magnitude of the ideal power changes in the AVR loop must be felt in the ALFC Loop.

6)What are the assumptions made in Dynamic response of uncontrolled case ?

    a) Neglect the turbine dynamics

    b) the speed changer action is instantaneous

7) List the advantages of multi area operation ?

    a) Under normal operating condition , each control area should have the capacity to meet its own load from its own spinning generator, plus the scheduled interchange between the neighbouring areas.

    b) Under emergency condition, the energy can be drawn from the spininig reserve of all the neighbouring areas immediately due to the sudden loss of generating unit.

8) What are the advantages of pool operation with respect to LFC ?

    a) 50 % of the added load in area (2) will be supplied by area (1) through the tie line.

    b) Frequency drop will be only half compared with that of single area.

9) Differentiate Static and Dynamic Response of an ALFC Loop ?

    Static response of an ALFC loop will inform about frequency accuracy, where as the dynamic response of ALFC loop will inform about the stablity of the loop.

10) What are the types of automatic load frequency control for interconnected power system ?

    a) Flat frequency control

    b) Flat tie – line Control

    c) Frequency bias tie- line control

11) Explain the principle of tie line bias control.

The control strategy is to all pool members must contribute their share to frequency control in addition to taking care of their own net interchange.

12) State the advantages of state variable model.

Optimum linear Regulator (OLR) design results in a controller that minimizes the both transient variable Oscillations and control effects.

EE8702 - POWER SYSTEM OPERATION AND CONTROL
UNIT 3– PART A - Question with Answers

1) State the function of AVR ?

The function of Automatic voltage control is to regulate generator voltage and relative power output.As the terminal voltage varies the excitation control maintains the terminal voltage to the required standard and the demand of the reactive power is also met by the excitation unit.

What are the various functions of excitation system ?

a) Provide direct currnt to the synchronous machine field winding.

b) To perform the Control functions such as the voltage , reactive power flow are not exceeded.

c) To perform the protective functions that ensures the capability limits of the synchronous machine , excitation system and other equipment are not exceeded.

d) To enhance the system stability .

2) What is meant stability compensation ?

Stability compensation improves the dynamic response characteristics without affecting the static loop gain. The stability compensation will damp out the oscillations in the system by introducing a controller which would add a zero to the AVR open loop transfer function.

3) What are the different types of Excitation Sytems ?

a) DC Excitation System

b) AC Excitation System

c) Static Excitation System

4) What is the condition to determine k value of AVR loop ?

$$K > \frac{100}{P} - 1$$

$$\Delta e_0 < \frac{P}{100} \Delta V_{refo}$$

Δe_0 is less than 1 % , K must exceed 99 %

5) List out the methods to improve the voltage profile in the power system ?

The following are the methods of voltage control:

a. By excitation control.

b. By static shunt capacitors.

c. By static series capacitors.

d. By static shunt reactors.

e. By synchronous condensers.

Other methods for voltage control:

a. Tap-changing transformer.

b. Booster transformer.

c. Regulating transformer.

d. Static VAR compensators.

6) What are the different types of reactive power compensation ?

a) Variable impedance : Inductor and Capacitor

b) Switching Converter : TCR, TCSC, STATCOM,SVC

7) Explain booster transformer? Where is it used?

Booster Transformer is a compensating device which gives a inphase boost similar to tap changing transformer. To increase the voltage at an intermediate point in a line ,the booster can be brought into the circuit by closing relay.

It used in distribution feeders where the cost of tab changing transformer is not warranted.

8) What is SVC ?

SVC (Static VAR Compensator) are located in receiving substations and distribution system for smooth and stepless variation of compensation of reactive power injected into line to maintain specific voltage profile and can limit the voltage and frequency deviation under load disturbances , by shunt capacitors and shunt reactors.

9) What is the different types of Static VAR Compensator ?

a. Saturated reactor

b. Thyristor- Controlled Reactor (TCR).

c. Thyristor Switched capacitor (TSC)

d. Thyristor Switched Reactor(TSR)

e. Thyristor Controlled Transformer (TCT)

f. Fixed Capacitor and Thyristor controlled Reactor (FC-TCR)

g. Combined Switched capacitor (TSC) and Thyristor- Controlled Reactor (TCR).

10)What are the advantages and disadvantages of Synchronous Compensators ?

Advantages

It is flexible to operate at all conditions

The reactive power can be varied in a smooth manner

Disadvantages

They cannot be designed to work at more than 20000 V

The cost of installation is higher.

11)Where the synchronous condensers are installed ?

It is connected in parallel with the load at the receiving end of the line.

State the relation between voltage , real and reactive power at node ?

$$P = \frac{EV}{R} - \frac{V^2}{R} - \frac{QX}{R}$$

Where P – real power , V – voltage , R – resistance , Q – reactive power , X – reactance

12)How are voltage and reactive power interrelated ?

$$\text{Reactive power in VAR} = Q = \frac{EV}{X} - \frac{V^2}{X} - \frac{PR}{X}$$

Where P – real power , V – voltage , R – resistance , Q – reactive power , X – reactance

1) Write the condition for the optimal power dispatch in lossless system.

The necessary condition of a minimum cost operating condition exists , when the incremental cost rate of all units be equal to some undetermined value λ called lagrangian multiplier

$$\lambda = \frac{dFi}{dPGi}$$

2) Define base point and participation factor ?

Suppose the economic dispatch problem has to be solved repeatedly by moving the generators from one economically optimum schedule to another as the load changes by a reasonably small amount. Then The initial optimal schedule in which the generator operates is called the base point and The factor indicating how much the generating unit needs to participate in the load change so as to serve the new load at the most economic operating point is called the participation factor.

3) List the equalityand inequality constraints considered in the economic dispatch problem ?

The Equality constraints are

Power demand = Total Power generation

$P_D = P_{G1}+P_{G2}+P_{G3}+\ldots\ldots+ P_{GN} = \sum_{i=1}^{N} PGi$

The Inequality constraints

$PGi,min \le PGi \le PGi,max$ for $i = 1,2,\ldots..N$

4) List the significance of Unit Commitment.
   a. Enough units will be committed to supply the system load.
   b. To reduce loss or fuel cost
   c. By running the most economic unit , the load can be supplied by the unit operating closer to efficiency.

5) List the constraints that are accounted in unit commitment problem.
   a. Spinning reserve
   b. Thermal constraints

i. Minimum uptime

ii. Minimum down time

iii. Crew constraints

iv. Start up

c. Other constraints

i. Hydro constraints

ii. Must run Constraints

iii. Fuel constraints

6) Compare the unit commitment and Economic load Dispatch

S no	Unit Commitment	Economic Load Dispatch
1	Optimum allocation of number of units to be operated .	Optimum allocation of generation to each station
2	There are number of subsets of the complete set of N units that would satisfy the expected demand	The problem assumes that there are N units already connected to the system.
3	Purpose of unit commitment is to find the optimal subset among the subsets providing the minimum operating cost.	Purpose of unit commitment is to find the optimum operating policy for these n units

EE8702 - POWER SYSTEM OPERATION AND CONTROL
UNIT 5– PART A - Question with Answers

1)What is SCADA ? List its Major Components ?

SCADA stands for supervisory control and data acquisition system. It allows a few operators to monitor the generation and high voltage transmission systems and to take action to correct overloads.

The major components are Sensors ,Relay, Remote terminal unit , Master terminal unit, and Communication link

2)What are the functions of SCADA ?

- ✓ Monitoring
- ✓ Alarm
- ✓ Control and indication of AGC
- ✓ Data Acquisition and logging
- ✓ ON/OFF control
- ✓ Raise/Lower command to speed changer
- ✓ Display

3)Define Network Topology in a Power System ?

In order to run the state Estimation, we must know how the transmission lines are connected to the load and generation buses. This information is called network Topology

4)Define State Estimation ?

State estimation is defined as the process of assigning a value to an unknown system state variable based on measurements from that system according to some criteria. (i.e   minimizing the sum of the squares of the differences between the estimated and true value of the function)

State Estimation can be done by Maximum Likelihood Criterion and Weighted least Square Criterion methods.

5) What are the states of power system?

The states of power system are

- ✓ Normal state
- ✓ Alert state
- Emergency state
- ✓ Extremis state
- ✓ Restorative state..