QUESTION BANK

Name of the Department : **Electrical and Electronics Engineering**

Subject Code & Name : **EE8702 & Power System Operation and Control**

Year & Semester : **IV& VII**

UNIT I PRELIMINARIES ON POWER SYSTEM OPERATION AND CONTROL

PART-A

1. What is load 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

2. What is daily load curve?

The curve drawn between the variations of load with reference to various time period of day is known as daily load curve.

3. What is monthly load curve?

It is obtained from daily load curve. Average value of the power at a month for a different time periods are calculated and plotted in the graph which is known as monthly load curve.

4. What is yearly load curve?

It is obtained from monthly load curve which is used to find annual load factor.

5. What is connected load?

It is the sum of continuous ratings of all the equipments connected to supply systems.

6. What is Maximum demand?

It is the greatest demand of load on the power station during a given period.

7. What is Demand factor?

It is the ratio of maximum demand to connected load. Demand factor= (max demand)/ (connected load)

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

8. What is Diversity factor?

The ratio of the sum of individual maximum demand on power station is known as diversity factor.
Diversity factor = (sum of individual maximum demand)/(maximum demand).

9. What is Capacity factor?

This is 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)

10. What is Plant use factor?

It is the ratio of units generated to the product of plant capacity and the number of hours for which the plant was in operation.
Units generated per annum= average load * hours in a year

11. What is Load duration curve?

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

PART B

1. A generating station has the following daily load cycle:

Time (hours)	6-10	10-12	12-16	16-20	20-24
Load(M	25	30	25	35	20

Draw the Load curve (1)and load duration curve(1) and find
i. Maximum demand
ii. Units generated per day
iii. Average Load
iv. Load Factor.

2 .Consider an inductive Load of type Z=R+Jx

i)By how many percent will the real load drop if the voltage is reduced by 5 percent?
ii)How would a 2 percent drop in frequency affects the real load, if the load is assumed to have a power factor of 0.8.

3. A Power station has to meet the following demand.

Group A: 200kW between 8 A.M and 6 P.M
Group B: 100kW between 6 A.M and 10 A.M
Group C: 50kW between 6 A.M and 10 A.M
Group D: 100kW between 10 A.M and 6 P.M and 6 P.M and 6 A.M Plot the daily load cure and load duration curve and determine

(i) Diversity factor
(ii) Units generated per day
(iii)Load factor.

4. Explain about load forecasting & weather sensitive load model

5. Explain plant level control

6. Explain system level control

7. Explain static and dynamic characteristics of power system load.

UNIT-II REAL POWER FREQUENCY CONTROL

PART-A

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

The major control loops used in large generators are

1. Automatic voltage regulator (AVR)
2. Automatic load frequency control (ALFC).

2. What is the use of secondary loop?

A slower secondary 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 but focuses instead on drift like changes which take place over periods of minutes.

3. What is the adv of AVR loop over ALFC?

AVR loop is much faster than the ALFC loop and therefore there is a tendency, for the VR dynamics to settle down before they can make themselves felt in the slower load frequency control channel.

4. What is the diff. between large and small signal analysis?

Large signal analysis is used where voltage and power may undergo sudden changes of magnitude that may approach 100 percent of operating values. Usually this type of analysis leads to differential equations of non-linear type. Small signal anaysis is used when variable excursions are relatively small, typically at most a few percent of normal operating values.

5. What is an exciter?

The exciter is the main component in AVR loop. It delivers the DC power to the generator field. It must have adequate power capacity and sufficient speed of response (rise time less than 0.1 sec).

6. What is the function of AVR?

The basic role of the AVR is to provide constancy of the generator terminal voltage during normal, small and slow changes in the load.

7. Explain about static AVR loop.

In a static AVR loop, the execution power is obtained directly from the generator terminals or from the station service bus. The AC power is rectified by thyristor bridges and fed into the main generator field via slip rings. Static exciters are very fast and contribute to proved transient stability.

8. Write the static performance of AVR loop?

The AVR loop must regulate the terminal |V| to within required static accuracy limit. Have sufficient speed of response. Be stable.

9. What is the dis.adv of high loop gain? How is to be eliminated?

High loop gain is needed for static accuracy but this causes undesirable dynamic response, possibly instability. By adding series AND/OR feedback stability compensation to the AVR loop, this conflicting situation can be resolved.

10. What are the effects of generator loading in AVR loop?

Added load does not change the basic features of the AVR loop, it will however affect the values of both gain factor Kf and the field constant. High loading will make the generator work at higher magnetic saturation levels. This means smaller changes in |E| for incremental increases in if, translating into the reduction of KF. The field time constant will likewise decreases as generator loading closing the armature current paths. This circumstance permits the formation of transient stator currents the existence of which yields a lower effective field induction.

11. What are the functions of ALFC?

The basic role of ALFC"s is to maintain desired MW output of a generator unit and assist in controlling the frequency of large interconnection. The ALFC also helps to keep the net interchange of power between pool members at predetermined values. Control should be applied in such a fashion that highly differing response characteristics of units of various types are recognized. Also unnecessary power output changes should be kept at a minimum in order to reduce wear of control valves.

12. Specify the dis.adv of ALFC loop.

The ALFC loop will main control only during normal changes in load and frequency. It is typically unable to provide adequate control during emergency situations, when large MW imbalances occur.

13. How is the real power in a power system controlled?

The real power in a power system is being controlled by controlling the driving torque of the individual turbines of the system.

14. What is the need for large mechanical forces in speed-governing system?

Very large mechanical forces are needed to position the main valve against the high stream pressure and these forces are obtained via several stages of hydraulic amplifiers

PART B

1.Using a simplified functional diagram explain the operating features of a speed governing system.
2.Develop a linear mathematical model of a speed governing system.
3.Explain the static and dynamic response of ALFC control loop.
4. Explain the technique involved in load frequency control (LFC) of a single area system.
5. Explain the principle, involved in tie line frequency control in case of two area system.
6. Develop a linear mathematical model of two area system.
7. Explain the tie line bias control of two area system..
8. Briefly discuss the LFC control of single area systems.
9. Explain the dynamic response of two area system.
10. Develop a linear mathematical model of two area system.
11. Explain the tie line bias control of two area system.
12. Describe the expression for Critical gain.

UNIT-III REACTIVE POWER -VOLTAGE CONTROL

PART-A

1. What are the sources of reactive power? How it is controlled?

The sources of reactive power are generators, capacitors, and reactors.
These are controlled by field excitation. Give some excitation system amplifier.
The excitation system amplifiers are,

a) Magnetic amplifier
b) Rotating amplifier
Modern electronic amplifier.

2. When is feedback stability compensation used?

High loop gain is needed for static accuracy but this causes undesirable dynamic response, possibly instability. This conflicting situation is resolved by adding feedback stabling compensation to the AVR loop.

3. Give the characteristics of line compensators.

The characteristics of line compensators are,

a. Ferranti effect is minimized.
b. Under excited operation of synchronous generator is not required.

4. What is known as bank of capacitors? How it is adjusted?

When a number of capacitors are connected in parallel to get the desired capacitance, it is known as bank of capacitors. These can be adjusted in steps by switching (mechanical).

5. What is the disadvantage of switched capacitors are employed for compensation?

When switched capacitors are employed for compensation, these should be disconnected immediately under light load conditions to avoid excessive voltage rise and Ferro resonance in presence of transformers.

6. What are the effects of capacitor in series compensation circuit?

The effects of capacitor in series compensation circuit are,
Voltage drop in the line reduces.
Prevents voltage collapse.
Steady state power transfer increases.
Transient stability limit increases.

7. Give two kinds of capacitors used in shunt compensator.

The two kinds of capacitors used in shunt compensator are, a. Static Var Compensator (SVC). These are banks of capacitors (sometimes inductors also for use under light load conditions).

8. What is synchronous condenser?

It is a synchronous motor running at no-load and having excitation adjustable over a wide range. It feeds positive VARs into the line under overexcited conditions and negative VARs

when under excited.

9. Write about Static VAR Compensator (SVC).

These comprise capacitor bank fixed or switched or fixed capacitor bank and switched reactor bank in parallel. These compensators draw reactive power from the line thereby regulating voltage, improve stability (steady state and dynamic), control overvoltage and reduce voltage and current unbalances. In HVDC application these compensators provide the required reactive power and damp out sub harmonic oscillations.

10. What is Static VAR Switches or Systems?

Static VAR compensators use switching for var control. These are also called static VAR switches or systems. It means that terminology wise SVC=SVS. And we will use these interchangeably.

11. Give some of the Static compensators schemes.

a. Saturated reactor
b. Thyristor- Controlled Reactor (TCR)
c. Thyristor Switched capacitor (TSC)
d. Combined TCR and TSC compensator.

12. What is tap changing transformers?

All power transformers and many distribution transformers have taps in one or more windings for changing the turn‟s ratio. It is called tap changing transformers.

13. Write the types of tape changing transformers.

a. Off- load tap changing transformers.
b. Tap changing under load transformers.

14. What is the use of off-load tap changer and TCUL ?

The off- load tap changers are used when it is expected that the ratio will need to be changed only infrequently, because of load growth or some seasonal change. TCUL is used when changes in ratio may be frequent or when it is undesirably to de-energize the transformer to change the tap.

PART – B

1. (a) Discuss generation and absorption of Reactive Power.
   (b) Explain how voltage control can be effected by injection of Reactive Power.

2. (a) Draw the composite SVS power system characteristics .

   b) What are the applications of SVS.

3. Explain different types of static VAR compensators with a phasor diagram.

4. A 3Φ, 230 kV transmission line having the following parameters operates at no-load. R=20ohm, X= 80 ohm, B= $4x10^{-4}$ mho. If the receiving end voltage is 210kV find the sending end voltage representing the transmission line as π model.

5. The load at receiving end of a 3Φ overhead line is 30 MW, 0.8 pf lag at the line voltage of 66kV. A synchronous compensator is situated at sending end and the voltage at both ends of the line is maintained at 66kV. Calculate the MVAR of compensator. The line has a resistance and reactance of 6ohm/ph, 24 ohm/ph, respectively.

6. A 415 kV line is fed through an 132/415kVtransformer from a constant 132kV supply. At the load end of the line, the voltage is reduced by another transformer of ratio 415/132kV. The total impedance of the line is (30+j60)Ω. Both transformers are equipped with tap-changing, the product of the two off-nominal setting is unity. If the load on the system is 200 MW at 0.8of lagging. Calculate the settings of the tap-changer required to maintain the voltage at 132kV.

7. Two sub-station are connected by two lines in parallel with negligible impedance, but each containing a tap-changing transformer of reactance 0.22pu on the basis of its rating of 200 MVA. Find the net absorption of reactive power when the transformer, taps are set to 1:1.08, and 1:0.95 respectively. Assume pu voltages to be equal at the two ends.

UNIT-IV UNIT COMMITMENT AND ECONOMIC DISPATCH

PART-A

1. Define economic dispatch problem.

The objective of economic dispatch problem is to minimize the operating cost of active power generation.

2. Define incremental cost.

The rate of change of fuel cost with active power generation is called incremental cost. Write the load balance equation? Pg-pd-pl=0.

3. Define base point.

The present operating point of the system is called base point.

4. Define participation factor.

The change in generation required to meet power demand is called as participation factor.

5. Define hydrothermal scheduling problem.

The objective is to minimize the thermal generation cost with the constraints of water availability.

6. Define Unit commitment.

Commitment of minmum generator to meet the required demand.

7. Define spinning reserve.

It is the term describe the total amount of generation availability from all units synchronized on the system.

8. What is meant by scheduled reserve?

These include quick start diesel turbine units as well as most hydro units and pumped storage hydro units that can be brought online, synchronized and brought up to full capacity quickly.

9. What are the thermal unit constraint?

Minimum up time, minimum down time crew constraints.

10. Define minimum up time.

Once the unit is running, it should not be turned off immediately.

11. Define min.down time.

Once the unit is decommited, there is a minimum time before it can be recommended.

12. Define crew constraints.

If a plant consist of two (or) more units, all the units cannot be turned on at the same time since there are not enough crew members to attend both units while starting up.

13. What are the two approaches to treat a thermal unit to operating temperature?

The first allow the unit boiler to cool down and then heat backup to operating temperature in time for a scheduled turn on. The second requires that sufficient energy be input to the boiler to just maintain operating temperature.

14. What are the techniques for the solution of the unit commitment problem?

Priority list method dynamic programming Lagrange relation

15. What are the assumptions made in dynamic programming problem?

A state consists of an array of units with specified units operating and the rest of the time. The startup cost of a unit is independent of the time it has been offline. There are no costs for shutting down the units.

16. Define long range hydro scheduling problem.

The problem involves the long range of water availability and scheduling of reservoir water releases. For an interval of time that depends on the reservoir capacities.

17. What are the optimization technique for long range hydro scheduling problem?

Dynamic programming composite hydraulic simulation methods statistical production cost.

18. Define short range hydro scheduling problem.

It involves the hour by hour scheduling of all generators on a system to achieve minimum production condition for the given time period.

19. Define system blackout problem.

If any event occurs on a system that leaves it operating with limits violated, the event may be followed by a series of further actions that switch other equipment out of service. If the process of cascading failures continues, the entire system of it may completely collapse. This is referred as system blackout.

20. What is meant by cascading outages?

If one of the remaining lines is now too heavily loaded, it may open due to relay action, thereby causing even more load on the remaining lines. This type of process is often termed as cascading outage.

PART – B

1. (a) Explain briefly the constraints on unit commitment problem.
   (b) What is spinning reserve and does this reserve help in operating a power system efficiently?

2. Explain Priority list method using full load average production cost. State the merits and demerits.

3. Explain with a neat flowchart the procedure for finding the solution for unit commitment problems using forward DP method.

4. There are three thermal generating units which can be committed to take the system load. The fuel cost data and generation operating unit data are given below:

$$F_1 = 392.7 + 5.544\,P_1 + 0.001093\,P_1^2$$

$$F_2 = 217^1 + 5.495\,P_2 + 0.001358\,P_2^2$$

$$F3 = 65.5 + 6.695\,P_3 + 0.004049\,P^2$$

Generation limits : $150 \le P_1 \le 600$ MW
$100 \le P_2 \le 400$ MW
$50 \le P_3 \le 200$MW

There are no other constraints on system operation. Obtain an optimum unit commitment table. Adopt Brute force enumeration technique. Show the details of economic schedule and the component and total costs of operation for each feasible combination of units for the load level of 900 MW.

5. Derive the expression for base point and participation method.

6. Give iteration algorithm for solving economic scheduling problem, without transmission loss.

7. Derive coordination equation for economic dispatch including losses, in the power system. Give steps for economic dispatch calculation. Neglecting losses

8. Consider the following three units:

$$I_{C1} = 7.92 + 0.003124\,P_{G1}$$
$$I_{C2} = 7.85 + 0.00388\,P_{G2}$$
$$I_{C3} = 7.97 + 0.00964\,P_{G3}\ P_D$$
$$= 850 \text{ MW}$$
$$P_{G1} = 392.2 \text{ MW}, P_{G2} = 334.6 \text{ MW}, P_{G3} = 122.2 \text{ MW}$$

Determine the optimum schedule if the load is increased to 900 MW by using Participation Factor method.

UNIT-V COMPUTER CONTROL OF POWER SYSTEMS

PART-A

1. What are the functions of control center?

System monitoring contingency analysis security constrained optimal power flow.

2. What is the function of system monitoring?

System monitoring provides upto date information about the power system.

3. Define SCADA system.

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

4. What are the states of power system?

Normal state alert mode contingency mode emergency mode. Define normal mode? The system is in secure even the occurrence of all possible outages has been simulated the system remain secure is called normal mode.

5. Define alert mode.

The occurrence of all possible outages the system does not remain in the secure is called alert mode.

6. What are the distribution factors?

Line outage distribution factor, generation outage distribution factor.

7. Define state estimation.

State estimation is the process of assigning a value to an unknown system state variable based on measurements from that system according to some criteria.

8. Define max. likelihood criterion.

The objective is to maximize the probability that estimate the state variable x, is the true value of the state variable vector (i.e, to maximize the P(x)=x).

9. Define weighted least-squares criterion.

The objective is to minimize the sum of the squares of the weighted deviations of the estimated measurements z, from the actual measurement.

10. Define minimum variance criterion.

The objective is to minimize the expected value of the squares of the deviations of the estimated components of the state variable vector from the corresponding components of the true state variable vector.

11. Define must run constraint.

Some units are given a must run status during certain times of the year for reason of voltage support on the transmission network.

12. Define fuel constraints.

A system in which some units have limited fuel or else have constraints that require them to burn a specified amount of fuel in a given time.

13. What are the known values in short term hydro scheduling problem?

The load, hydraulic inflows & uit availabilities are assumed known. What is meant by telemetry system? The states of the system were measured and transmitted to a control center by means of telemetry system.

14. What are the functions of security constraints optimal power flow?

In this function, contingency analysis is combined with an optimal power flow which seeks to make changes to the optimal dispatch of generation. As well as other adjustments, so that when a security analysis is run, no contingency result in violations.

15. Define the state of optimal dispatch.

This is the state that the power system is in prior to any contingency. It is optimal with respect to economic operation but may not be secure.

16. Define post contingency.

This is the state of the power system after a contingency has occurred. Define secure dispatch? This is state of the power system with with no contingency outages,but with correction to the operating parameters to account for security violations.

17. What are the priorities for operation of modern power system?

Operate the system in such a way that power is delivered reliably. Within the constraints placed on the system operation by reliability considerations, the system will be operated most economically.

18. What is meant by linear sensitivity factor?

Many outages become very difficult to solve if it is desired to present the results quickly. Easiest way to provide quick calculation of possible overloads is linear sensitivity factors.

19. What are linear sensitivity factors?

Generation shift factors line outage distribution factors.

20. What is the uses of line distribution factor?

It is used to apply to the testing for overloads when transmission circuits are lost.

21. What is meant by external equivalencing?

In order to simplify the calculations and memory storage the system is sub divided into 3 sub systems called as external equvalencing.

PART – B

1. Explain the different system operating states .
2. Discuss about automatic substation control using SCADA.
2. Explain about SCADA configuration.
4. Briefly discuss the various functions of energy control centre.
5. Explain the hardware components and functional aspects of SCADA system using a fundamental block diagram.
6. Explain the various controls for secure operation.
7. Explain briefly how the system states are continuously monitored and controlled.