



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

DEFINITIONS AND TERMINOLOGY

Course Name	:	POWER SYSTEM OPERATION AND CONTROL
Course Code	:	AEE016
Program	:	B.Tech
Semester	:	SEVEN
Branch	:	Electrical and Electronics Engineering
Section	:	B
Academic Year	:	2020-2021
Course Faculty	:	Dr. P Sridhar, Professor

COURSE OBJECTIVES:

Students will try to learn:	
I	The economic operation through optimal generation - load dispatch, hydro - thermal and pumped storage plant scheduling and their implementation through various classical methods.
II	The required mathematical and engineering fundamentals for controlling the governing system, turbine, excitation models and automatic, load frequency controllers in the power system.
III	The necessity and effective management of generation, transmission and distribution of electrical power for optimal operation of the system.
IV	The concepts of load frequency control in interconnected systems, its operation, reactive power control, compensation techniques in transmission line and types of loads with characteristics for real-world engineering problems and applications.
V	The control actions required on the system to meet the minute-to-minute variation of system demand and its significance in power system operation and control by maintaining the frequency and voltage as constant.

DEFINITIONS AND TERMINOLOGY - QUESTION BANK

S No	QUESTION	ANSWER	Blooms Level	Course Outcome
UNIT - I ECONOMIC OPERATION OF POWER SYSTEMS				
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.	Understand	CO1
2	Define economic dispatch problem?	The objective of economic dispatch problem is to minimize the operating cost of active power generation.	Remember	CO2
3	Define incremental cost?	The rate of change of fuel cost with active power generation is called incremental cost	Remember	CO2

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4	Define hydrothermal scheduling problem?	The objective is to minimize the thermal generation cost with the constraints of water availability.	Remember	CO2
5	What is long-term hydrothermal scheduling?	Long-term hydrothermal scheduling problem is concerned with minimization of total cost of fuel spent in thermal plants through effective utilization of the water inflow to the various hydro reservoirs during the year of interest.	Remember	CO3
6	Define Hydrothermal coordination?	Determination of thermal power and hydro power such that total system generation cost is minimum while satisfying the system constraints.	Remember	CO3
7	Define Unit Commitment?	Commitment of minimum generator to meet the required demand	Remember	CO4
8	Define spinning reserve?	It is the term describe the total amount of generation availability from all units synchronized on the system	Remember	CO4
9	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.	Remember	CO4
10	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	Remember	CO2
11	Define control variables?	The real and reactive power generations are called control variables since they are used to control the state of the system.	Remember	CO2
12	What is heat rate curve?	It generally indicates the amount of fuel required to generate one unit of electricity	Remember	CO2
13	What is an input output curve?	It is a plot of the input in British thermal units (BTU) per hour versus the power output of the plant in MW.	Understand	CO2
14	What is the meaning of BTU?	The acronym stands for British Thermal Unit, which is the unit used to measure thermal (heat) energy. Specifically.	Remember	CO2
15	Define disturbance variables?	The real and reactive power demands are called demand variables since they are beyond the system control and are hence considered as uncontrolled or disturbance variables.	Remember	CO2
UNIT-II				
MODELING OF GOVERNOR, TURBINE AND EXCITATION SYSTEMS				
1	What is the function of speed governor?	It comprises of the elements which are directly responsive to speed, and whose positions influence the action of other elements of speed governing system	Remember	CO5
2	What is the function of speed changer?	It is a device by means of which the speed governing system may be adjusted to change the speed or power output of the turbine in operation.	Remember	CO5
3	What is meant by free governor operation?	Only governor control is called as free governor action. It can be obtained by deactivating the integral controller.	Understand	CO5
4	What is AGC?	Automatic Generation Control (AGC) is a centralized generating unit that operates both in real time and in closed loop with strong interface towards economy & security of power system. It is an online computer control between the power companies in the interconnection	Understand	CO5

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5	What is the 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).	Understand	CO5
6	Define inertia constant?	Inertia constant is defined as the ratio of kinetic energy stored in the rotor to the MVA rating of the generator	Remember	CO5
7	Define regulation?	Regulation is defined as percentage rise in voltage when full load at the specified power factor is switched off, the excitation being adjusted initially to give normal voltage.	Remember	CO5
8	Define prime mover?	The engine, turbine, water wheel, or similar machine that drives an electric generator.	Remember	CO1
9	What is static excitation system?	Where the exciting current is fed from a controlled rectifier that gets its power either directly from the generator terminals.	Remember	CO6
10	Define exciter ceiling voltage?	It is defined as the maximum voltage that may be attained by an exciter with specified conditions of load.	Remember	CO6
11	Define function of hydraulic amplifier?	It comprises of a pilot valve and main piston arrangement. It converts low power level pilot valve movement into high power level piston valve movement.	Remember	CO5
12	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	Remember	CO7
13	What is meant by fly ball speed governor?	Fly ball governor is a purely mechanical speed-sensitive device coupled directly to the hydraulic amplifier which adjusts the control valve opening via the linkage mechanism.	Remember	CO5
14	State the basic role of ALFC	Basic role of Automatic Load Frequency Control is to maintain desired megawatt output of a generator unit and assist in controlling the frequency of the larger interconnection.	Remember	CO7
15	Define Swing Equation?	The equation describing the relative motion is known as the swing equation, which is a non-linear second order differential equation that describes the swing of the rotor of synchronous machine.	Remember	CO1
UNIT-III				
SINGLE AREA AND TWO AREA LOAD FREQUENCY CONTROL SYSTEMS				
1	What is area control error?	Area control error (ACE) is the change in area frequency when used in integral control loop forced the steady state frequency error to zero. $ACE = \Delta P_{tie} + b \Delta f_{p.u}$ (for multi area system) $ACE = \Delta f$ (for Single area system) Where, ΔP_{tie} = change in tie-line power, Δf = change in frequency, b = area frequency bias.	Understand	CO7
2	What is the function of load frequency control?	The function of load frequency control is to change the control valve or gate opening of the prime movers as a function of load variations in order to hold system frequency constant.	Remember	CO5
3	Write the tie-line power deviation equation in terms of frequency	The tie-line power deviation equation is given by, $\Delta P_{tie,1} = 2\pi T_{12} [\int \Delta f_1 dt - \int \Delta f_2 dt]$ Where, T_{12} = Synchronizing power coefficient;	Remember	CO7

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		$\Delta f_1, \Delta f_2$ are incremental frequency changes of areas 1&2 respectively.		
4	What is meant by control area?	It is possible to divide an extended power system into sub- areas in which the generators are tightly coupled together so as to form a coherent group, i.e., all the generators respond in unison to change in load or speed changer settings. Such a coherent area is called control area	Remember	CO7
5	Define AFRC?	Area frequency response coefficient (AFRC) is defined as the ratio between the incremental disturbance input and change in steady state frequency. It is equal to the addition of load damping constant and inverse of regulation.	Remember	CO7
6	Define load frequency control?	In inter connected systems with two or more independent controlled areas, in addition to control of frequency, generation with in each area has to be controlled to maintain scheduled power interchange.	Understand	CO5
7	Define single area system?	Single area has number of generators which are closely coupled together so as to form a coherent group, i.e. all the generators in power system should respond in unison to change in load, Initially the changes in load are managed by the speed governing system	Remember	CO7
8	Define two Area load frequency control?	An extended power system can be divided into a number of Two Area Load Frequency Control areas interconnected by means of tie lines.	Understand	CO7
9	What is tie line bias control?	A mode of Automatic Generation Control that allows the Balancing Authority to maintain its Interchange Schedule and respond to Interconnection frequency error.	Remember	CO7
10	Define dynamic response?	The variation of frequency with respect to time for a given step change in load demand.	Remember	CO5
11	State the basic role of ALFC?	Basic role of Automatic Load Frequency Control is to maintain desired megawatt output of a generator unit and assist in controlling the frequency of the larger interconnection	Remember	CO5
12	Define static response in isolated power system?	A static response is the response of a structure to static loads (such as the self-weight of a structure).	Remember	CO5
13	What is uncontrolled case?	For uncontrolled case $\Delta P_c = 0$ i.e, constant speed changer position with variable load.	Remember	CO5
14	Define pool operation?	An extended power system can be divided into a number of LFC areas, which are interconnected by tie lines.	Remember	CO5
15	Define steady state response in isolated power system?	Steady-state response is the behavior of a circuit after a long time when steady conditions have been reached after an external excitation.	Remember	CO5
UNIT - IV				
COMPENSATION FOR POWER FACTOR IMPROVEMENT AND REACTIVE POWER CONTROL				
1	What is Static VAR Switches?	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	Remember	CO8
2	What is synchronous condenser?	It is a synchronous motor running at no-load and having excitation adjustable over a wide range.	Remember	CO9

S No	QUESTION	ANSWER	Blooms Level	Course Outcome
		It feeds positive VARs into the line under overexcited conditions and negative VARs when under excited.		
3	What is known as bank of capacitors?	When a number of capacitors are connected in parallel to get the desired capacitance	Remember	CO9
4	Define tap changing transformers	All power transformers and many distribution transformers have taps in one or more windings for changing the turn's ratio.	Remember	CO8
5	Define reactive power?	The resultant power in watts of an AC circuit when the current waveform is out of phase with the waveform of the voltage, usually by 90 degrees if the load is purely reactive, and is the result of either capacitive or inductive loads	Remember	CO8
6	Define reactive power compensation?	The management of reactive power to improve the performance of alternating-current power systems. In general, the problem of reactive power compensation is related to load and voltage support	Remember	CO8
7	What is reactive power control?	Reactive power production and consumption by generators allows the network operator to control voltages throughout their system.	Remember	CO8
8	What is power factor correction?	The process of increasing the power factor to near unity without altering the original load. In order to eliminate line losses, the power factor correction device must be mounted at the inductive load.	Remember	CO9
9	What is utilization voltage?	Utilization voltage allows for voltage drop in facility wiring between the point of utility delivery and the utilization equipment.	Remember	CO8
10	What is automatic voltage controller?	The automatic voltage regulator (AVR) is a device designed to regulate voltage automatically – that is, to take a fluctuating voltage level and turn it into a constant voltage level	Remember	CO8
11	What is voltage control method?	The task of voltage control is closely associated with fluctuating load conditions and corresponding requirements of reactive power compensation. Therefore several voltage control methods are employed in power system to keep the voltage levels within the desirable limits	Remember	CO8
12	Define power factor?	The power factor is the ratio of the real power that is used to do work and the apparent power that is supplied to the circuit	Remember	CO1
13	What do you mean by line drop compensation?	A connection option of automatic voltage regulators. Regulation speed is the same as the terminal voltage regulation, resulting in improved transient angle and voltage stability. Difficulties with line drop compensation arise when two or more generators are paralleled at their terminals.	Remember	CO9
14	What is power capacitor?	Power capacitors are passive electronic components that provide a static source of reactive power in electrical distribution systems.	Remember	CO1
15	What is the use of series capacitor?	This capacitive reactance produces a voltage drop across each capacitor, therefore the series connected capacitors act as a capacitive voltage divider network.	Remember	CO9
UNIT - V				
COMPENSATION FOR POWER FACTOR IMPROVEMENT AND REACTIVE POWER CONTROL				
1	What is daily load curve?	The curve drawn between the variations of load	Remember	CO10

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		with reference to various time period of day is known as daily load curve.		
2	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.	Remember	CO10
3	What is connected load?	It is the sum of continuous ratings of all the equipment is connected to supply systems	Remember	CO10
4	What is Maximum demand?	It is the greatest demand of load on the power station during a given period.	Remember	CO10
5	What is Demand factor?	It is the ratio of maximum demand to connected load. Demand factor= (max demand)/ (connected load)	Understand	CO10
6	What is Average demand?	The average of loads occurring on the power station in a given period (day or month or year) is known as average demand. Daily average demand = (no of units generated per day)/ (24 hours) Monthly average demand = (no of units generated in month)/ (no of hours in a month) Yearly average demand = (no of units generated in a year)/ (no of hours in a year)	Understand	CO10
7	Define Load factor?	The ratio of average load to the maximum demand during a given period is known as load factor. Load factor = (average load)/ (maximum demand)	Understand	CO10
8	Define 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).	Understand	CO10
9	Define 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)	Understand	CO10
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	Understand	CO10
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.	Remember	CO10
12	Define loss factor?	Loss factor is a factor which when multiplied by energy lost at time of peak and the number of load periods will give overall average energy lost. It is calculated as the ratio of the average load loss to the peak load loss.	Remember	CO10
13	What is contribution factor?	It is the contribution of particular load, in per unit of individual demand, to the group maximum demand.	Remember	CO10
14	What is the load compensation?	The management of reactive power to improve power quality i.e. V profile and pf.	Remember	CO10

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15	What is coincident demand?	The energy demand required by a given customer or class of customers during a particular time period. Coincident peak demand is the energy demand by that group during periods of peak system demand.	Remember	CO10

Signature of the Faculty

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