Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN

[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]

Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 8004

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – MAY / JUNE 2024

Sixth Semester

Electrical and Electronics Engineering

U19EE623 – POWER SYSTEM OPERATION AND CONTROL

(Regulation 2019)

Time: Three Hours Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Justify out the need of reactive power control in electrical power transmission lines.	2	K2	CO1
2.	What are the effects of capacitor in series compensation?	2	K1	CO1
3.	Show the condition for the optimal power dispatch in lossless system.	2	K1	CO2
4.	What is the need of hydro thermal scheduling?	2	K2	CO2
5.	List the few constraints that are accounted in unit commitment problem.	2	K1	CO3
6.	Differentiate minimum up and minimum down time in unit commitment problem.	2	K2	CO3
7.	Distinguish between reliability and security of power system.	2	K2	CO4
8.	Mention four types of SCADA system and its application area.	2	K1	CO4
9.	Compare load flow and state estimation.	2	K2	CO5
10.	Point out the importance of state estimation in power system.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.			Questions	Marks	KL	CO
11.	a)	i.	Name the producer and consumers of reactive power in a power system.	6	K2	CO1
		ii.	Describe working of static VAR compensators with its advantages.	7		
			(OR)			
	b)		Develop the block diagram of AVR and obtain its transfer function and explain its static and dynamic response.	13	K3	CO1
12.	a)		The fuel inputs per hour of plants 1 and 2 are given as $F1= 0.2P_1{}^2 +40 P_1+120$ Rs/hr $F2=0.25P_2{}^2 +30 P_2+150$ Rs/hr Calculate the economic operating schedule and the corresponding cost of generation. The maximum and the minimum loading on each unit are 100 MW and 25 MW. Assume the transmission losses are ignored and the total demand is 180 MW. Also determine the savings obtained if the load is equally shared by both the units.	13	K5	CO2
			(OR)			
	b)		The fuel cost of two units are given by $F1 (P_{G1}) = 1.5+20P_{G1}+0.1P_{G1}{}^2$ Rs/hr $F2 (P_{G2}) = 1.9+30P_{G2}+0.1P_{G2}{}^2$Rs/hr If the total demand on the generator is 200 MW, calculate the economic load scheduling of the two units.	13	K5	CO2
13.	a)		Give out the priority list of unit commitment using full load average production cost for the given data: Heat rate of unit1 $H1= 510+7.2P_{G1}+0.00142 P_{G1}{}^2$ MW/hr Heat rate of unit2 $H2= 310+7.85P_{G2}+0.00194P_{G2}{}^2$ MW/hr Heat rate of unit3 $H3= 78+7.97P_{G3}+0.00482P_{G3}{}^2$ MW/hr. PD=500 MW	13	K5	CO3

Unit	Min(MW)	Max(MW)	Fuel cost
1	150	600	1.1
2	100	400	1.0
3	50	200	1.2

			(OR)			
	b)		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: $F1 = 392.7 + 5.544\ P_1 + 0.001093\ P_1{}^2$ $F2 = 217 + 5.495\ P_2 + 0.001358\ P_2{}^2$	13	K5	CO3

$F3 = 65.5 + 6.695 P_3 + 0.004049 P_3^2$

P_1 , P_2 , P_3 in MW

Generation limits:

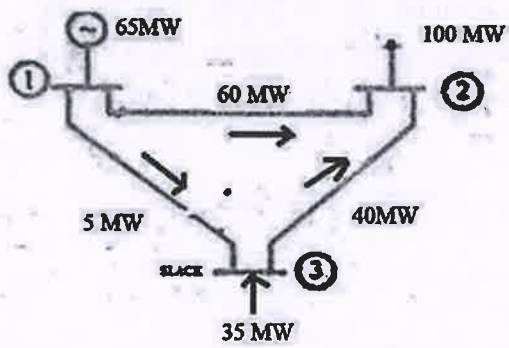
$150 \leq P_1 \leq 600$ MW;

$100 \leq P_2 \leq 400$ MW;

$50 \leq P_3 \leq 200$ MW

There are no other constraints on system operation. Obtain an optimum unit commitment table. Adopt Brute force enumeration technique.

14.	a)	Explain the hardware components and functional aspects of SCADA system using its fundamental block diagram.	13	K2	CO4
		(OR)			
	b)	What is EMS? Explain in detail major functions in power system operation and control.	13	K2	CO4
15.	a)	Determine the state vectors, line flow and power injections at the buses using state estimation for the given measurements for the figure. Take 100 MVA base, $X_{12} = 0.2$, $X_{13} = 0.4$, $X_{23} = 0.25$ Without errors, measurements are M_{12} = 60 MW, $M_{13} = 5$ MW, $M_{32} = 40$ MW With errors, measurement are $M_{12} = 62$ MW, $M_{13} = 6$ MW, $M_{32} = 37$ MW	13	K5	CO5



(OR)

b)	i. Draw a state transition diagram of a power system showing different sets of operating states classified according to security level. ii. Explain the state transition that may occur due to system disturbances the different control actions taken to improve the security level of the system.	13	K5	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	A system consists of two power plants connected by transmission line. The total load located at plant-2 is as shown in figure. Data of evaluating loss coefficients consist of information that a power transfer of 100 MW from station-1 to station-2 results in a total loss of 8 MW. Find the required generation at each station and power received by the load when λ of the system in Rs.100/MWh. The IFCs of the two plants are given by	15	K5	CO3

When 212.5 MW received by the load, find the savings in Rs/hr obtained by co-coordinating the transmission losses rather than neglecting in determining the load division between the plants.

(OR)

	b)	A 3Φ, 230 kV transmission line having the following parameters operates at no-load. R = 20 Ω, X= 80 Ω, B = $4x10^{-4}$ mho. If the receiving end voltage is 210 kV find the sending end voltage representing the transmission line as π model.	15	K5	CO1