Reg. No.



(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL / MAY 2019

SUBJECT: POWER SYSTEM OPERATION AND CONTROL [ELE 4008]

REVISED CREDIT SYSTEM

Time	: 3 Hours	Date: 03 MAY 2019	Max. Marks: 50
Instr	 uctions to Candidates: Answer ALL the questions. Use of MATLAB/SIMULINK m Missing data may be suitably and the suitably suitably	ay be allowed. assumed.	
1A. 1B. 1C.	With a neat diagram, discus highlighting the differences bet Explain the constraints that lim With the help of flow chart, disc	s the various operating states of powe ween them. its the capability of generator and transmis uss the hierarchy of control centers.	er system (03) sion line. (04) (03)
2A. 2B.	Explain the modeling of single a complete block diagram. An isolated power system 'A constant=0.25s, turbine time co D=0.9 p.u on 1000MVA base. Co i. Draw the dynamic respo increase in load by 300M deviation and verify your ii. Implement an automatic state frequency deviation and show the dynamic re iii. If the given system 'A' wi a tie line of P12=2 p.u, dra there is sudden increase deviation and comment of	rea system for load frequency control and of A' has the following parameters: gover instant=0.5s, inertia constant= 4 s, Regulation impute the following inse of the frequency deviation when there W. From the response, find the steady state or answer analytically. generation control for the system so that in becomes zero. Design the gain of integral esponse of the system with controller. thout AGC is connected to an identical syste with dynamic response of frequency devia in load by 300MW in first area A. Find the sto on the result. Also find the tie line power de	Iraw the (05)rnor time n=4% andis sudden frequencythe steady controllerm through tion when teady state viation.(05)
3A.	A SVC is connected at the mid voltage. In addition to improv frequency oscillations. With the strategy to be adopted by SVC.	point of the line in order to improve the ring the voltage, SVC is required to dam ne help of neat block diagram, explain th	midpoint p the low he control (04)
3B.	The fuel cost functions in Rs/hr $C1 = 0.004 P_{1^2} + 6P_1 + 400$ $C2 = \alpha P_{2^2} + \beta P_2 + 500$ i. The incremental fuel cost MW. Determine the optimit. ii. The incremental fuel cost 1300 MW. Determine the	of two 800 MW thermal plants are t of power is 8 Rs/MWh when the total dem nal generation of each plant. st of power is 10 Rs/MWh when the total e optimal generation of each plant.	and is 550 demand is

iii. From results of (i) and (ii), compute the values of α and β of second plant. (06)

- **4A.** With the help of a diagram, explain the principle of operation of STATCOM. Derive the expressions for midpoint voltage and current when STATCOM is connected to the midpoint of a symmetrical, lossless line.
- **4B.** The fuel cost functions of two thermal power plants are $C1 = 0.004 P_{1^2} + 6.2P_1 + 320 R_s/h$ $50 \le P_{1} \le 250MW$ $C2 = 0.003 P_{2^2} + 6 P_2 + 200 R_s/h$ $50 \le P_{2} \le 350MW$ If the load is 412.35 MW, then find the optimal loading and cost on each unit by i. Analytical method ii. Iterative method by taking initial $\lambda = 6.5 R_s/MWh$
 - iii. Considering a transmission loss of $P_L=0.000125 P_1^2+0.0000625 P_2^2$
- **5A.** Derive the expressions for loss or B coefficients for a 2 bus system connected by a transmission line.
- **5B.** Derive the expression for estimated state variable using weighted least square estimation technique. Consider a four bus system shown in Fig. Q(5B) with line reactance given in pu on 100 MVA base. Assuming generator bus angle θ 1=0 rad, compute the best estimate for the phase angle θ 2, θ 3 and θ 4 using weighted least square estimation method given the following measurements.

 $M_{12}\text{=}80$ MW with measurement error $\sigma_{12}\text{=}0.01$ p.u

M₁₃=40 MW with measurement error σ_{13} =0.01 p.u

 M_{24} = -60 MW with measurement error σ_{24} =0.02 p.u

 $M_{43}\text{=}70$ MW with measurement error $\sigma_{43}\text{=}0.001\,$ p.u

Also compute the value of performance index J and estimate power generation, loads and line flows. Use DC load flow.



(07)

(04)

(03)

(06)