BENGAL ENGINEERING AND SCIENCE UNIVERSITY,SHIBPUR

M.E.(Elec.Engg) Ist SEMESTER EXAMINATION 2013

POWER SYSTEM OPERAION AND CONTROL

(EE-910)

Time: 3 hours Full Marks: 70

GROUP-A

(Answer any three questions from this group)

1 a) Derive co ordination equations for N number of thermal plants in order to have economic operation with network losses considered.

b) Two thermal generating stations A and B are connected by a transmission line L. The load on station A is 400MW while the load on station B is 100MW. The transmission line loss is given by the following equation

$$P_l = 0.0008\,(P_{g3} - 100)^2 \text{ MW}$$

The incremental fuel cost (IFC) for each thermal station is given by

$$(IFC)_A = (0.006P_{gA} + 4) \text{ Rs /MWhr}$$

$$(IFC)_B = (0.007P_{gB} + 4) \text{ Rs /MWhr.}$$

Find optimal generation of each station and the power loss in the line. [6 + 8]

2. Two thermal plants A and B are interconnected by a line whose power loss in MW is given by the following equation

$P_l = 0.0002P_A^2$, where P_A and P_B are the power generation of plants A and B respectively. The maximum and minimum generation limits of A and B are 400MW and 70MW for each of these plants. The cost function of both the plants is identical and is expressed by the following expression

$$F(P) = 400 + 7P + 0.002P^2$$

When both the plants are loaded at 250MW and load is 500MW on bus station B, then 12.5MW power is lost in the line. Find where should the extra power be generated for economic operation for a constant load of 500MW on bus of station B? What is the value of line loss at the state of economic operation of both the plants? Attempt a rescheduling to minimize transmission loss and comment on your result. [14]

3. a) Develop an analytical method for hydrothermal scheduling of a pumped storage plant with network loss being considered.

b) Briefly explain the concept of short term and long term hydrothermal scheduling. [10+4]

4. a) What is unit commitment? Explain the concept of unit commitment and state briefly the procedure for solution of unit commitment problem.

b) What do you mean by stand alone and longitudinal power systems? What is the function of SCADA in power system control? [10+4]

5. A generator having induced emf E, d-axis transient reactance X_d' and terminal voltage V is connected to an infinite bus, having voltage $E_0\angle 0^0$, through a line having reactance X_e. $|E_0|$ is constant throughout the operation while |E| is constant during pre-disturbance level. E leads E_0 by an angle δ (delta). Show that for analysis of small signal stability problem of such a system the elements of the state matrix A depends on the damping factor (K_d), inertia constant (H), line reactance (X_e) and the initial operating condition governed by E and δ_0 (initial value of δ). Obtain the expressions for undamped frequency of oscillation and damping ratio. Also comment on your findings. [14]

GROUP-B

(Answer any two questions from this group)

6 a) Explain MW-Frequency and MVAR - $|V|$ control.

b) Draw, with the help of, block diagram the dynamic structure of power system showing the Primary ALFC, Secondary ALFC & AVR Loop. [8+6]

7 a)"Recently the whole country except the southern Grid and Kolkata area (under Eastern grid) was plunged into darkness due to Grid Collapse" – Why do these two regions remain unaffected ? State the effect of longer restoration time.

b) What do you mean by Black Start Facility ? State the common characteristics of Restoration. [(5+2) + 3+4]

8 a) Derive the mathematical model of Load. What is meant by Isochronous Governor ? State its application.

b) What do you mean by "Stiffness" of a system? Derive the equation of stiffness of a system. Obtain the composite regulating character of the system. [(3+2+1)+1+6+1]

9 Derive the model transfer function of Reference and Speed Relay, Speed Governor, Servomotor and Steam Valves. Draw the complete model of Turbine considering a re-heat unit. Addition of re-heater results addition of a Zero to the forward path transfer function- State its impact on Bandwidth. [2+2+3+3+3+1]