* S F - 7 7 6 4 / 3 0 0 *

SF-7764

B. E. - IV (Sem. VIII) (Electrical) Examination

May / June - 2011

Power System Operation & Control

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. - 4 (SEM. 8) (ELECTRICAL)

Name of the Subject :

☛ POWER SYSTEM OPERATION & CONTROL

☛ Subject Code No. : 7 7 6 4 ☛ Section No. (1, 2,.....) : NIL

Seat No. :

Student's Signature

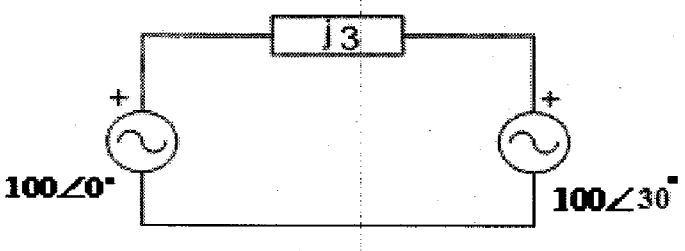
(2) Attempt all questions.
(3) Figure to the right indicates full marks.
(4) Assume necessary data wherever required.
(5) Scientific calculator up to Casio-100D, 100MS or equivalent is permitted.

1 (a) (i) Explain briefly why Y_{bus} is a sparse matrix for a large size power system. **6**

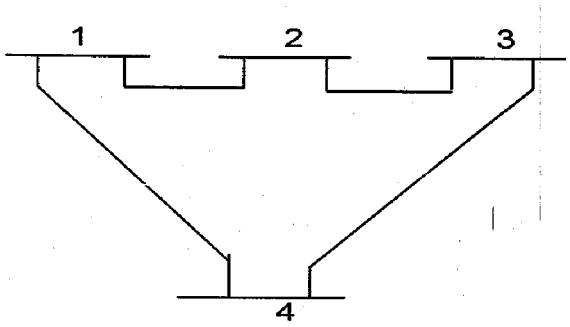
(ii) Define acceleration factor used in calculation of load flow analysis.

(iii) Explain why power injection of slack bus is not required to calculate while using approximate load flow solution.

(b) Calculate the active and reactive power exchange between two machines. **4**



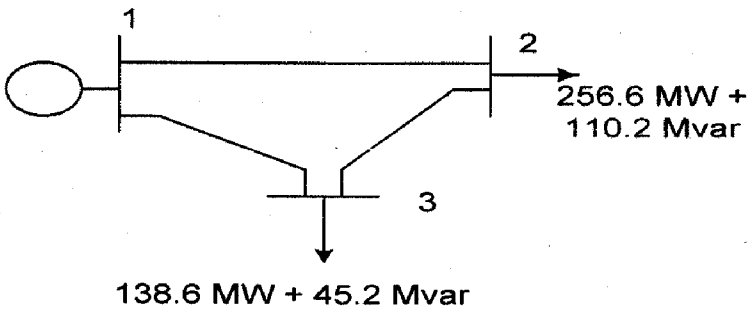
(c) For given 4-bus system the line impedances and shunt admittances are as under. Draw its equivalent network and Formulate Y_{bus}. 8



Bus to Bus	1-2	2-3	3-4	2-4	1-3
R (pu)	0.2	0.3	0.25	0.2	0.1
X (pu)	0.8	0.9	0.12	0.8	0.7
$y_{pq}/2$	j0.02	j0.03	j0.04	j0.02	j0.01

2 For a 3-bus power system with generation at bus no. 1. Magnitude of which is adjusted is 1.05 pu. Obtain Jacobian matrix using Newton - Raphson method, and also determine the phasor values of the voltage at the load buses 2 and 3 accurate to four decimal places. Use 100 MVA base. **16**

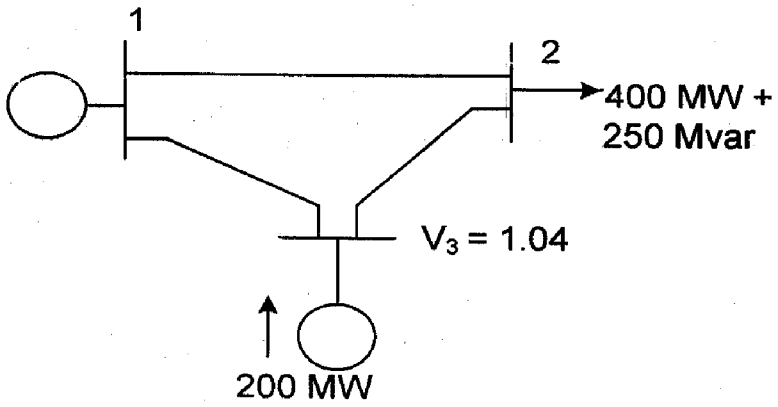
Bus to Bus	1-2	2-3	1-3
R (pu)	0.02	0.0125	0.01
X (pu)	0.04	0.025	0.03



OR

2 For a 3-bus power system with generation at buses no. 1 Magnitude of bus no 1 is adjusted is 1.05 pu and bus no 3 is fixed at 1.04 pu with a real power generation of 200 MW. Using Gauss-Seidal method, determine the phasor values of the voltage at the load buses 2 and 3 accurate to four decimal places. Also find slack bus real and reactive power. Use 100 MVA base **16**

Bus to Bus	1-2	2-3	1-3
R (pu)	0.02	0.0125	0.01
X (pu)	0.04	0.025	0.3



3 Attempt any two : **16**

(i) Derive Generalized power flow equations.

(ii) Write an algorithm for the Newton-Raphson Method for Load flow study.

(iii) Draw the flow chart for the FDLF method/algorithm

(iv) State all assumptions made for approximate load flow solution. Explain individually how these assumptions make load flow solution easy.

4 (a) Two generators rated 300MW and 600MW are operating in parallel. The drop characteristics of their governors are 4% and 5% respectively from no load to full load. The speed changers are so set that the generators operate at 50Hz at no load. How would a load of 800MW be shared among the generators and what will the system frequency be ? Assume free governor operation. The speed changers of the governors are reset so that the load of 600MW is shared among the generators at 50Hz in the ratio of their ratings. What are the no load frequencies of the generators? 8

(b) With a neat schematic diagram, explain load frequency control loop and voltage control loop of a generator connected in an isolated power system. Explain why these loops are analyzed independently ? 8

OR

4 (a) Derive exact coordination equation for a system in which m generating stations are there and line losses are to be accounted for. 8

(b) Incremental fuel costs in rupees per MWh for a plant consisting of two units are : **6**

$$\frac{dC_1}{dP_{G1}} = 0.2P_{G1} + 40 \quad \text{and} \quad \frac{dC_2}{dP_{G2}} = 0.25P_{G2} + 30$$

Calculate the extra cost incurred in Rs/hr, if a load of 220MW is scheduled equally.

(c) Explain in brief the term :Unit Commitment". **2**

5 (a) Consider the following three IC curves **4**

$$P_{G1} = -100 + 50(IC)_1 - 2(IC)_1^2 \ , \ P_{G2} = -150 + 60(IC)_2 - 2(IC)_2^2$$

and $P_{G3} = -80 + 40(IC)_3 - 2(IC)_3^2$

Where ICs are in Rs/MWh and PGs are in MW. Neglect the transmission losses and calculate the optimum generation scheduling.

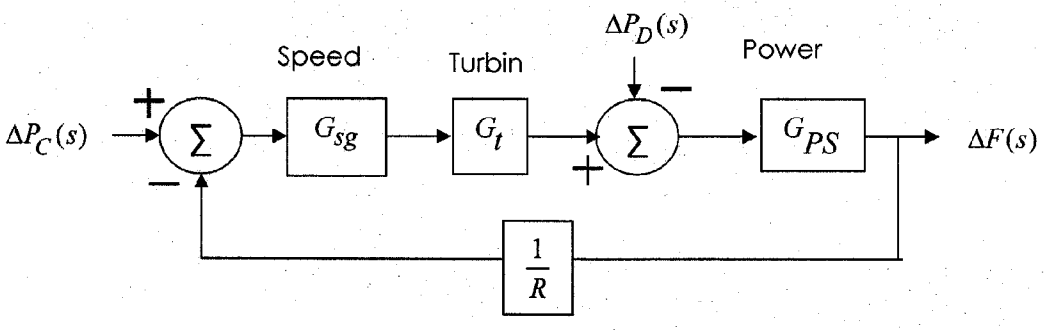
(b) The complete block diagram representation of frequency control of an isolated power system is shown in the figure. The ΔP_c is change in speed changer setting and ΔP_D is change in load demand. It is given that **6**

$$G_{sg} = \frac{K_{sg}}{1+sT_{sg}} \quad G_t = \frac{K_t}{1+sT_t} \quad G_{PS} = \frac{K_{PS}}{1+sT_{PS}}$$

Assume that $K_{sg}K_t = 1$ and $K_{PS} = 1/B$, where $B = \frac{\partial P_D}{\partial f} / P_r$

and P_r is rated power of the generator.

Obtain the expression of Δf in terms of ΔP_C and ΔP_D under steady state.



(c) Write short note on Automatic Voltage Control for a single area system. **6**

OR

5 (a) Draw schematic diagram of turbine speed governing system. Explain various components of the system. **6**

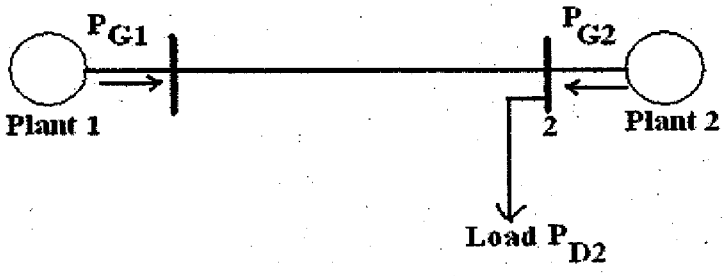
(b) Assume that in an isolated power system all generators operating at their rated power generation limit. Also assume that all loads are frequency dependent loads. Explain qualitatively the effect of increase in load on frequency and load bus voltages under steady state with suitable expression. Neglect effect of load variation due to change in voltage. **4**

(c) Write a short note on how a power system can be operated optimally. Explain the terms, fuel cost and incremental fuel cost, for thermal power plants. Explain briefly that why there are maximum and minimum limits on the generated power of a thermal unit of turbine and generator. **6**

6 (a) A two bus system is shown in figure. If 100MW is transmitted from plant 1 to the load, a transmission loss of 10MW is incurred. Find the required generation for each plant and the power received by the load when the system λ is Rs. 25/MWh. **8**

The incremental fuel costs of the two plants are given below :

$$\frac{dC_1}{dP_{G1}} = 0.02P_{G1} + 16 \quad \text{and} \quad \frac{dC_2}{dP_{G2}} = 0.04P_{G2} + 20$$



(b) Consider the system of the above problem with a load of 237.04MW at bus 2. Find the optimum load distribution between the two plants (1) when losses are included but not coordinated, and (2) when losses are also coordinated. Also find the savings in rupees per hour when losses are coordinated. **6**

(c) Explain physical significance of λ. Take usual notations for various related variables. Assume that k generating stations are connected in a system and losses are coordinated. **4**