Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech/EEE/NEW/SEM-6/EEE-601/2013

2013
POWER SYSTEM – II

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten of* the following :

$10 \times 1 = 10$

i) An equipment has a per unit impedance of 0.9 p.u. to a base of 20 MVA, 33kV. the per unit impedance to the base of 20MVA, 11 kV will be

a) 0·9 b) 2·7

c) 0·3 d) 8·1.

ii) In a power system, the maximum no. of buses is

a) P – Q buses b) P – |V| buses

c) Slack buses d) P – δ buses.

iii) At a generator bus in power system, the quantities specified are

a) Q and V b) P and |V|

c) P, |V| and Q limit d) P, |V| and δ.

iv) An acceleration factor is used in load flow study by

a) Gauss-Seidel method

b) Newton-Raphson method

c) Decoupled Newton-Raphson method

d) Fast Decoupled load-flow method.

v) Buchholz relay is suitable for protection of

a) Transformers b) Alternators

c) Bus-bars d) Feeders.

vi) The pick-up value of a relay is 7·5 A and fault current in the coil is 30A. Its plug setting multiplier is

a) 2 b) 4

c) 0·5 d) 0·25.

vii) The unit of inertia constant is

a) kV/MVA b) MJ/MVA

c) MW/MJ d) $MJ/(kV)^2$.

viii) $a + a^2$ is equal to

a) $-j\sqrt{3}$ b) $+j\sqrt{3}$

c) -1 d) $\sqrt{3}$.

ix) The presence of shunt capacitance in a long transmission line will cause in a power system network,

a) reduction in the diagonal elements of Y_{bus} matrix

b) reduction in the diagonal elements of Z_{bus} matrix

c) accelerated convergence in the load-flow study

d) increase in the damping of oscillation following large disturbances.

x) Indicate which of the following statements are correct.

A) The rotor of a generator in a thermal station is salient pole type.

B) Cadmium rods are used in Nuclear Power plants for efficient cooling of reactor.

C) For hydro-stations with low-head, impulse turbines cannot be used.

D) Governors are used as sensors of speed of the rotor to control the reactive power.

a) (A) and (D) only b) (C) only

c) (A) and (B) only d) (C) and (D) only.

xi) In a load flow study by decoupled N-R method

a) ΔP is related to $\Delta|V|$ and $\Delta|\delta|$

b) ΔQ is related to $\Delta|V|$ and $\Delta|\delta|$

c) ΔP is related to $\Delta|V|$ and ΔQ is related to $\Delta\delta$

d) ΔP is related to $\Delta\delta$ and ΔQis related to $\Delta|V|$.

xii) Two synchronous machines having inertial constraints M_1, and M_2 are swinging together. The inertia constant of the combination is

a) $M_1 + M_2$ b) $\frac{M_1 + M_2}{2}$

c) $\frac{M_1 M_2}{M_1 + M_2}$ d) $\frac{M_1 - M_2}{M_1 + M_2}$.

xiii) If V_s and V_r are sending and receiving end voltages and δ is the angle between them, then the reactive power flow mainly depends on

a) $|V_s| - |V_r|$ b) δ

c) $|V_s|$ d) V_r and δ.

GROUP – B

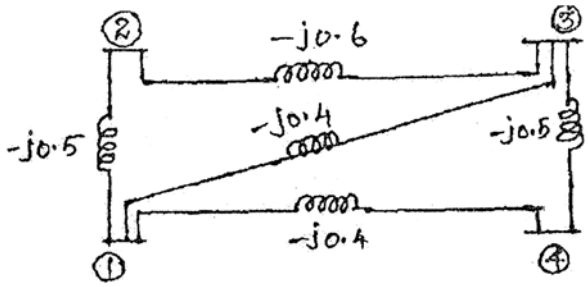
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define per unit value. A generator rated at 30 MVA, 11 kV has a reactance of 20%. Calculate its per unit reactance for a base of 50 MVA and 10 kV. 2 + 3

3. Write the Load-flow equation by Gauss-Seidel Method, mentioning the checks for convergence.

4. Determine the Y_{bus} matrix for the network shown below (the values shown are the admittances of the lines)



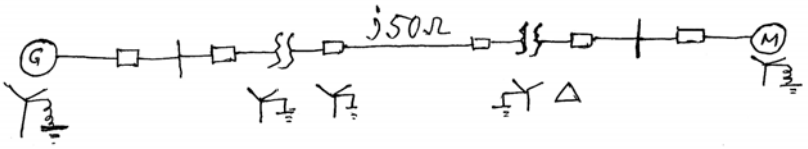
5. Draw the connection for the sequence networks for a Line to Ground (L-G) fault in a generator and derive the fault current. 3 + 2

6. Define the terms 'recovery voltage' and 'rate of rise of restriking voltage'.

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. For the following draw the reactance diagram. Neglect resistance and use a base of 100 MVA, 220 kV, in 50 ohm line.



The ratings of the motor, generator and transformers are given below :

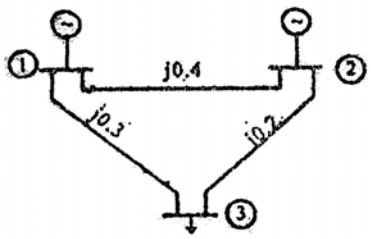
Generator : 40 MVA, 25 kV, $X^{//}$ = 20%.

Syn. Motor : 50 MVA, 11 kV, $X^{//}$ = 30%

$Y - Y$ transformer : 40 MVA, 33/220 kV, X = 15%

$Y - \Delta$ transformer : 30 MVA, 11/220 kV (Δ/Y), X = 15%.

8. a) Consider the 3-bus system shown below :



Bus 1 : Slack bus, V = 1·05 p.u.

Bus 2 : PV bus, V = 1·0 p.u. P_g = 3 p.u.

Bus 3 : PQ bus, P_l = 4 p.u. Q_l = 2 p.u.

Carry out one iteration of load flow solution by Gauss. Seidel method. Neglect limits on reactive power generation.

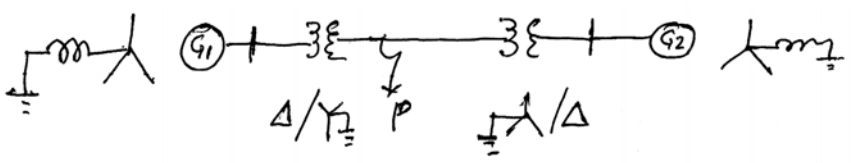
b) What is a Jacobian Matrix ? How does it help in the evaluation of bus voltages in a load flow study ? 8 + 7

9. a) Derive the swing equations for non-coherent machines.

b) How does the equal area criterion help in estimating the transient stability limit of a generator ? Explain with a diagram.

c) Determine the frequency of oscillation of the rotor of a generator following a small disturbance, when it is delivering a load of P_r .

10. a) For the following system show the sequence networks and their interconnections for a line to line to ground fault (L-L-G)



b) The positive, negative and zero sequence reactances of a 20 MVA, 13·2 kV alternator are 0·35 p.u., 0·2 p.u. and 0·1 p.u. respectively. A line to earth fault develops on phase 'a' of the unloaded generator. Assuming the neutral of the alternator to be solidly grounded, determine the fault current and fault voltage in p.u.

11. Write short notes on any *three* of the following : 3×5

a) SF_6 Circuit Breaker.

b) Critical clearing time and critical clearing angle

c) Bus impedance matrix

d) Definite distance relay

e) Earth fault protection for transformer

f) Plug setting and time setting multiplier of overcurrent relay.