M.E.(Elec.), 1st Semester Examination, 2012

Advanced Power System Analysis (EE–908)

Time: 3 hours | Full Marks: 70

(*i*) *Answer any three questions from Group -A and any two from Group -B*
(*ii*) *Marks are indicated in the margin*
(*iii*) *The symbols are of usual meanings*

GROUP – A

1.(*a*) What is primitive network? Draw the primitive network for a $1-\phi$ element in impedance form. Write its performance equation in matrix notation.

(*b*) The self and mutual pu reactances of the network elements are shown in Fig.1.

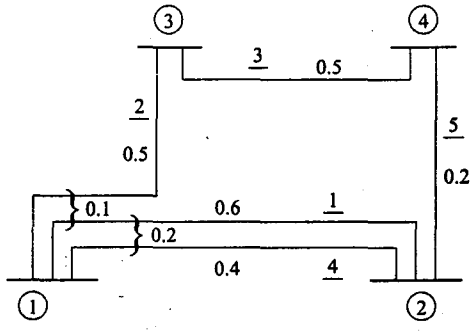

Fig.1: Problem 1(b)

The primitive admittance matrix of the network is

$[y] =$

	1	2	3	4	5
1	2.083	−0.417		−1.042	
2	−0.417	2.083		0.208	
3			2.000		
4	−1.042	0.208		3.021	
5					5.000

(i) Form the bus incidence matrix and (ii) compute the bus admittance matrix of the network. Assume bus ① as reference. (4+(4+6))

2.(*a*) Derive the equations for formation of bus impedance matrix when the partial network is connected to a mutually coupled link in a $1-\phi$ network.

(b) The zero sequence bus impedance matrix of the network of Fig.2 is formed by step-by-step method. The first four elements in the sequence of 1-2-4-5 are already connected to obtain

$Z_{BUS}^{(0)} =$

	②	③	④
②	0.0345	0.0005	0.0209
③	0.0005	0.0345	0.0141
④	0.0209	0.0141	0.6182

The zero sequence pu reactances and the reference node are shown in the diagram.

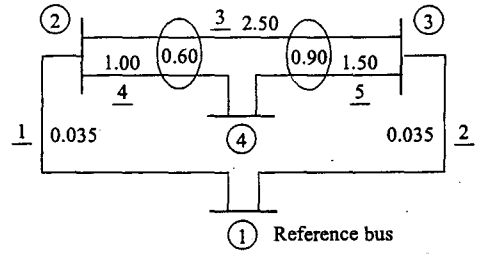

Fig.2: Problem 2(b)

Given the inversion of

2.5	0.6	0.9
0.6	1.0	0.0
0.9	0.0	1.5

is

0.625	−0.375	−0.375
−0.375	1.225	0.225
−0.375	0.225	0.892

Modify $Z_{BUS}^{(0)}$ to connect the element 3 which is mutually coupled with elements 4 and 5. Take bus ① as the reference bus. (8+6)

3.(a) What is symmetrical component? Apply it to diagonalize the 3–ϕ rotating elements into zero, positive and negative sequence impedances.

(b) Derive expressions for

(i) fault current and voltage at the faulted bus

(ii) fault voltages at other buses

(iii) fault current through an element

for three phase to ground fault in symmetrical components of a balanced 3–ϕ network. (6+8)

4. Write notes on the following: (7+7)

(a) Network graph

(b) Short circuit program

GROUP – B

5. A fixed tap-setting transformer with an off-nominal turns ratio a:1 and admittance y_{pq} *is connected between bus nos. p and q of an existing n-bus system. Show that the* following modifications are to be done so as to obtain the new bus admittance matrix Y_{BUS}.

(i) $Y_{pp}^{new} = Y_{pp}^{old} + y_{pq} / a^2$

(ii) $Y_{qq}^{new} = Y_{qq}^{old} + y_{pq}$

(iii) $Y_{pq}^{new} = Y_{qp}^{new} = - y_{pq}/a$ **(14)**

6. (i) A 20 bus, 30 line system has 16 load buses, and 3 voltage controlled buses. *Calculate the following for this system and justify your result.*

(a) Degree of sparsity of *Bus Admittance matrix.*
(b) No. of rows and columns of the *Jacobian matrix* (used in Newton Raphson Load Flow Study) **(1 + 2)**

(ii) In connection with Jacobian matrix derive mathematical expressions for H_{pp}, H_{pq}, L_{pp}, L_{pq} . **(11)**

7. (i) Explain how Fast Decoupled Load Flow method is made faster than Newton *Raphson method.* *(4)*

(ii) Derive two basic equations used in Fast Decoupled Load Flow method. **(10)**