CBCS SCHEME

18EE71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023

Power System Analysis – 2

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following with example:
i) Oriented graph
ii) Basic loop
iii) Co-tree. **(06 Marks)**

b. What is primitive network? Give the representation of a typical component and arrive at their performance equation in impedance and admittance form. **(06 Marks)**

c. The below Fig.Q.1(c) shows the one-line diagram of a simple four-bus system, Table Q.1(c) gives the line impedances identified by the buses on which these terminates. The shunt admittances at all the buses is assumed to be negligible.
i) Find Y_{BUS} assuming that the line shown dotted is not connected
ii) What modification need to be carried out in Y_{BUS} if the line shown dotted is connected?

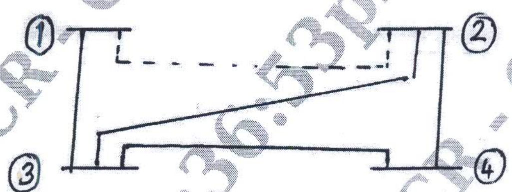

Fig.Q.1(c)

Table Q1(c)

Line (bus to bus)	R (pu)	X (pu)
1 – 2	0.05	0.15
1 – 3	0.10	0.30
2 – 3	0.15	0.45
2 – 4	0.10	0.30
3 – 4	0.05	0.15

(08 Marks)

OR

2 a. With usual notation, deduce the expression for Y_{BUS} using singular transformation method. **(06 Marks)**

b. Determine Y_{BUS} by singular transformation of the system with data as given in Table Q.2(b) **(08 Marks)**

Table Q.2(b)

Element No.	1	2	3	4	5
Bus code (p-q)	0-1	1-2	2-3	3-0	2-0
Self admittance y_{pqpq}	1.4	1.6	2.4	2.0	1.8

c. The bus incidence matrix A for a network of 8 elements and 5 nodes (4-buses) is given in Table Q.2(c). Reconstruct the oriented graph. Hence obtain the one-line-diagram of the system indicating the generator position. **(06 Marks)**

Table Q.2(c)

A =

	1	2	3	4	5	6	7	8
①	1	0	0	0	-1	0	-1	0
②	0	1	0	0	1	-1	0	-1
③	0	0	1	-1	0	1	0	0
④	0	0	0	1	0	0	1	1

Module-2

3 a. Why load flow analysis in power system is necessary? Explain. **(06 Marks)**

b. What is the data required to conduct load flow analysis? Discuss the need of acceleration factor in load flow solution. **(06 Marks)**

c. Obtain the load flow solution using Gauss-Seidal method at the end of one iteration of the power system shown in Fig.Q.3(c). The data is given in Table Q.3(c)-1 and Table Q.3(c)-2.

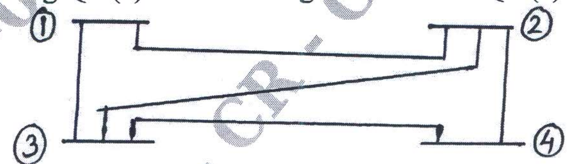

Fig.Q.3(c)

Table Q.3(c) – 1
Line data

S. B.	E. B	R (PU)	X(PU)
1	2	0.05	0.15
1	3	0.10	0.30
2	3	0.15	0.45
2	4	0.10	0.30
3	4	0.05	0.15

Table Q.3(c) – 2
Bus data

Bus No	P_i (p.u)	Q_i (p.u)	V_i
1	-	-	$1.04 \angle 0$
2	0.5	-0.2	-
3	-1.0	0.5	-
4	0.3	-0.1	-

(08 Marks)

OR

4 a. Explain how buses are classified for load flow study. **(06 Marks)**

b. Discuss operating constraints in load flow analysis. **(06 Marks)**

c. For the three bus system shown in Fig.Q.4(c), use Gauss-Seidel method and determine the voltages at bus 2 and bus 3 at the end of first iteration. Line impedances marked on the diagram are in p.u. The information relating to bus data is given in Table Q.4(c).

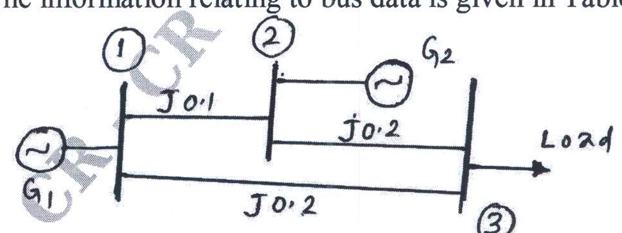

Fig.Q.4(c)

Table Q.4(c)

Bus No.	Type	Generation		Load		Voltage magnitude |V|	Reactive Power Limit	
		P	Q	P	Q		Q_{min}	Q_{max}
1	Slack	-	-	-	-	1.0	-	-
2	PV	5.32	-	-	-	1.1	0	5.32
3	PQ	-	-	3.64	0.53	-	-	-

(08 Marks)

Module-3

5 a. Discuss the algorithm procedure for load flow analysis using Newton-Raphson's method in polar coordinates. **(06 Marks)**

b. Obtain the voltages at all buses for three bus system shown in Fig.Q.5(b) at the end of first iteration by N-R method. The data is given in Table Q.5(b) – 1 and Table Q.5(b) – 2.

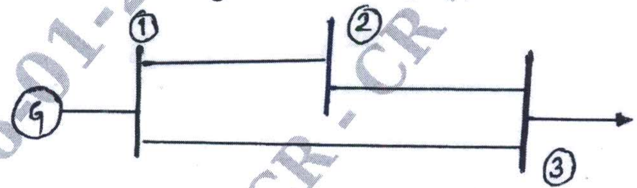

Fig.Q.5(b)

Table Q.5(b) – 1 Line data

SB	EB	R(pu)	X(pu)
1	2	0.0	0.1
1	3	0.0	0.2
2	3	0.0	0.2

Table Q.5(b) – 2 Bus data

Bus No.	P_G	Q_G	P_L	Q_L	V_{sp}
1(slack)	-	-	-	-	1.0
2 (pv)	5.3217	-	-	-	1.1
3 (PQ)	-	-	3.6392	0.5339	-

(08 Marks)

c. Compare load flow methods with standard features. **(06 Marks)**

OR

6 a. Stating all assumptions, deduce FDLF model. Explain the step by step procedure for load flow solution using FDLF method. **(08 Marks)**

b. Draw a flow chart for Fast Decoupled Load Flow (FDLF) method. **(06 Marks)**

c. Derive expression for all elements of Jacobian matrices in polar form. **(06 Marks)**

Module-4

7 a. Explain the followings:

i) Input-output curve

ii) Heat rate curve

iii) Incremental cost curve related to thermal plants. **(06 Marks)**

b. The fuel inputs per hour of plant 1 and 2 are given as $F_1 = 0.2P_1^2 + 40P_1 + 120$ RS/hr ; $F_2 = 0.25P_2^2 + 30P_2 + 150$RS/hr. Determine the economic operating schedule and the corresponding cost of generation if the maximum and minimum loading units is 100MW and 25MW, the demand is 180MW and transmission line losses are neglected. If the load is equally shared by both units, determine the saving obtained by loading the units as per equal incremental production cost. **(06 Marks)**

c. Discuss the algorithm procedure for priority list method of unit commitment solution. **(08 Marks)**

OR

8 a. With usual notation, derive the generalized transmission loss formula and B-coefficient. **(08 Marks)**

b. A system consists of two plants connected to a transmission line, the load is located at Plant-2. The power transfer of 100MW from station 1 to the load results in a loss of 8MW. Find the required generation at each station and the power received by the load, when the system, is operating with λ = RS 100/MWh. The incremental fuel cost of two plants are $\frac{dc_1}{dp_1} = 0.12P_1 + 65\ RS/MWh$ and $\frac{dc_2}{dp_2} = 0.25P_2 + 75 RS/MWh$. **(06 Marks)**

Fig.Q.8(b)

c. Draw the flow chart of dynamic forward DP approach for unit commitment. **(06 Marks)**

Module-5

9 a. Obtain the generalized algorithm expression for bus impedance matrix elements when a link is added to the partial network. Also discuss the special cases. **(10 Marks)**

b. Explain clearly the point-by-point method of solving swing equation. Mention the assumptions made. **(10 Marks)**

OR

10 a. Obtain Z_{bus} by building algorithm for the system shown in Fig.Q.10(a). All values are in p.u. (impedance). Take bus '0' as reference bus. Add the elements in the order of ref. bus to bus1, ref. bus to bus2 and finally bus 1 to bus 2. **(10 Marks)**

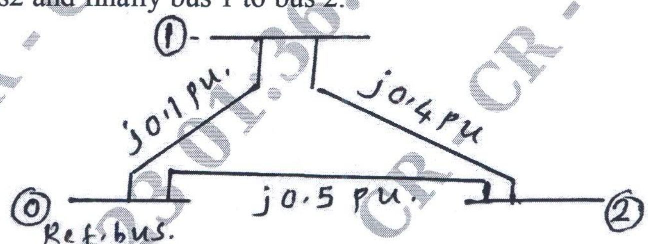

Fig.Q.10(a)

b. Describe the methodology of using Runge-Kutta technique for transient stability studies of a power system. **(10 Marks)**

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