## Seventh Semester B.E. Degree Examination, June/July 2011
# Computer Techniques in Power System Analysis

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

## PART – A

1 a. Given two primitive elements p-q and r-s with mutual admittance $y_{pqrs}$, represent in admittance form and obtain the primitive performance equation. **(06 Marks)**

b. Explain the terms with example i) Tree ; ii) Basic cutsets. **(06 Marks)**

c. The oriented connected graph of a system is shown in Fig.Q.1(c).

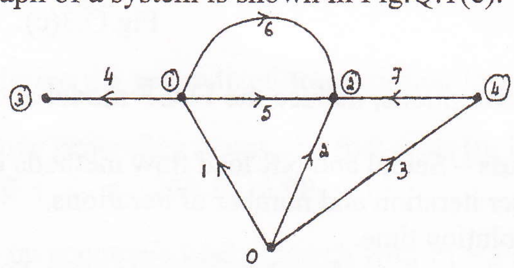


Fig.Q.1(c).

Obtain :
i) Basic cutset incidence matrix B
ii) Basic loop incidence matrix C.

Select elements 5, 6 and 7 as links. Hence verify the relation $C_b = -B_l^t$. **(08 Marks)**

2 a. With usual notation, deduce the expression for $Y_{BUS}$ by singular transformation. **(07 Marks)**

b. The bus admittance matrix with ground node 0 as reference of a power system network with 4 buses is given below. Obtain the admittance diagram. Assume no mutual coupling.

$Y_{BUS}$ =

| | ① | ② | ③ | ④ |
|---|---|---|---|---|
| ① | -j15 | j10 | 0 | j5 |
| ② | j10 | -j17 | j5 | 0 |
| ③ | 0 | j5 | -j19 | j10 |
| ④ | j5 | 0 | j10 | -j15 |

**(06 Marks)**

c.

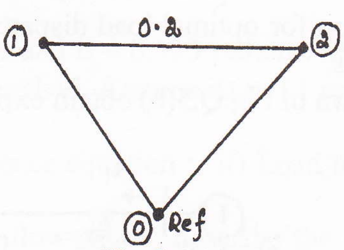


Fig.Q.2(c).

The bus impedance matrix with node 0 as reference of the system shown in Fig.Q.2(c) is

$Z_{BUS}$ =

| | 1 | 2 |
|---|---|---|
| 1 | 0.08 | 0.04 |
| 2 | 0.04 | 0.12 |

Using $Z_{BUS}$ algorithm, modify the above $Z_{BUS}$ for the removal of element 1 – 2 with self impedance 0.2 pu. Neglect mutual coupling. **(07 Marks)**

3 a. Define power flow problem and explain its importance. **(04 Marks)**

b. Derive expressions for diagonal elements of NR Jacobian submatrices in polar form. **(08 Marks)**

c. In the power system of Fig.Q.3(c), bus 1 with slack and remaining are load buses. Write down the bus voltage equations for Gauss – Seidel iterative technique. **(08 Marks)**

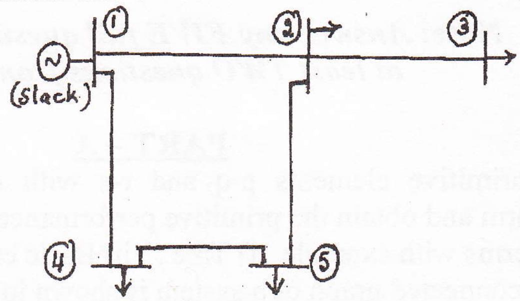


Fig.Q.3(c).

4 a. Stating all assumptions, deduce the FDLF model and give the computational flow-diagram. **(07 Marks)**

b. Compare Gauss – Seidel and NR load flow methods in respect of
  i) Time per iteration and number of iterations.
  ii) Total solution time.
  iii) Effect of selection of slack bus, acceleration factor.
  iv) Convergence characteristics. **(06 Marks)**

c. For a three bus system, $Y_{BUS}$ (with ground as reference) is

$Y_{BUS}$ =

| | 1 | 2 | 3 |
|---|---|---|---|
| 1 | -j32 | j10 | 0 |
| 2 | j10 | -j15 | j5 |
| 3 | 0 | j5 | -j6 |

Bus 1 is slack with voltage (1.02 + j0) pu. The real and reactive power injections (in pu) at buses 2 and 3 (load buses) are $P_2 = -0.5$ ; $Q_2 = -0.1$ ; $P_3 = -0.3$ ; $Q_3 = 0.0$. Assuming (1 + j0) pu voltage at buses 2 and 3, determine its voltages at the end of first iteration using G-S method. **(07 Marks)**

## PART – B

5 a. Deduce the condition for optimal load dispatch considering transmission losses in a system comprising K-plants. **(06 Marks)**

b. For the system shown in Fig.Q.5(b) obtain expressions for B – coefficients $B_{11}$, $B_{22}$ and $B_{12}$. **(07 Marks)**

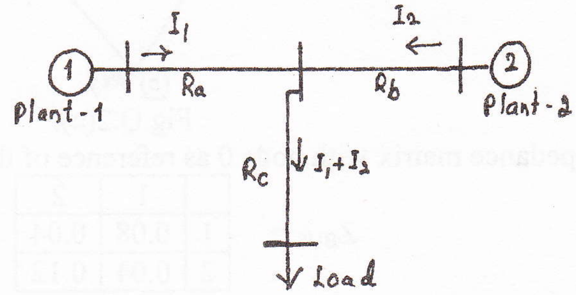


Fig.Q.5(b).

c. A system with two generating units is shown in Fig.Q.5(c).

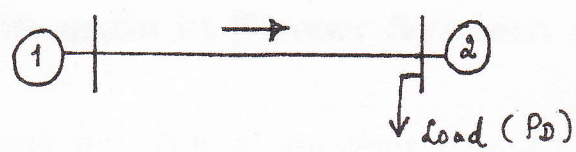


Fig.Q.5(c).

When a load of 125 MW is transmitted from unit 1 to load, loss of 15.625 MW is incurred in the line. Determine the optimal generation schedule and total load demand if the cost of received power ($\lambda$) is Rs.24/MWh. The incremental fuel costs (in Rs/MWh) are $\frac{dF_1}{dP_1} = 0.0255\,P_1 + 15$ and $\frac{dF_2}{dP_2} = 0.05\,P_2 + 20$. **(07 Marks)**

6 a. With a usual notation, derive the generalized transmission loss formula and B-coefficients. **(07 Marks)**

b. In a system comprising two generating plants, the fuel costs (in Rs/hr) are
$F_1 = 0.004\,P_1^2 + 8P_1 + 10$ ; $F_2 = 0.006\,P_2^2 + 9P_2 + 15$.
The system is operating on economic load dispatch with $P_1 = P_2 = 500$ MW and $\frac{dP_L}{dP_2} = 0.2$.
Find the penalty factor of plant 1. **(06 Marks)**

c. The incremental fuel cost in Rs./MWh for 3 generating units in a system are :
$\frac{dF_1}{dP_1} = 0.12\,P_1 + 30$ ; $\frac{dF_2}{dP_2} = 0.2\,P_2 + 40$ ; $\frac{dF_3}{dP_3} = 0.16\,P_3 + 10$.
The constraints on the generating units are :
$30 \le P_1 \le 150$ MW , $20 \le P_2 \le 100$ MW and $50 \le P_3 \le 250$ MW. Determine the optimal load allocation when the total load demand is 310 MW. Neglect losses. **(07 Marks)**

7 a. Explain with necessary equations the solution of swing equation by point by point method. How discontinuities are handled? **(08 Marks)**

b. List the merits and demerits of Runge – Kutta method. **(05 Marks)**

c. The swing equations of a synchronous generator is
$\frac{d\delta}{dt} = \omega - 377$ rad/sec ; $\frac{d\omega}{dt} = 32[1 - 0.4\,\text{Sin}\,\delta]$ .
At t = 0.0 sec, $\omega$ = 377 rad/sec and $\delta$ = 0.523 radians. Determine the values of $\omega$ and $\delta$ at 0.1 sec. using modified Euler method. Assume $\Delta t$ = 0.1 sec. **(07 Marks)**

8 a. Explain : i) Network performance equation ; ii) Load models employed in multi machine stability studies. **(10 Marks)**

b. With necessary equations and flow-charts, describe the solution of swing equations using modified Euler method in a multi machine stability analysis. **(10 Marks)**

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USN | | | | | | | | | | 06EE71

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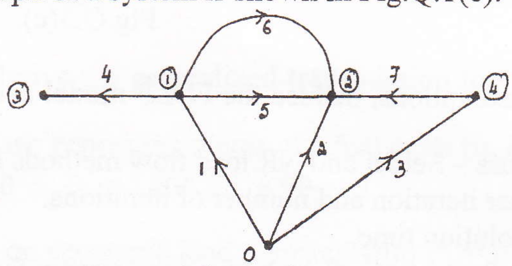


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**(06 Marks)**

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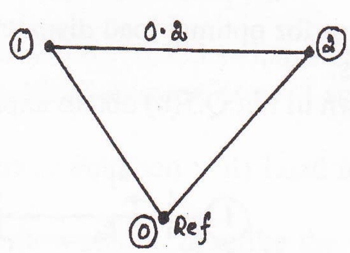


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