Code No. M0222 **R07** **Set No. 1**

IV B.Tech I Semester Supplementary Examinations, February/March, 2012

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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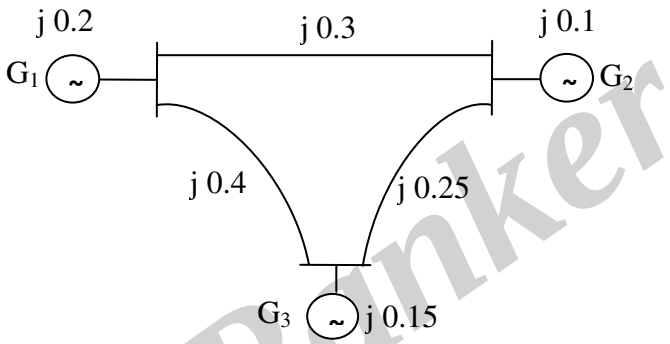
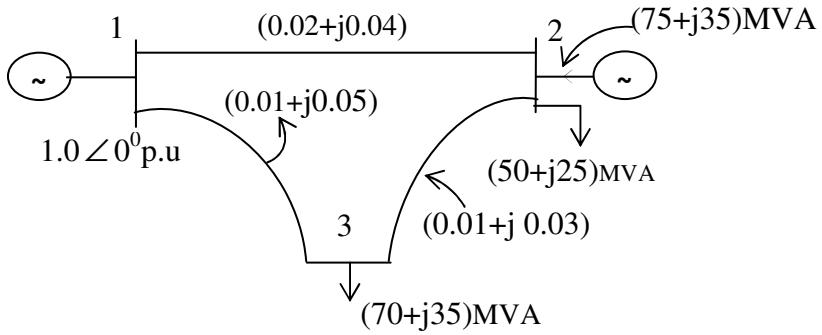
1. Compute the bus admittance matrix for the power system network shown in below figure by (i) direct inspection method and (ii) by using singular transformation.



2. A transmission line exists between buses 1 and 2 with p.u impedance 0.4. Another line of impedance 0.2 p.u is connected in parallel with it making a double circuit line with mutual impedance of 0.1 p.u. Obtain the building algorithm method the impedances of the two circuit system. Derive necessary expressions.

3. The power system network shown in below network. The line impedances in p.u are indicated in the same figure on 100MVA base value and neglecting the line charging admittance. Determine the voltage and phase angles at bus 2 and 3 and also slack bus power at the end of first iteration using gauss seidel method.



Code No. M0222 **R07** **Set No. 1**

4. a) Determine how do you determine the Jacobian elements in N-R rectangular coordinates method.
   b) Draw the flow chart for load flow solution using N – R method when the system contain all types of buses .

5. a) Explain the importance of short circuit currents calculations.
   b) A 3-phase, 50 kW, star connected load is fed by a 210 KVA transformer with voltage rating 11 kV/400v through a feeder. The length of the feeder is 0.75 km and the impedance of feeder is (0.15+j3) ohm/km. If the load P.F is 0.75, calculate p.u impedance of the feeder and the load.

6. a) What are sequence impedances? Obtain expression for sequence impedances in a balanced static 3-phase circuit.
   b) The following sequence currents were recorded in a power system under an unbalance fault condition. $I_{positive} = -j1.6$p.u, $I_{negative} = j\ 0.5$ p.u and $I_{zero} = j\ 1.15$p.u. Identify the type of fault. Assume that the pre fault voltage is 1.0 p.u and the post fault positive sequence voltage is 0.175 p.u . Find the sequence impedances for the system under the above condition .

7. a) Differentiate between steady state stability and transient stability of a power system. Also Discuss the factors that effect (i) steady state stability and (ii) transient stability of the system.
   b) A 4 pole, 50Hz, 22 kV turbo alternator has a rating of 100 MVA, 0.8 p.f lag. The value of inertia of rotor is 800 kg-m^2. Determine M and H.

8. a) Derive swing equation and discuss its application in the study of power system stability.
   b) Explain the various methods of improving transient stability.

Code No. M0222 **R07** **Set No. 2**

IV B.Tech I Semester Supplementary Examinations, February/March, 2012

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time : 3 hours **Max. Marks :80**

Answer any FIVE Questions

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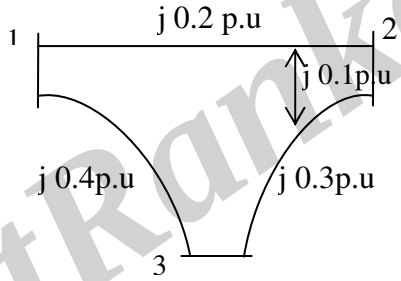
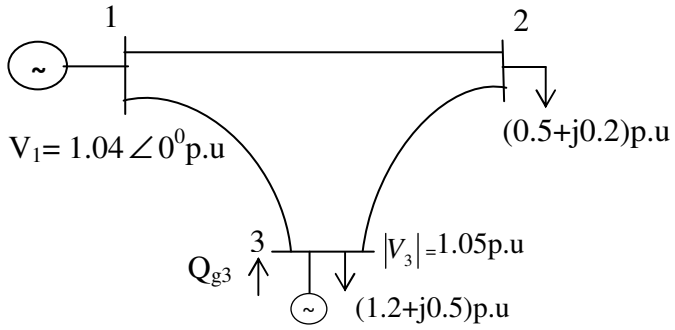
1. A power system consists of 4 buses. Generators are connected at buses 1 and 2 reactances of which are j 0.1 and j 0.25 respectively. The transmission lines are connected between buses 1-2, 1-4, 2-3 and 3-4 and have reactances j 0.3, j 0.4, j 0.6 and j 0.2 respectively. Find the bus admittance matrix (i) by direct inspection, (ii) using bus incidence matrix and admittance matrix.

2. Compute the bus impedance matrix for the system shown in below figure by adding element by element. Take bus -2 as reference bus.



3. The power system network shown in below figure. Each line has a series impedance of (0.01+j0.06) p.u and the total shunt admittance of j 0.04 p.u. The specific quantities of the buses are given in the figure. A controlled reactive power source is available at bus 3, with the constraint $0 \leq Q_{g3} \leq 2.0$ p.u. Using gauss – seidel method, find the voltage at bus '2' and '3' after the first iteration.



Code No. M0222 **R07** **Set No. 2**

4. a) Explain the DC load flow and derive necessary expressions.
   b) Compare the N-R method, decoupled and fast decoupled load flow methods.

5. a) How are reactors are classified? Explain the merits and demerits of different types of series reactors.
   b) Two generators rated at 10MVA, 11KV and 15MVA, 11KV respectively are connected parallel to a bus. The bus bar feed two motors rated 7.5 MVA and 10MVA respectively. The rated voltage of the motors is 9kV. The reactance of each generator is 12% and that of the motor is 15% of their own rating. Assume 50MVA, 10KV base and draw the reactance diagram with necessary values.

6. a) Derive an expression for the fault current of a single line to ground fault as an unloaded generator.
   b) The unbalance voltages across a 3 phase system are V_a=$400\angle 25^0 V$, V_b =$360\angle 90^0 V$, V_c=$450\angle -140^0 V$. Determine the symmetrical components of voltages.

7. a) Derive an expression for the maximum power transfer between two nodes. Show that this power is maximum when X =$\sqrt{3}$ R, Where X is the reactance and R is the resistance of the system.
   b) A turbo alternator with 4 pole, 50Hz, 80MW, p.f 0.8 lag and moment of inertia 40,000kg-m^2 is interconnected via a short transmission line to another alternator with 2 pole, 50Hz, 100MW 0.8 p.f lag and moment of inertia 10,000 kg-m^2. Determine the inertia constant of single equivalent machine on a base of 100 MVA.

8. Discuss the application of equal area criterion for the system stability study when (i) a sudden increase in load takes place and (ii) a short circuit on one of the parallel feeders takes place which is cleared after certain time.

Code No. M0222 **R07** **Set No. 3**

IV B.Tech. I Semester Supplementary Examinations, February/March, 2012

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

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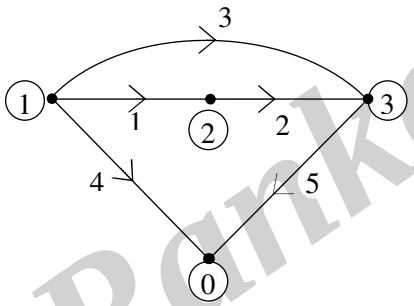
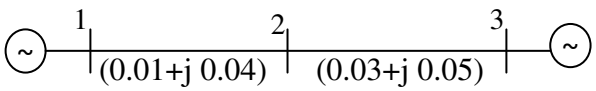
1. Consider the linear graph shown below which represents a 4 bus transmission system with all the shunt admittance lumped together. Each line has a series reactance of j 0.04 and half line charging admittance of j 0.01. Compute the Y_{bus} by singular transformation and also by direct inspection method.



2. Derive the necessary expressions for the building up of Z bus when (i) new element is added (ii) new element is added between two existing buses. Assume mutual coupling between the added element and the elements in the partial network.

3. a) Explain the necessity of power flow studies.
   b) Draw the flow chart for load flow solution using gauss seidel method when PV buses are included.

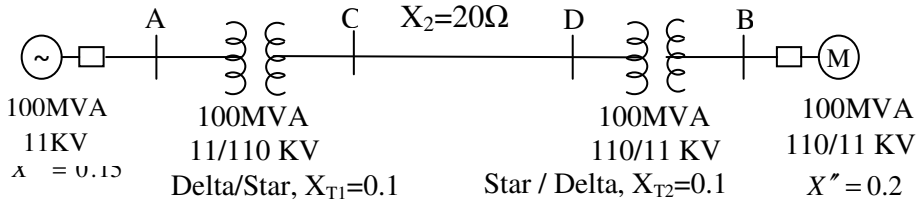
4. a) Derive the expression for Jacobian elements by using Fast decoupled load flow method.
   b) Determine the complex bus bar voltage at bus 2 at the end of first iteration by using decoupled load flow method for the power system shown in below figure.



$V_1 = 1.0 \angle 0^0$ p.u
$P_2 + j\,Q_2 = (-4.2 + j1.5)$ p.u
$V_3 = 1.02$ p.u, $P_3 = 2.0$ p.u

Code No. M0222 **R07** **Set No. 3**

5. Consider the power system network shown in below network



The synchronous generator is operating at its rated MVA at 0.9 p.f lag and at rated voltage. A 3-phase short circuit occurs at bus 'A', calculate p.u value of (i) sub transient fault current (ii) sub transient generator and motor current. Neglect prefault current. Also compute (iii) sub transient generator and motor currents including the effect of prefault currents.

6. a) Explain the sequence networks for synchronous generator.
   b) Two alternators of rating 11KV, 50MVA are operating in parallel and supplying to a substation by a feeder having an impedance of (0.4+j0.7)Ω of positive and negative sequence and (0.7+ j 0.3)Ω of zero sequence. The alternator sequence impedances are j 0.7, j 0.4 and j 0.2 Ω of positive, negative and zero sequence respectively. Both the machines of neutral earthed with a resistance of 0.2 Ω. Determine the fault currents in each line and the potential above earth obtained by the alternator neutrals if an earth fault occurs at phases 'b' and 'c' at the substation.

7. a) Discuss the various methods of improving steady state stability.
   b) A synchronous machine has a synchronous reactance of 1.0 p.u connected to an infinite bus of voltage 1.1 p.u. The terminal voltage of the generator is held constant at 1.0 p.u by an automatic voltage regulator. Determine the dynamic steady state stability limit. If the voltage regulator is done manually, what is the power limit?

8. a) What is equal area criterion? Discuss its application and limitation in the study of power system stability.
   b) A 50Hz, generator supplies 50% maximum power that is capable of delivering to a transmission line to infinite bus. A fault occurs that increases the reactance between generator and infinite bus to 500% of the value before the fault. The maximum power that can be delivered in 70% of the original maximum value after the fault is cleared. Calculate the critical clearing angle of the system.

Code No. M0222 **R07** **Set No. 4**

IV B.Tech I Semester Supplementary Examinations, February/March, 2012

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

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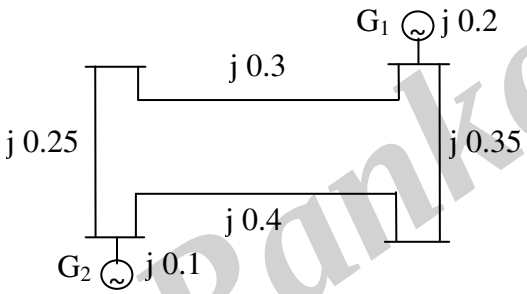
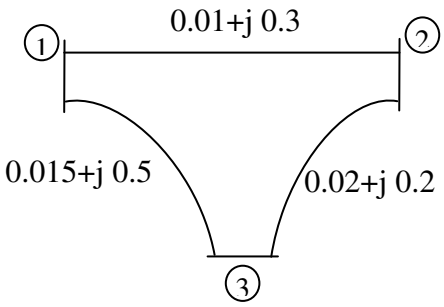
1. Form the Y_{Bus} by using singular transformation for the network shown in below figure including the generator buses.



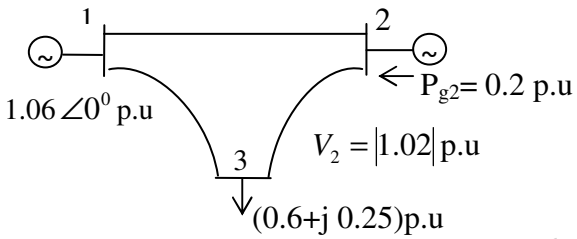
2. Obtain Z_{Bus} by using building algorithm for the following figure



3. a) How the buses are classified in a given power system? Explain.
   b) Write an algorithm for load flow solution using gauss seidel method when PV buses are present.

Code No. M0222 **R07** **Set No. 4**

4. The power system network shown in below figure. Each line has a series impedance of (0.02+j 0.05) p.u and line charging admittance is j 0.02 p.u. The specified quantities of the buses are given in the figure. The maximum and minimum reactive power limits at bus 2 are 0.35 and 0.0 p.u respectively. Determine the set of load flow equations at the end of first iteration by using N-R method.



5. a) What are the merits of per unit system?
   b) A 33KV line has a resistance of 4 Ω and reactance of 16 Ω respectively. The line is connected to a generating station bus bars through a 6000 KVA step up transformer which has a reactance of 6%. The station has two generators rated 10,000 KVA with 10% reactance and 5000 KVA with 5% reactance. Calculate the fault current and short circuit KVA when a3-phase fault occurs at the HV terminals of the transformer and at the load end of the line.

6. a) Where are symmetrical components? Explain.
   b) A generator rated 100 MVA, 20 KV has $x_1 = x_2 = 20\%$ and $x_0 = 5\%$. Its neutral is grounded through a reactor of 0.32 Ω. The generator is operating at rated voltage with load and is disconnected from the system when L.G fault occurs at its terminals. Find the sub transient current in the faulted phase and line to line voltages.

7. a) Explain the following terms
   (i) Steady state stability (ii) transient stability and (iii) dynamic stability
   b) A 3-phase line has the following constants
   A = D = 0.98 $\angle 0.2^0$, B =80 $\angle 75^0$ ohm, C = 0.0003 $\angle 90^0$ mho
   (i) Find the steady state stability limit if the end voltages are fixed at 132KV
   (ii) What is Steady State Stability limit if the shunt admittance is neglected? Comment on the results.

8. a) Explain the point by point method of solving the swing equation. Compare this method with the equal area criterion method.
   b) Discuss the application of auto reclosing and fast operating circuit breakers on improvement of stability.