

III B. Tech II Semester Regular/Supplementary Examinations, April - 2017

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

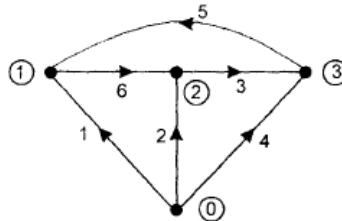
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 2. Answering the question in **Part-A** is compulsory
 3. Answer any **THREE** Questions from **Part-B**

PART -A

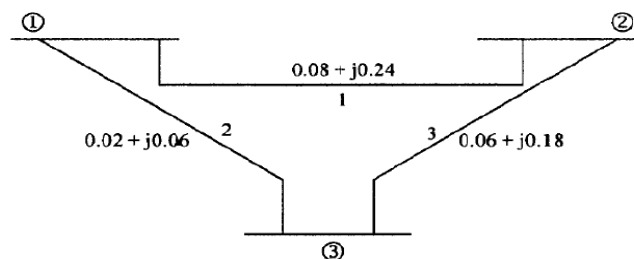
- 1 a) Describe tree and co-tree with an example? [3M]
 b) Discuss the necessity of load flow studies? [4M]
 c) What are the features of admittance matrix over the impedance matrix in solving the power system problems? [4M]
 d) What is the significance of reactance in symmetrical fault analysis? [4M]
 e) What is a zero sequence network? [3M]
 f) Define critical clearing angle and critical clearing time. [4M]

PART -B

- 2 a) Write the advantages of Per Unit form of representation? [3M]
 b) Derive the expression for bus admittance matrix Y_{BUS} in terms of primitive admittance matrix and bus incidence matrix. [7M]
 c) What is fundamental cut-set? Obtain cut-set matrix for the following graph [6M]



- 3 a) Compare Gauss-Seidel, Newton Raphson, Decoupled and Fast decoupled methods with respect to
 i) Number of iterations ii) Convergence characteristics iii) Initial values [10M]
 b) Write the assumptions fast decoupled load flow method. [6M]
- 4 a) Describe the procedure of modification of Z_{bus} by adding mutually coupled branch from any two existing buses. [8M]
 b) For the 3-bus system shown in the figure, Obtain Z_{bus} ? [8M]



- 5 a) A 100 MVA, 13.8 kV, three phase generator has a reactance of 20%. The generator is connected to a three phase transformer T_1 rated 100 MVA, 12.5kV/110kV with 10% reactance. The h.v. side of the transformer is connected to a transmission line of reactance of 100 ohm. The far end of the line is connected to a step down transformer T_2 , made of three single phase transformers each rated 30 MVA, 60 kV/10 kV with 10% reactance the generator supplies two motors connected on the l.v. side T_2 . The motors are rated at 25 MVA and 50 MVA both at 10 kV with 15% reactance. Draw the reactance diagram showing all the values in per unit. Take generator rating as base. [10M]
- b) Explain how a synchronous generator is represented in short circuit analysis. [6M]
- 6 a) Derive the necessary equations to determine the fault current for a double line to ground fault. Draw a diagram showing inter connection sequence networks. [10M]
- b) What are the advantages of symmetrical components? [6M]
- 7 a) Derive the swing equation of single machine connected to infinite bus and also write the assumptions to derive it. [12M]
- b) Explain the terms [4M]
i) Transient stability ii) Dynamic stability



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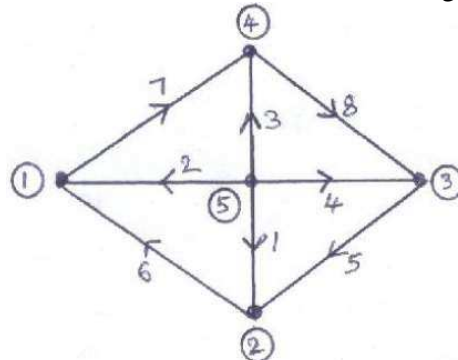
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PART -A

- 1 a) Distinguish between cut-set and basic cut-set with an example. [4M]
- b) Describe the classification of buses? [3M]
- c) Write the advantages of Z_{bus} building algorithm. [4M]
- d) What is the importance of representing power system with its equivalent reactance diagram in short circuit studies? [4M]
- e) What is effect of fault impedance? Explain. [4M]
- f) What is the significance of 'swing curve'? [3M]

PART -B

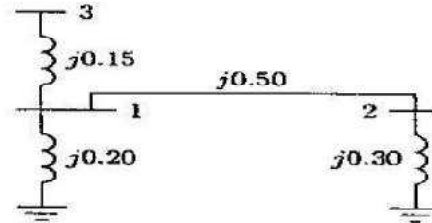
- 2 a) Find the bus incidence matrix for the following network? [4M]



- b) Derive the Bus admittance matrix by singular transformation? [8M]
 - c) What is meant by primitive network in power systems? [4M]
- 3 a) Draw the flowchart for load flow solution by Gauss-Seidel iterative method using Y_{bus} [8M]
 - b) Write the advantages of Newton-Raphson method? [4M]
 - c) What are the assumptions of static load flow equations? [4M]



- 4 a) Using the method of building algorithm find the bus impedance matrix for the network shown in the figure. [10M]



- b) What is primitive network, primitive impedance matrix and primitive admittance matrix. [6M]
- 5 a) Two generators rated at 10 MVA, 11 KV and 15 MVA, 11 KV respectively are connected in parallel to a bus. The bus bars feed two motors rated 7.5 MVA and 10 MVA respectively. The rated voltage of the motors is 9 KV. The reactance of each generator is 12 % and that of each motor is 15 % on their own ratings. Assume 50 MVA, 10 KV base and draw reactance diagram. [8M]
- b) What do you understand by short circuit KVA? Explain with an example. [8M]
- 6 a) Derive an expression for fault current in Line to ground fault. Also draw sequence network connections. [10M]
- b) Determine the symmetrical components for the three phase currents. [6M]
 $I_R = 15 \angle 0^\circ$, $I_Y = 15 \angle 230^\circ$ and $I_B = 15 \angle 130^\circ$ A
- 7 a) Define steady state stability and Explain the methods for improving steady state stability. [8M]
- b) Explain the equal area criterion? How it is useful for predicting system stability. [8M]



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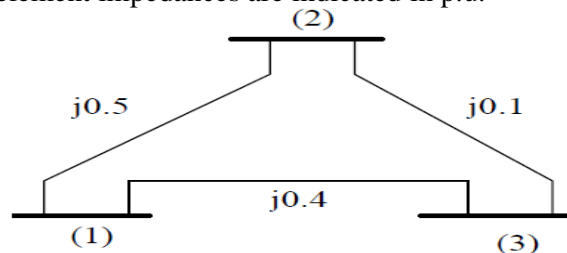
3. Answer any **THREE** Questions from **Part-B**

PART -A

- 1 a) What is Bus incidence matrix and write its properties? [4M]
- b) What is the need of slack bus in power system? Explain. [3M]
- c) Explain primitive impedance matrix with an example. [4M]
- d) How reactors are classified in short circuit MVA calculations. [4M]
- e) Write the order of severity of unsymmetrical faults on power system. [3M]
- f) Define synchronizing power coefficient? What is its significance? [4M]

PART -B

- 2 a) Determine the following terms with suitable examples. [8M]
i) Graph ii) Tree iii) Co-Tree iv) Cut-set matrix v) Basic cut-set
- b) For the system shown below, Obtain Y_{bus} by direct inspection method. Take bus (1) as reference. The element impedances are indicated in p.u. [8M]



- 3 a) Develop load flow equations suitable for solution by Newton Raphson method using rectangular when only PQ buses are present. [8M]
- b) Discuss the advantage of using Y_{bus} model in of power system network for load flow analysis. [4M]
- c) What is its role of acceleration factor in Gauss-Seidel method for power flow solution? [4M]
- 4 a) Derive an expression for adding a branch element between two buses in the Z_{BUS} building algorithm. [10M]
- b) Write the merits and demerits of Z_{BUS} building algorithm. [6M]
- 5 a) For a three phase symmetrical fault on a balanced power system using matrix notation, derive the expression for i) current ii) current at any other bus iii) Voltage at any bus excluding the faulted bus. [12M]
- b) Write a short note on the assumptions made in short circuit studies? [6M]



Code No: RT32024

R13

SET - 3

- 6 a) Prove that neutral current can flow only if zero sequence currents are present. [4M]
b) Derive an expression for fault current with necessary conditions for a double-line fault as an unloaded generator. Also draw sequence diagrams. What is the severity of fault current compared to other type of faults? [12M]
- 7 a) Discuss the methods for improving transient stability. [6M]
b) Explain equal area criterion in detail and write its limitations. [10M]

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PART -A

- 1 a) Define graph and oriented graph with an example. [3M]
 b) Write the advantages of Newton Raphson method. [4M]
 c) Give the applications of Z_{BUS} building algorithm. [4M]
 d) What is the importance of short circuit currents in power system analysis? [4M]
 e) Write a short note on symmetrical components. [4M]
 f) List out the various applications of Equal area criterion. [3M]

PART -B

- 2 a) What is Reduced incidence matrix? Explain with an example. [4M]
 b) Find Y-bus for a network with following data by direct inspection method. [7M]
 Line impedance and line charging data:

Line (bus to bus)	Impedance	Line charging (Y/2)
1-2	$0.02 + j 0.1$	$j 0.03$
1-5	$0.05 + j 0.25$	$j 0.02$
2-3	$0.04 + j 0.2$	$j 0.025$
2-5	$0.05 + j 0.25$	$j 0.02$
3-4	$0.05 + j 0.25$	$j 0.02$
3-5	$0.08 + j 0.4$	$j 0.01$
4-5	$0.10 + j 0.5$	$j 0.075$

- c) Discuss the advantage and disadvantages of finding Y_{BUS} by singular transformation? [5M]
- 3 a) Explain the advantages and disadvantages of Gauss-Seidel method. [5M]
 b) What are the assumptions in static load flow equations and derive the approximate load flow equations. [6M]
 c) What are the assumptions made in reducing Newton Raphson method to decoupled method for power flow solution. [5M]
- 4 Derive the necessary expressions for the building up of Z_{BUS} when [16M]
 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.



- 5 a) Discuss the behaviour of a 3-phase synchronous generator subjected to symmetrical three phase short circuit. Also define the several reactances of the synchronous machine and their time constants. [10M]
- b) Write the three phase representation of power system for short circuit studies briefly? [8M]
- 6 a) Draw the sequence network connections for single-line to ground, double line fault and double-line to ground fault conditions. [9M]
- b) Derive an expression for fault current for a LLL fault on an unloaded generator. [7M]
- 7 a) A 200 MVA, 2 pole, 50 Hz alternator has a moment of inertia of 50000 Kg-m². What is the energy stored in the rotor at the rated speed? Find the value of H and determine the corresponding angular momentum. [8M]
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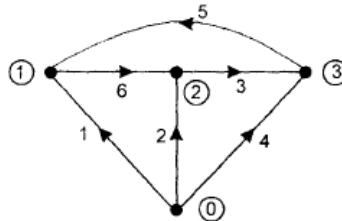
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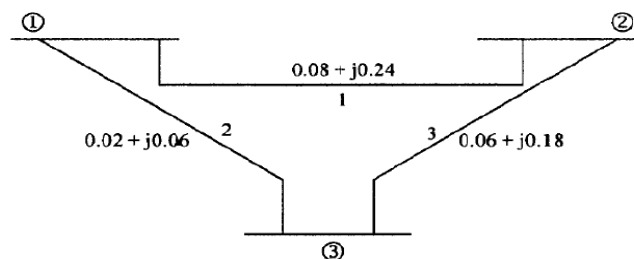
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PART -B

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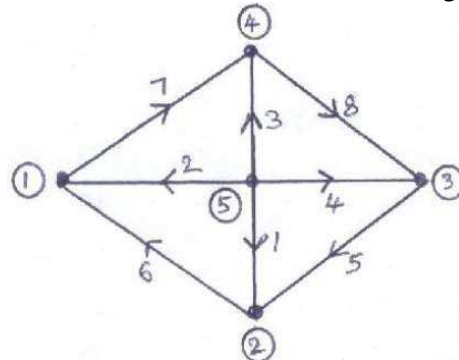
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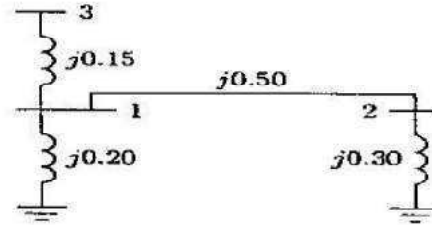
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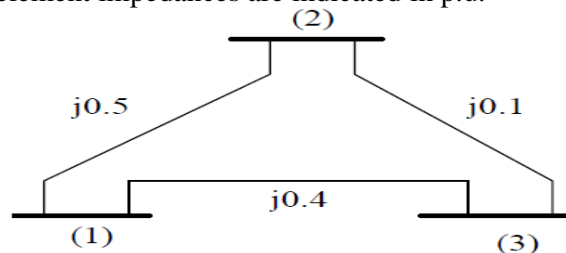
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