Code No: R1632022 **R16** SET - 1

**III B. Tech II Semester Regular Examinations, April/May - 2019**

# POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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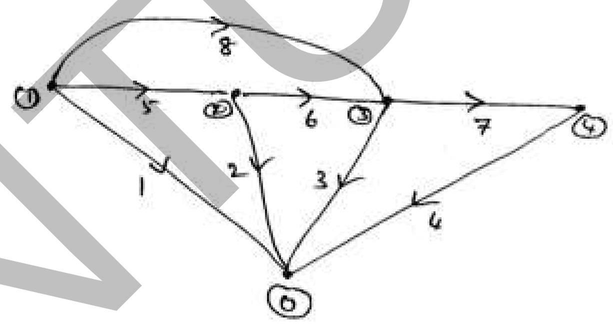
## PART –A

1. a) What are the disadvantages of per unit quantities? [2M]
b) What are the merits and demerits of Gauss-Seidel method? [3M]
c) How the $Z_{bus}$ is modified when a new branch $Z_b$ is added from a new bus P to reference bus 'Ó'. [2M]
d) How do you get the short circuit MVA from per unit impedance? [2M]
e) Write the definition of symmetrical components. [3M]
f) What are the causes for large disturbances in the power system? [2M]

## PART -B

2. Fine the Y $_{Bus}$ matrix by singular transformation method for the following data: [14M]




| Element | Bus code | Self impedance in p.u |
|---|---|---|
| 1 | 0 – 1 | 0.15 |
| 2 | 0 – 2 | 0.1 |
| 3 | 0 – 3 | 0.3 |
| 4 | 0 – 4 | 0.2 |
| 5 | 1 – 2 | 0.4 |
| 6 | 2 – 3 | 0.15 |
| 7 | 3 – 4 | 0.2 |
| 8 | 1 – 3 | 0.1 |
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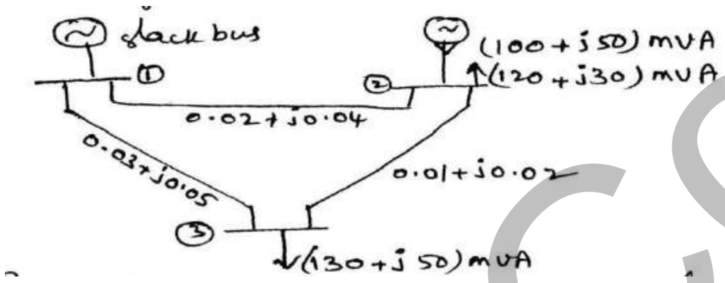
3. The power system network is shown in below figure. Bus 1 is considered as a slack bus of voltage $1.4\angle 0^0$ p.u., the line impedances are indicated in the same figure as 100 MVA base value and neglecting the line charging admittances, calculate the bus voltages at the end of first iteration using Fast decoupled load flow method. [14M]




4. Determine the $Z_{Bus}$ using building algorithm for a power system whose element data is given in the following table: [14M]

| Element No. | Connected between bus No. | Self reactance (p.u) |
|---|---|---|
| 1 | 1-2 | 0.1 |
| 2 | 1-3 | 0.15 |
| 3 | 2-3 | 0.2 |

5. a) Explain the selection of reactors. [5M]

   b) A generator and motor are rated of 20 MVA, 11 kV and both have sub transient reactance of 15% and line reactance of 10% on the base of machine ratings. The motor drawing 15 MW at 0.85 p.f leading. The terminal voltage is 10.5 kV when a symmetrical fault occurs at generator terminals; determine the sub transient current in generator, motor and at the fault point with necessary diagrams. [9M]

6. a) Explain the sequence networks of three phase transformer. [7M]

   b) A generator rated 100 MVA, 12.6 kV has $X_1 = X_2 = 20\%$ and $X_0 = 10\%$. Its neutral is grounded through a reactance of $0.15\,\Omega$. The generator is operating at rated voltage; load is disconnected from the system when double line fault occurs at its terminals. Determine the sub-transient current in the faulted phases and line to line fault current. [7M]

7. a) Describe the latest methods for improving the transient stability. [7M]

   b) An alternator has reactance of 1.3 p.u is connected to an infinite bus bar with voltage 1.1 p.u through transformer and a line of total reactance of 0.75 p.u. The alternator no load voltage is 1.04 p.u and its inertia constant is 6 MW-Sec/MVA p.u with a frequency of 50 Hz. Find the frequency of natural oscillations if the machine is loaded to (i) 50% and (ii) 75% of its maximum power limit. [7M]

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(Electrical and Electronics Engineering)

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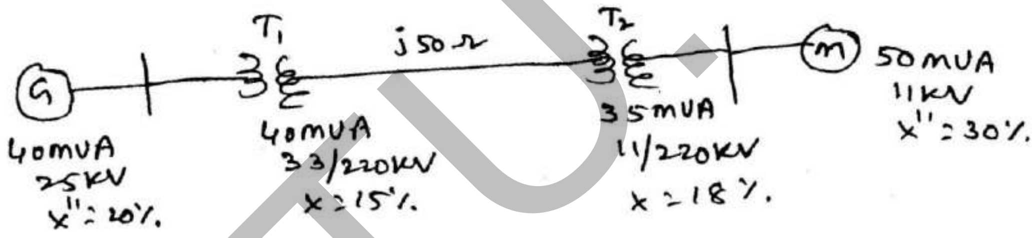
### PART –A

1. a) What is meant by single line diagram of power system? [2M]
b) What is the need of slack bus? [2M]
c) What are the four ways of adding impedance to an existing system so as to modify $Z_{bus}$ matrix? [3M]
d) Why the circuit breakers are designed based on 3-phase short circuit current? [2M]
e) Derive the expression for power in symmetrical components. [3M]
f) What are the methods considered for improving steady state stability? [2M]

### PART -B

2. a) Develop the reactance for the following power system. [10M]




b) What are the properties of tree in graph theory? [4M]

3. a) Write an algorithm for G-S load flow method including PV buses in the power system. [7M]
b) Derive the general expressions for calculating the line losses and slack bus power. [7M]

4. Determine the $Z_{Bus}$ using building algorithm for a power system whose element data is given in the following table: [14M]

| Element No. | Connected between bus Nos. | Self reactance (p.u) |
|---|---|---|
| 1 | 1-2 | 0.3 |
| 2 | 1-3 | 0.1 |
| 3 | 2-3 | 0.2 |
| 4 | 1-2 | 0.1 |

5. a) Discuss the harmful effects of short circuit fault on the power system. [5M]
b) Describe the transients on a transmission line and derive necessary expressions. [9M]

6. a) What are symmetrical components? Why are they used in power system fault analysis? Explain in details. [7M]
b) Describe the positive, negative and zero sequence impedance diagrams of unloaded alternator. [7M]

7. a) Derive the expression for swing equation with a necessary diagram. [7M]
b) Explain the determination of steady state stability. [7M]

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Code No: R1632022 **R16** SET - 3

**III B. Tech II Semester Regular Examinations, April/May - 2019**

# POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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## PART –A

1. a) Define the bus incidence matrices. [2M]
   b) What are the merits of Newton Raphson method? [3M]
   c) What are the methods used for forming the $Z_{bus}$ matrix? [2M]
   d) What are the reasons for the occurrence of faults in a power system? [3M]
   e) Give examples of symmetrical and unsymmetrical faults. [2M]
   f) What are the methods considered for improving transient stability? [2M]

## PART -B

2. A 100 MVA, 13 kV, three phase generator has a subtransient reactance of 12%. The generator supplies two synchronous motors through a 75 km transmission line having transformers at both ends. In this, first transformer is a three phase, 100 MVA, 13/220 kV, 10% reactance and second one is made of three single phase transformers of rating 100 MVA, 127/10.5 kV, 10% reactance. Synchronous motors ratings are 75 MVA and 25 MVA and both operating at 10.5 kV with 18% subtransient reactance. Series reactance of transmission line is 0.25 ohm/km. Develop the single line diagram with all the are marked in p.u. [14M]

3. a) How the buses are classified in power system? Discuss the significance of slack bus in power systems. [7M]
   b) Derive the expressions of static power flow equations. [7M]

4. Determine the $Z_{Bus}$ using building algorithm for a power system whose element data is given in the following table: [14M]

| Element No. | Connected between bus Nos. | Self reactance (p.u) |
|---|---|---|
| 1 | 1-2 | 0.3 |
| 2 | 1-3 | 0.15 |
| 3 | 2-3 | 0.2 |
| 4 | 1-3 | 0.25 |

5. A transformer rated at 75 MVA and having a short circuit reactance of 0.02 p.u is connected to the bus bar of a generating station which is supplied through two 12.6 kV feeders each having an impedance of (1.5+j 4) $\Omega$. One of the feeder is connected to the generating station using generator capacity of 50 MVA connected to its bus bars having a short circuit reactance of 0.2 p.u and other feeder to a generator with 25MVA and having a reactance of 0.35 p.u. Calculate the MVA supplied to the fault in the event of a short circuit occurring between the secondary terminals of the transformer. [14M]

6. a) Derive the expression for fault current and the terminal voltages of a 3-phase alternator, when there is a double line to ground fault occurs at the far end of the alternator. Assume that the generator neutral is solidly earthed. [7M]
   b) Discuss the symmetrical component method to analyze an unbalanced system. [7M]

7. Illustrate the determination of transient stability by equal area criterion with three different conditions. [14M]

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Code No: R1632022 **R16** SET - 4

**III B. Tech II Semester Regular Examinations, April/May - 2019**

# POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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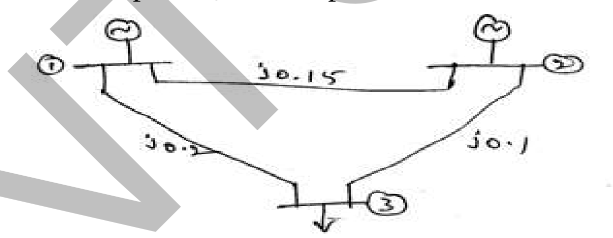
## PART –A

1. a) What is meant by primitive network representation? [2M]
   b) What are the necessities of power flow studies? [3M]
   c) What is bus impedance matrix? [2M]
   d) What are the uses of protective reactors in the power system? [2M]
   e) What are the observations made from the analysis of various faults? [3M]
   f) Define swing curve? What is the use of this curve? [2M]

## PART -B

2. a) What are the needs of representing all parameters in p.u. values? [5M]
   b) Illustrate the formation of element node incidence matrix with suitable example. [9M]

3. Determine the load flows at the end of first iteration by using fast decoupled load flow method for the following data. [14M]
   Bus 1 : Slack bus, $V_{spec} = 1.04 \angle 0^0$ p.u
   Bus 2 : P V bus, $V_{spec} = 1.0$ p.u, $P_{G2} = 2.5$ p.u
   Bus 3 : PQ bus, $P_{D3} = 3.2$ p.u, $Q_{D3} = 2.1$ p u




4. Develop the $Z_{Bus}$ using building algorithm for a power system whose element data is given in the following table: [14M]

| Element No. | Connected between bus Nos. | Self reactance (p.u) |
|---|---|---|
| 1 | 1-2 | 0.25 |
| 2 | 1-3 | 0.3 |
| 3 | 2-3 | 0.2 |
| 4 | 2-3 | 0.15 |

5. a) What do you understand by a short circuit? Discuss the possible causes of short circuit in the power system. [7M]
   b) Explain the selection of reactors for reducing the fault current in the power system. [7M]
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6. a) What is a 3-phase unsymmetrical fault? Discuss the different types of unsymmetrical faults that occur in a power system. [7M]

   b) A 3-phase generator noted 25 MVA, 12.6kV has a solidly grounded neutral. The sequence impedances of the alternator are $Z_1$= j0.3, $Z_2$= j0.25 and $Z_0$= j0.01 p.u. determine the values of (i) resistance and (ii) reactance must be placed in general neutral for a LG fault of zero fault impedance to the rated line current? [7M]

7. a) Explain the elementary concepts of steady state, dynamic and transient stabilities. [5M]

   b) A double circuit, 3-phase feeder connects a single generator to a large network. The power corresponding to the limit of steady state stability for each circuit is 120 MW. The line is transmitting 90 MW, where one of the circuits is suddenly switched out. Find with reference to appropriate diagram whether the generator is likely to remain in stable. [9M]

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