Code: 20EE3603

## III B.Tech - II Semester – Regular / Supplementary Examinations APRIL 2024

# POWER SYSTEMS ANALYSIS
## (ELECTRICAL & ELECTRONICS ENGINEERING)
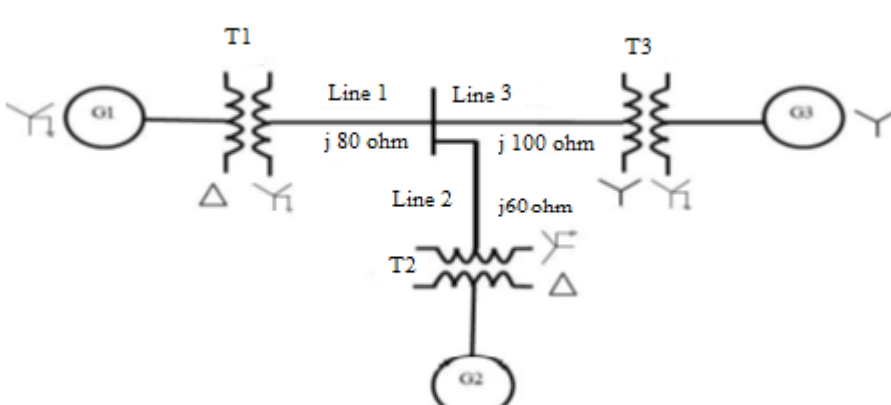
Duration: 3 hours                          Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
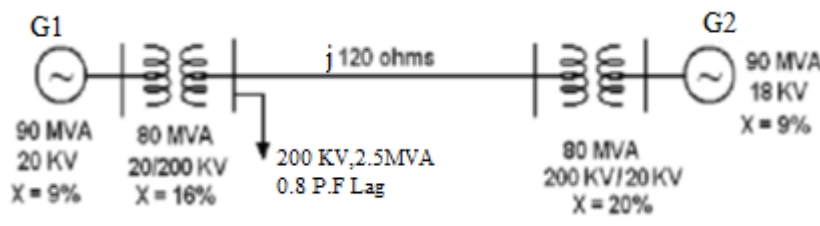2. All parts of Question must be answered in one place.

BL – Blooms Level                          CO – Course Outcome

| | | | BL | CO | Max. Marks |
|---|---|---|---|---|---|
| | | **UNIT-I** | | | |
| 1 | a) | Discuss the advantages of per unit system. Prove that per unit impedance of a transformer referred to either HV or LV side is same. | L2 | CO1 | 4 |
| | b) | Construct the reactance diagram using a base of 50MVA and 13.8KVon generator G1  G1: 20MVA, 13.8KV, X''=20%; <br> G2: 30MVA, 18.0KV, X''=20% <br> G3: 30MVA, 20.0KV, X''=20% ; <br> T1: 25MVA, 220/13.8 KV, X =10% <br> T2:Three Single phase transformers each rated 10MVA, 220/18 KV, X =10% <br> T3: 35MVA, 220/22 KV, X =10% | L3 | CO2 | 10 |

| | | | | | |
|---|---|---|---|---|---|
| | | **OR** | | | |
| 2 | a) | Discuss the single line diagram? Explain with suitable example. | L2 | CO1 | 7 |
| | b) | Construct the PU impedance diagram for the system shown in figure. Choose Base MVA as 100 MVA and Base KV as 20 KV at transmission line.  | L3 | CO2 | 7 |
| | | **UNIT-II** | | | |
| 3 | a) | Analyze the expression for static load flow equations in power flow studies? What is slack bus and why it is used in load flow studies. | L4 | CO4 | 4 |
| | b) | Calculate voltage and angle at bus 3, reactive power and angle at bus 2 using G.S. method. Perform one iteration | L3 | CO3 | 10 |
| | | **OR** | | | |
| 4 | a) | Explain algorithm for G.S load flow method Write the advantages and disadvantages of Gauss-Seidel method. | L4 | CO4 | 7 |

For question 3 b):

| Bus code | Impedance |
|---|---|
| 1-2 | 0.06 + j 0.18 |
| 1-3 | 0.02 + j 0.06 |
| 2-3 | 0.04 + j 0.12 |

| BUS | $P_G$ | $Q_G$ | $P_D$ | $Q_D$ | Bus voltage |
|---|---|---|---|---|---|
| 1 (slack) | - | - | - | - | $1.04 \angle 0^0$ |
| 2 (PV) | 3 | 0 | - | - | $V_2 = 1.02 \angle 0^0$ $(0 < Q_2 < 4)$ |
| 3 (PQ) | 0 | 0 | 2 | 1.4 | -- |

| | b) | The line data for the 3 bus system, Obtain Y-bus using direct inspection method and draw the line diagram. | L3 | CO3 | 7 |
|---|---|---|---|---|---|

| Bus code | Line impedance |
|---|---|
| 1-2 | j 0.20 |
| 1-3 | j 0.15 |
| 2-3 | j 0.10 |

## UNIT-III

| 5 | a) | Infer the various methods used to solve load flow problem and discuss their merits and demerits. | L4 | CO4 | 7 |
|---|---|---|---|---|---|
| | b) | Construct the N-R method load flow algorithm and discuss the advantages of the method. | L3 | CO3 | 7 |

## OR

| 6 | | Calculate voltages and angles at bus 2 and bus 3 using Newton Rapshon method. Perform one iteration. | L3 | CO3 | 14 |
|---|---|---|---|---|---|

| Bus code | Impedance |
|---|---|
| 1-2 | 6 - j 10 |
| 1-3 | 4 - j 8 |
| 2-3 | 3-j6 |

| BUS CODE | P | Q | V | Type of bus |
|---|---|---|---|---|
| 1 | ---- | ------ | $1.06\angle 0^0$ | slack |
| 2 | 0.9 | 0.1 | $1\angle 0^0$ | PQ |
| 3 | 0.8 | 0.3 | $1\angle 0^0$ | PQ |

## UNIT-IV

| 7 | a) | Explain expression for the fault current for a single line to ground fault as an unloaded generator and draw its sequence network. | L4 | CO5 | 7 |
|---|---|---|---|---|---|
| | b) | A generator rated 100MVA, 20KV has $X_1=X_2=20\%$ and $X_0=5\%$. Its neutral is grounded | L3 | CO2 | 7 |

| | | | | | |
|---|---|---|---|---|---|
| | | through Reactor of 0.32 ohms. The generator is operating at rated voltage without load. when Line to Line fault occurs at the its terminal. Calculate the sub transient current in fault phase. | | | |
| **OR** | | | | | |
| 8 | a) | Draw and explain the positive, negative, zero sequence impedance diagrams for different 3-phase transformer winding connections. | L4 | CO5 | 7 |
| | b) | Interpret expression for the fault current for Line to Line fault as an unloaded generator and draw its Sequence network. | L3 | CO2 | 7 |
| **UNIT-V** | | | | | |
| 9 | a) | Explain Transient stability and Discuss the methods to improve transient stability. | L4 | CO4 | 7 |
| | b) | Explain and derive the expression for swing equation. | L4 | CO4 | 7 |
| **OR** | | | | | |
| 10 | a) | Differentiate between steady state stability, dynamic stability and transient stability with suitable examples. | L4 | CO4 | 7 |
| | b) | Explain power angle curve and sketch the power angle curve. | L4 | CO4 | 7 |
| | | | | | |