Code No: R2032023 **R20** SET -1

III B. Tech. II Semester Regular Examinations, July - 2023
POWER SYSTEM ANALYSIS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

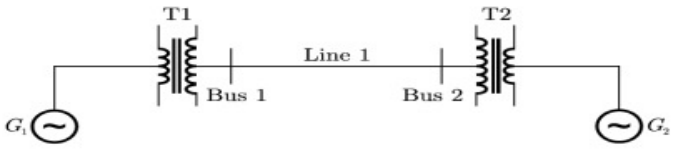
UNIT-I

1. a) Derive the bus admittance matrix by singular transformation. [7M]
   b) For the system shown below, obtain i) Primitive admittance matrix ii) Bus incidence matrix Select ground as reference. [7M]

Line no.	Bus code	Admittance in pu
1	1-4	1.4
2	1-2	1.6
3	2-3	2.4
4	3-4	2.0
5	2-4	1.8

(OR)

2. a) Illustrate the procedural steps to calculate bus admittance matrix by direct method. [7M]
   b) Construct impedance diagram for the power system shown in the Figure ,the specifications of the components are the following: [7M]
   G1:25 kV, 100 MVA, X =9%
   G2:25 kV, 100 MVA, X =9%
   T1:25 kV/220 kV, 90 MVA, X=12%
   T2:220 kV/25 kV, 90 MVA, X=12%



Figure

Line 1: 200 kV, X = 150 ohms
Choose 25 kV as the base voltage at the generator G1and 200 MVA as the MVA base.

UNIT-II

3 The power system network is shown in 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]

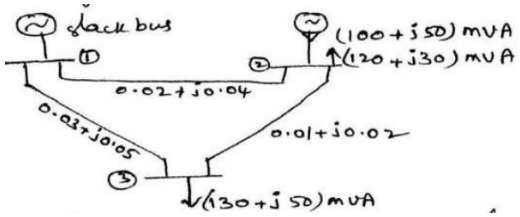


Figure
(OR)

|''|'||||''|''|||'|

4. a) Write the step-by-step procedure for load flow solution of G-S method with PV buses. Give flowchart. [7M]
   b) Why direct simulation of load flow is not possible? And mention data required for load flow solution. [7M]

UNIT-III

5. a) Give merits and demerits of building Z_{bus} algorithm. [7M]
   b) Point out Bus impedance matrix. Describe the construction of Bus impedance matrix Z_{Bus} using Bus building algorithm for lines without mutual coupling. [7M]

(OR)

6. a) Form bus impedance matrix for the data given below. [8M]

Element number	Bus code From bus – To bus	Self impedance
1	2-3	0.6 p.u.
2	1-3	0.5 p.u.
3	1-2	0.4 p.u.

   b) Mention the importance of short circuit currents in power system analysis. [6M]

UNIT-IV

7. a) Define the term sequence network. Mention its importance in unsymmetrical fault calculations. [7M]
   b) What is a 3-phase unsymmetrical fault? Discuss the different types of unsymmetrical faults that occur in a power system. [7M]

(OR)

8. a) List out the different unsymmetrical faults and compare their characteristics. [7M]
   b) A 3-phase generator noted 25 MVA, 12.6kV and has a solidly grounded neutral. The sequence impedances of the alternator are Z1= j0.3, Z2= 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]

UNIT-V

9. a) Discuss the methods for improving transient stability. [7M]
   b) A synchronous machine having E=1.2 p.u is supplying power to an infinite bus with voltage 1.0 p.u if the transfer reactance is 0.6 p.u, Find the steady state power limit. [7M]

(OR)

10. a) Explain about equal area criterion in detail and write its limitations. [7M]
    b) A generator operating at 50 Hz delivers 1 p.u. power to an infinite bus through a transmission circuit in which resistance is ignored. A fault takes place reducing the maximum power transferable to 0.5 p.u whereas before the fault this power was 2.0 p.u, and after the clearance of the fault it is 1.5 p.u. By the use of equal area criterion, determine the critical clearing angle. [7M]

Code No: R2032023 **R20** SET -2

III B. Tech II Semester Regular Examinations, July - 2023
POWER SYSTEM ANALYSIS
(Electrical and Electronics Engineering)

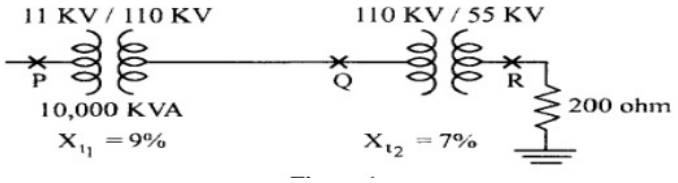
Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

UNIT-I

1. a) What is primitive network matrix and represent its forms? Prove $Y_{bus}=A^T[Y]A$ using singular transformation. [7M]

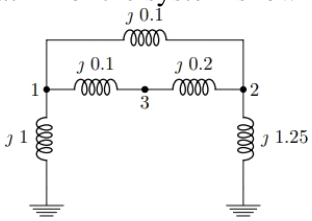
   b) Consider the system shown in Figure. Selecting 10,000 KVA and 110 KV as base values, find the p.u. impedance of 200 ohm load referred to 110 KV side and 55 kV side. [7M]



Figure

(OR)

2. a) Find the bus admittance matrix for the system shown in Figure. [7M]



Figure

   b) Give the relationship among the number of nodes, number of branches, number of links and number of elements. [7M]

UNIT-II

3. a) Write advantages and disadvantages of GS and NR methods with reference to load flow problem. [7M]

   b) Explain algorithm for decoupled method. [7M]

(OR)

4. a) The system data for a load flow problem is given in table. [7M]
   i. Compute Y_{bus}.
   ii. Solve bus voltages at the end of first iteration by G-S method by taking $\alpha = 1.6$

Line no.	Bus code	Admittance in pu
1	1-2	2-j8
2	1-3	1-j4
3	2-3	0.6-j2.6

   b) List out assumptions made in reducing Newton Raphson method to decoupled method for power flow solution. [7M]

Code No: R2032023 **R20** SET -2

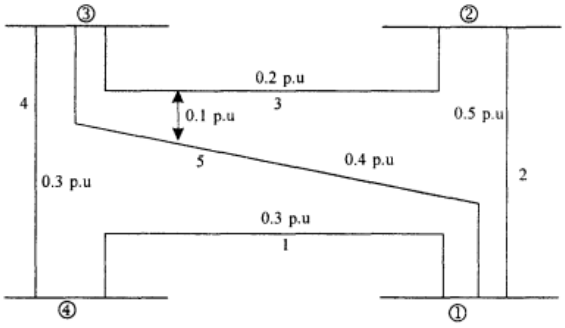
UNIT-III

5. a) Write the three-phase representation of power system for short circuit studies briefly. [7M]

   b) Three 10MVA generators each having reactance of 0.2p.u are operating in parallel. They feed a transmission line through a 30MVA transformer having a per unit reactance of 0.05. Find the fault MVA for a fault at the sending end of line. [7M]

(OR)

6. a) Using the building algorithm, construct Z_{BUS} for the system shown in Figure. Choose 4 as reference BUS. [7M]



Figure

   b) Mention the advantages of Y_{bus}matrix over Z_{bus} Matrix. [7M]

UNIT-IV

7. a) Bring out the relationship between symmetrical components and unbalanced phasors. [7M]

   b) What are the different unsymmetrical faults and compare their characteristics. [7M]

(OR)

8. a) Name the different symmetrical components. Why they are used in power system fault analysis? Explain in detail. [7M]

   b) Determine the symmetrical components for the three phase currents I_R =15 $\angle 0^0$A, I_Y= 15 $\angle 230^0$ A and I_B=15 $\angle 130^0$ A. [7M]

UNIT-V

9. a) Define steady state stability and explain the methods for improving steady state stability. [7M]

   b) A 200 MVA, 2 pole, 50 Hz alternator has a moment of inertia of 50000 Kg-m^2. What is the energy stored in the rotor at the rated speed? Find the value of H and determine the corresponding angular momentum. [7M]

(OR)

10. a) Derive the swing equation of a single machine connected to infinite bus and also write the assumptions to derive it. [8M]

    b) State synchronizing power coefficient. What is its significance? [6M]

Code No: R2032023 **R20** SET -3

III B. Tech., II Semester Regular Examinations, July -2023
POWER SYSTEM ANALYSIS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

UNIT-I

1. a) Build Y_{Bus} matrix by using singular transformation. The branch impedances of the lines are as follows: [7M]

Line	Impedance
1-2	2+j*3
1-4	4+j*5
2-3	5+j*6
2-4	6+j*5
3-4	5+j*4

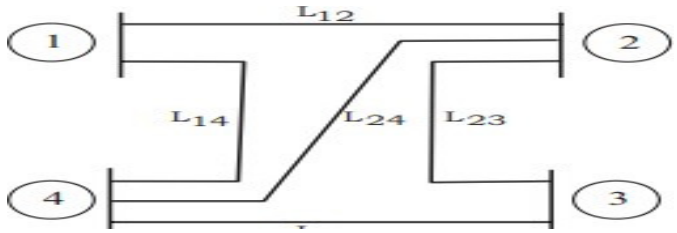


Figure L34

b) Write short notes on: (i) Node incident matrix Ā (ii) Elements of matrix (iii) Dimensions of matrix Ā. [7M]

(OR)

2. a) Form Y_{bus} for the network by direct inspection method: [7M]

Element	5-1	5-2	1-2	2-3	1-4	3-6	4-6
Positive sequence reactance	0.04	0.05	0.04	0.03	0.02	0.07	0.10

b) Define per unit system. Why it is required in power system calculations? [7M]

UNIT-II

3. a) Develop load flow equations suitable for solution by Newton Raphson method using rectangular when only PQ buses are present. [10M]

b) Give advantages and disadvantages of polar form of NR-method. [4M]

(OR)

4. a) Write the assumptions of fast decoupled load flow method. [4M]

b) Compare Gauss-Seidel, Newton Raphson, Decoupled and Fast decoupled methods with respect to i) Number of iterations ii) Convergence characteristics iii) Initial values. [10M]

UNIT-III

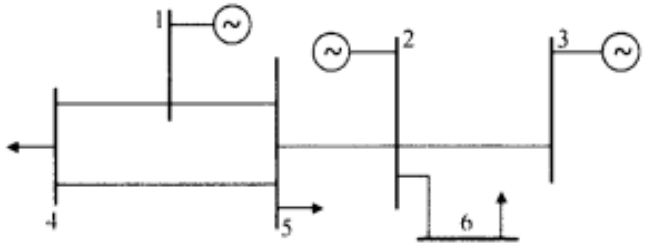
5. a) Modify the expression for Z_{BUS} when a link is added between two buses. [7M]

b) What do you understand by short circuit KVA? Explain with an example. [7M]

(OR)

|''|'||||''|''|||'|

6. Consider the bus system shown in Figure. [14 M]



Figure

The following is the data:

Line impedance (p.u.)	Real		Imaginary	
1 4	0.57000	E-1	0.845	E-1
1-5	1.33000	E-2	3.600	E-2
2-3	3.19999	E-2	1 750	E-1
2-5	1.73000	E-2	0.560	E-1
2-6	3 00000	E-2	1 500	E-1
4-5	1 94000	E-2	0 625	E-1

Scheduled generation and bus voltages:

Bus Code P	Assumed bus voltage	Generation		Load	
		MW p.u.	Mvar p.u	MW p.u.	Mvar p.u
1	1 05 +j0 0 (specified)	---	---	---	---
2	---	1.2	0.05	---	---
3	---	1.2	0.05	---	---
4	---	---	---	1.4	0.05
5	---	---	---	0.8	0.03
6	---	---	---	0.7	0.02

Taking bus-1 as slack bus and using an accelerating factor of 1.4, perform load flow by Gauss-Seidel method. Take precision index as 0.0001.

UNIT-IV

7. a) Explain the significance of Symmetrical Components. [7M]
   b) A generator rated at 150 MVA, 22 kV has $X_1=X_2=15\%$ and $X_0=5\%$. Its neutral is grounded through a reactor of 0.35Ω. The generator is operating at rated voltage with load disconnected from the system. Find the sequential currents, sub transient current in the faulted phase and line to line voltages if a line to line fault occurred at the terminals of the alternator. [7M]

(OR)

8. a) Write short notes on zero sequence system. [4M]
   b) Derive the expression for fault current and terminal voltage for a line to ground fault at the terminals of an unloaded three-phase alternator. Assume that the alternator neutral is solidly grounded. [10M]

UNIT-V

9. a) A two pole, three phase, 20 MVA, 12 kV generator is supplying rated power at 0.85 lagging power factor to an 12 kV bus. Due to a fault, the generator output is reduced to 30%. Determine (i) acceleration power and (ii) acceleration at the time of fault. Assume that the Kinetic Energy stored in the moving parts of the generator is 150 MJ. [7M]
   b) List out the essential factors affecting the stability. [7M]

(OR)

10. a) How stability studies are classified? What are they? [7M]
    b) A 4-pole, 50 Hz, 26 kV turbo alternator has a rating of 100 MVA, p.f 0.8 lag. The moment of inertia of rotor is 8000 kg-m^2. Determine M and H. [7M]

Code No: R2032023 **R20** SET -4

III B. Tech II Semester Regular Examinations, July -2023
POWER SYSTEM ANALYSIS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

UNIT-I

1. a) 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

b) List the advantage and disadvantage of finding Y_{BUS} by singular transformation. [7M]

(OR)

2. a) A synchronous generator is rated at 150MVA, 22kV has a reactance of 0.25 p.u and is connected to an overhead line through a transformer rated 200 MVA, 230/18 kV star delta with Xp.u is 0.21. Find the p.u reactance by considering the (i) generator ratings and (ii) transformer ratings as base values. [7M]

b) Define the following terms with suitable examples i) Graph ii) Tree iii) Co-tree iv) Cut-set v)Basic loop. [7M]

UNIT-II

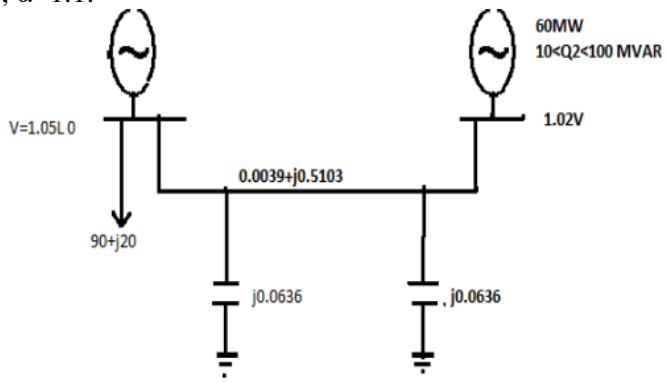
3. a) What are the assumptions in static load flow equations and derive the approximate load flow equations. [7M]

b) Compare N-R (polar) and N-R(rectangular form) load flow methods. [7M]

(OR)

4. a) Explain the representation of various components in power system for the power flow calculation by deriving the necessary expressions. [7M]

b) Using Gauss Seidel method, examine bus voltages for the Figure. Take base MVA as100, α=1.1. [7M]



Figure

Code No: R2032023 **R20** SET -4

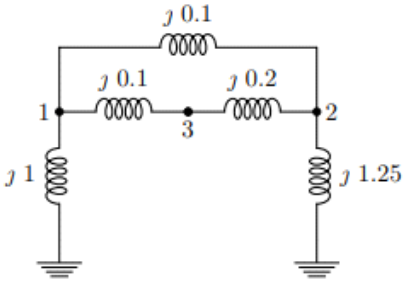
UNIT-III

5. a) Modify the expression for Z_{BUS}, modification of Z_{BUS} when a branch is added between old bus and new bus. [7M]

   b) Discuss the behavior of a 3-phase synchronous generator subjected to symmetrical three phase short circuit. Also define the several reactance's of the synchronous machine and their time constants. [7M]

(OR)

6. a) Find Z_{bus} matrix for the network shown Figure by building algorithm. [8M]

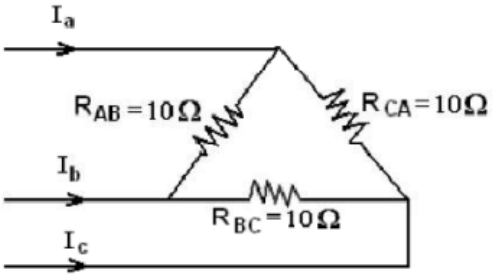


Figure

   b) How reactors are classified in short circuit MVA calculations? [6M]

UNIT-IV

7. a) A balanced 200 V, 3 phase supply feeds balanced resistive load as shown in figure. If the resistance R_{BC} is disconnected, determine I_a, I_b and I_c and symmetrical components of Ia, I_b and I_c. [7M]



   b) Enumerate the zero sequence network of transformers with diagrams. [7M]

(OR)

8. a) Derive an expression for fault current for a LLL fault on an unloaded generator. [7M]

   b) Draw the sequence network connections for single-line to ground fault, double line fault and double-line to ground fault conditions. [7M]

UNIT-V

9. a) Write some of the recent methods for maintain stability. [7M]

   b) Give the applications of equal area criterion. [7M]

(OR)

10. a) Mention the factors that affect transient stability. [7M]

    b) A 4 pole, 50 Hz, 60 MVA turbo generator has a moment of inertia of $9x10^3$ kg-m^2. Find the kinetic energy in MJ at rated speed, the inertia constant M and H, the acceleration in degrees per sec^2 and in rpm/sec, if the input power is 20 MW and the output power is 14 MW. [7M]