| Reg. No. | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Question Paper Code | 13616 |
|---|---|

**B.E. / B.Tech. - DEGREE EXAMINATIONS, APR / MAY 2025**

Fifth Semester

**Electrical and Electronics Engineering**

**20EEPC501 - POWER SYSTEM ANALYSIS**

Regulations - 2020

Duration: 3 Hours  Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

| | Question | Marks | K – Level | CO |
|---|---|---|---|---|
| 1. | What is the main purpose of system planning and operational studies in power systems?<br>(a) Reducing cost  (b) Ensuring reliable operation<br>(c) Maximizing load  (d) Minimizing voltage fluctuations | 1 | K1 | CO1 |
| 2. | In the per-unit system, what is the reference base value typically used for voltages?<br>(a) 1 Kv  (b) 100 V  (c) 1 V  (d) 1 MVA | 1 | K1 | CO1 |
| 3. | Which method is primarily used to handle voltage-controlled buses in load flow studies?<br>(a) Newton-Raphson method  (b) Gauss-Seidel method<br>(c) Jacobi’s method  (d) Fast Decoupled Load Flow method | 1 | K1 | CO2 |
| 4. | What are the three types of buses classified in power flow analysis?<br>(a) Load, generator, and slack buses<br>(b) Voltage, current, and power buses<br>(c) Generator, transmission, and distribution buses<br>(d) Load, transmission, and generator buses | 1 | K1 | CO2 |
| 5. | What assumption is made in short circuit analysis for symmetrical faults?<br>(a) All buses are in fault  (b) The fault impedance is infinite<br>(c) Faults are balanced  (d) System losses are zero | 1 | K1 | CO3 |
| 6. | Which type of fault results in the highest fault current?<br>(a) Single Line-to-Ground (LG)  (b) Line-to-Line (LL)<br>(c) Three-phase fault  (d) Line-to-Line-to-Ground (LLG) | 1 | K1 | CO3 |
| 7. | Which fault is most common in power systems?<br>(a) LG  (b) LL  (c) LLG  (d) Three-phase fault | 1 | K1 | CO4 |
| 8. | What are symmetrical components used for?<br>(a) Balancing the system voltages  (b) Analyzing unsymmetrical faults<br>(c) Calculating power losses  (d) Maintaining frequency stability | 1 | K1 | CO4 |
| 9. | What is the main objective of stability analysis in power systems?<br>(a) Ensuring economic operation  (b) Maintaining system frequency<br>(c) Maintaining rotor angle stability  (d) Reducing transmission losses | 1 | K1 | CO5 |
| 10. | Which method is commonly used to solve the swing equation?<br>(a) Newton’s method  (b) Modified Euler method<br>(c) Runge-Kutta method  (d) Gauss-Seidel method | 1 | K1 | CO5 |

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

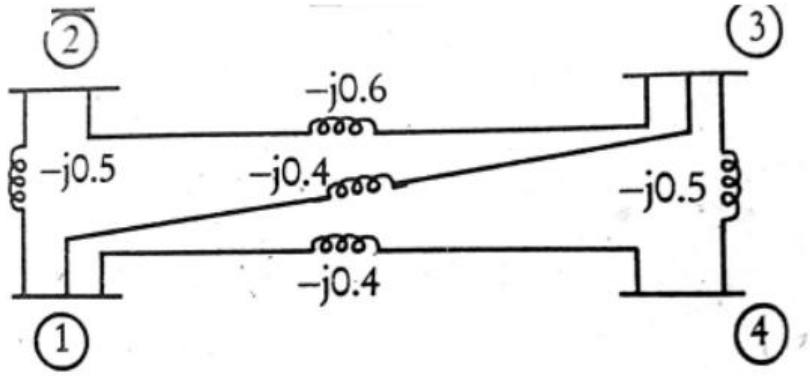
| | Question | Marks | K – Level | CO |
|---|---|---|---|---|
| 11. | Compare the significance of per-unit impedance diagrams with actual impedance diagrams. | 2 | K2 | CO1 |
| 12. | Recall how the incident matrix is related to the formation of the bus admittance matrix. | 2 | K1 | CO1 |
| 13. | What is a single line diagram? | 2 | K1 | CO1 |
| 14. | Compare Gauss-Seidel and Newton-Raphson methods for load flow analysis. | 2 | K2 | CO2 |
| 15. | Summarize the role of voltage-controlled buses in maintaining power system stability. | 2 | K2 | CO2 |
| 16. | What is the need for load flow study? | 2 | K1 | CO2 |
| 17. | Outline the process of calculating short circuit capacity using the bus impedance matrix. | 2 | K2 | CO3 |

| | | | | |
|---|---|---|---|---|
| 18. | Tell why symmetrical fault analysis assumes balanced fault conditions. | *2* | *K1* | *CO3* |
| 19. | Infer the role of sequence networks in analyzing unsymmetrical faults. | *2* | *K2* | *CO4* |
| 20. | Show the method to calculate fault current for a line-to-ground fault using symmetrical components. | *2* | *K1* | *CO4* |
| 21. | Compare rotor angle stability and voltage stability in power system analysis. | *2* | *K2* | *CO5* |
| 22. | Recall the significance of the critical clearing angle in transient stability analysis. | *2* | *K1* | *CO5* |

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

23. a) For the network shown below form the bus admittance matrix. Construct the reduced admittance by eliminating node 4. The values are marked in p.u. admittance. *11 K3 CO1*




**OR**

b) For a system network with the following data, *11 K3 CO1*

| Bus Code | p.u. line Impedance | Half line charging admittance in p.u. |
|---|---|---|
| 1-2 | 0.05+j0.12 | 0.025j |
| 2-3 | 0.06+j0.4 | - |
| 3-4 | 0.75+j0.4 | 0.02j |
| 1-3 | 0.045+j0.45 | 0.015j |
| 1-4 | 0.015+j0.05 | - |

Solve the problem by fining the bus incidence matrix & primitive admittance matrix also form the bus admittance matrix by singular transformation method.

24. a) Solve a load flow problem using the Newton-Raphson method for a 3-bus system. *11 K3 CO2*

**OR**

b) The following is the system data for a load flow solution. Solve the problem by obtaining the voltages at the end of first iteration using Gauss-Seidel method. Take α=1.6. The line admittances: *11 K3 CO2*

| ***Bus code*** | ***Admittance*** |
|---|---|
| 1-2 | 2-j8.0 |
| 1-3 | 1-j4.0 |
| 2-3 | 0.666-j2.664 |
| 2-4 | 1-j4.0 |
| 3-4 | 2-j8.0 |

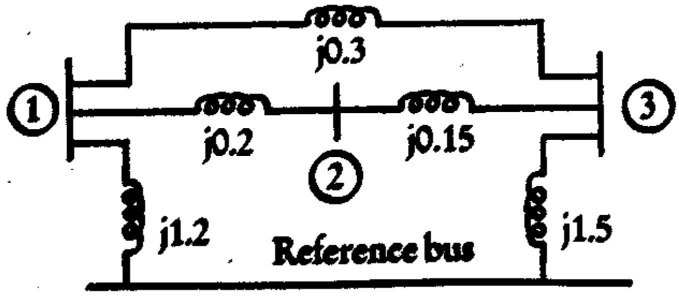
The schedule of active and reactive powers:

| ***Bus code*** | ***P in p.u*** | ***Q in p.u*** | ***V in p.u*** | ***Bus Type*** |
|---|---|---|---|---|
| 1 | - | - | 1.06 | Slack |
| 2 | 0.5 | 0.2 | 1+j0.0 | PQ |
| 3 | 0.4 | 0.3 | 1+j0.0 | PQ |
| 4 | 0.3 | 0.1 | 1+j0.0 | PQ |

25. a) Identify and calculate the short circuit current for a given three-phase symmetrical fault using Thevenin's theorem. *11 K3 CO3*

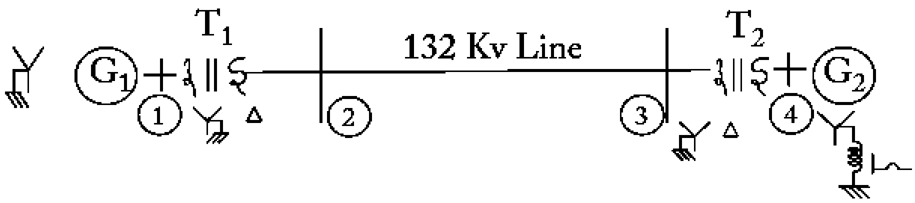
**OR**

b) Solve Zbus for whose reactance diagram is shown below by using bus building algorithm. *11 K3 CO3*




26. a) Figure below shows a simple power system network. Construct the positive, negative and zero sequence networks. The numerical data of various components in the power system is given as under: (all values are in p. u.) *11 K3 CO4*

Generator G1: 50 MVA, 11 KV, X1 = X2 = 0.2; X0 = 0.01;
Generator G2: 100 MVA, 11 KV, X1 = X2 =0.25; X0 = 0.02;
Transformer T1: 50 MVA, 11/132 KV, X1 = X2 =0.2; X0 =0.4
Transformer T2: 100 MVA, 11/132 KV, X1 = X2 = 0.1; X0 =0.1
132 KV Line: 100 MVA, 132 KV, X1 =X2 =0.1; X0 =0.25




**OR**

b) Develop the expression for fault current in double line to ground fault on unloaded generator. Draw an equivalent network showing the inter connection of networks to simulate double line to ground fault. *11 K3 CO4*

27. a) Develop a solution for the swing equation using the modified Euler method for a power system subjected to a disturbance. *11 K3 CO5*

**OR**

b) Model a transient stability scenario and use the equal area criterion to evaluate system stability. *11 K3 CO5*

28. a) (i) Explain the sequence network connections for analyzing an LG fault in a transmission line. *6 K2 CO4*

(ii) Illustrate the use of the equal area criterion in assessing transient stability for a power system fault. *5 K2 CO5*

**OR**

b) (i) Summarize the steps involved in using the bus impedance matrix to solve for unsymmetrical fault currents. *6 K2 CO4*

(ii) Compare the effects of critical clearing time and angle in determining the system's ability to remain stable post-fault. *5 K2 CO5*