

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO W24 – QUESTION BANK

Subject Name & Code:

Computational Geotechnics- 3170620

Unit 1 - Solution of Linear & Non-linear Equations

Repeated Questions:

1. **Explain Newton-Raphson method with a suitable example.**
 - Appeared in: S22 (Q1a, 03 marks), W23 (Q1b, 04 marks), S23 (Q1a, 03 marks), S24 (Q1b, 04 marks), W24 (Q15b, 04 marks)
2. **Explain Bisection method with a suitable example.**
 - Appeared in: S24 (Q1a, 03 marks), W24 (Q5b, 03 marks)
3. **Explain False Position (Regula-Falsi) method with a suitable example.**
 - Appeared in: S22 (Q2a, 03 marks), S23 (Q2b, 04 marks), S24 (Q2a, 03 marks)
4. **Solve the given system of equations using the Gauss-Seidal method.**
 - Appeared in: S22 (Q1c, 07 marks - *Similar type*), S23 (Q1c, 07 marks), W23 (Q1c, 07 marks), W23 (Q1c, 07 marks)
5. **Solve the given system of equations using the Gauss-Jacobi method.**
 - Appeared in: S22 (Q1c, 07 marks), S24 (Q1c, 07 marks)

Other Important Questions:

6. Enlist various linear and non-linear methods.
 - Appeared in: S23 (Q1a, 03 marks), W23 (Q1a, 03 marks)
7. Find a root of the equation $x^3 - 4x = 9$ using the Bisection method in four stages.
 - Appeared in: S22 (Q1b, 04 marks), S24 (Q2b, 04 marks)
8. Find negative roots of $x^3 - 7x + 3 = 0$ by Bisection method up to 3 steps.
 - Appeared in: S23 (Q2a, 03 marks)
9. Find a real root of $\cos x - 3x + 5 = 0$, correct to four decimal places using the False Position method.
 - Appeared in: W24 (Q3c, 04 marks)
10. Explain Taylor's series method.
 - Appeared in: W23 (Q2b, 04 marks), W23 (Q3a, 03 marks), W24 (Q17a, 03 marks)
11. Explain Jacobi's method with a suitable example.
 - Appeared in: W24 (Q18b, 03 marks)
12. Differentiate between FEM and FDM.
 - Appeared in: W23 (Q1b, 04 marks)
13. Explain the ordinary and partial differential equations with a suitable example.
 - Appeared in: W24 (Q20a, 03 marks)
14. Enlist different ODE and PDE methods.
 - Appeared in: W23 (Q2a, 03 marks)

Unit 2 - Finite Difference Method

Repeated Questions:

1. **Use the second-order Runge-Kutta method to solve the given initial value problem.**
 - Appeared in: S23 (Q2c, 07 marks), S24 (Q2c, 07 marks), W23 (Q2c, 07 marks), W24 (Q6c, 04 marks)
2. **Use the fourth-order Runge-Kutta method to solve the given initial value problem.**
 - Appeared in: S22 (Q2c, 07 marks - OR), S23 (Q2c, 07 marks - OR), S24 (Q2c, 07 marks - OR), W23 (Q2c, 07 marks - OR), W23 (Q2c, 07 marks), W24 (Q7c, 05 marks)
3. **What are Dirichlet and Neumann conditions?**
 - Appeared in: S23 (Q3a, 03 marks), W24 (Q23a, 03 marks)

Other Important Questions:

4. Explain Runge-Kutta Second and Fourth order methods of differential equations.
 - Appeared in: W23 (Q2c, 07 marks - OR)
5. Using the Runge-Kutta method of order four, obtain an approximate solution and compute the relative error.
 - Appeared in: W24 (Q7c, 05 marks)

Unit 3 - Discrete Modeling

Repeated Questions:

1. **Explain the concept of the Discrete Element Method (DEM). / Define DEM.**
 - Appeared in: S23 (Q3a, 03 marks), W23 (Q3a, 03 marks - *OR*), W23 (Q2b, 04 marks), S22 (Q3a, 03 marks)
2. **Differentiate between discrete modeling and continuum modeling.**
 - Appeared in: S23 (Q4a, 03 marks), S23 (Q3a, 03 marks - *OR*), S24 (Q3a, 03 marks - *OR*), W23 (Q3a, 03 marks), S22 (Q3a, 03 marks - *OR*), W24 (Q2b, 03 marks)
3. **Explain the basic concept of discrete modelling.**
 - Appeared in: S23 (Q4a, 03 marks), S24 (Q3c, 07 marks)

Other Important Questions:

4. Briefly explain continuum modeling.
 - Appeared in: S24 (Q3a, 03 marks)
5. Explain the role of the integration algorithm for the solution of DEM problems.
 - Appeared in: W23 (Q2a, 03 marks)
6. Give a detailed note on DEM for understanding soil behavior.
 - Appeared in: S23 (Q3a, 03 marks)
7. Give the difference between the Discrete Element Method and the Finite Element Method.
 - Appeared in: S23 (Q3b, 04 marks)

Unit 4 - Classical Plasticity and Soil Behavior

Repeated Questions:

1. **Explain Mohr-Coulomb theory. / Describe Mohr-Coulomb's strength theory.**
 - Appeared in: S22 (Q3c, 07 marks), S23 (Q3c, 07 marks), S24 (Q4c, 07 marks), W23 (Q4b, 04 marks)
2. **Explain Drucker-Prager theory.**
 - Appeared in: S22 (Q3b, 04 marks), S23 (Q3b, 04 marks - *Similar*), S24 (Q4b, 04 marks), W23 (Q3b, 04 marks)
3. **Differentiate between an elastic model and a plastic model.**
 - Appeared in: S24 (Q5b, 04 marks), W23 (Q4a, 03 marks), W24 (Q9b, 03 marks)
4. **Explain the theory of the Lade-Duncan criterion for the earth pressure coefficient.**
 - Appeared in: S23 (Q3c, 07 marks), S24 (Q5c, 07 marks), W23 (Q4c, 07 marks), W24 (Q19c, 04 marks)
5. **What is classical plasticity? Explain the general framework of classical plasticity.**
 - Appeared in: S23 (Q4c, 07 marks), S24 (Q5c, 07 marks), W24 (Q25c, 04 marks)
6. **Explain the concept of Cam clay.**
 - Appeared in: S23 (Q4b, 04 marks), W23 (Q4a, 03 marks), W24 (Q24b, 03 marks)

Other Important Questions:

7. Explain the application of the FEM method for geotechnical engineering.
 - Appeared in: S22 (Q3b, 04 marks), S23 (Q1b, 04 marks), S24 (Q3b, 04 marks), W23 (Q3c, 07 marks), W24 (Q1a, 03 marks)
8. Explain in detail One-dimensional (1D) plasticity theory for understanding the behavior of soil.
 - Appeared in: S22 (Q3c, 07 marks - *OR*), S23 (Q4c, 07 marks - *OR*), S24 (Q3c, 07 marks - *OR*), W24 (Q13c, 04 marks)
9. Explain Modified Mohr Coulomb failure theory for shear strength? Sketch a typical strength envelope for different types of soil.
 - Appeared in: S23 (Q4c, 07 marks), S24 (Q3b, 04 marks)
10. Explain the importance of the initial boundary value problem.
 - Appeared in: S24 (Q5a, 03 marks), S23 (Q4b, 04 marks)
11. Briefly explain the soil constitutive model.
 - Appeared in: W24 (Q8a, 03 marks)
12. Differentiate between Tresca failure theory and Von Mises failure theory for soil.
 - Appeared in: W24 (Q16c, 04 marks)
13. Explain the following terms: Angle of internal friction, Cohesion of soil particle, Shear strength of soil, Pore water pressure.
 - Appeared in: S23 (Q3b, 04 marks)
14. Explain the following terms: Angle of Repose, Shear strength of Soil.
 - Appeared in: W23 (Q3b, 04 marks)

Unit 5 - Numerical Solutions & Consolidation

Repeated Questions:

1. **Explain the Tri-axial test with a neat sketch. Also, enlist its limitations/merits and demerits.**
 - Appeared in: S22 (Q5c, 07 marks), S23 (Q5c, 07 marks), S24 (Q4c, 07 marks), W24 (Q10c, 04 marks)
2. **Explain the concept of consolidation. / Give a detailed note on one-dimensional consolidation.**
 - Appeared in: S23 (Q5a, 03 marks), S24 (Q4a, 03 marks)
3. **List the assumptions made in the theory of 1-D consolidation.**
 - Appeared in: S24 (Q4a, 03 marks), W24 (Q12a, 03 marks)
4. **Explain compression index (C_c) and Swelling index (C_s).**
 - Appeared in: S24 (Q4b, 04 marks), W24 (Q21b, 03 marks)
5. **Explain the flow through porous media.**
 - Appeared in: S22 (Q4a, 03 marks - OR), S24 (Q4a, 03 marks - OR), W24 (Q11a, 03 marks)
6. **Explain the consolidation mechanism through spring analogy theory.**
 - Appeared in: S23 (Q5c, 07 marks), S24 (Q5b, 04 marks), W24 (Q22c, 04 marks)
7. **Define the following terms: Immediate Settlement, Primary Consolidation, Secondary Consolidation.**
 - Appeared in: S23 (Q5a, 03 marks), S24 (Q5a, 03 marks), W23 (Q5a, 03 marks)

Other Important Questions:

8. Explain Terzaghi's theory of one-dimensional consolidation with assumptions.
 - Appeared in: S22 (Q4c, 07 marks - OR), W23 (Q3c, 07 marks)
9. Differentiate between consolidation and compaction.
 - Appeared in: S23 (Q5b, 04 marks)
10. Give a detailed explanation of the various types of consolidation.
 - Appeared in: S22 (Q5a, 03 marks)
11. A saturated clay layer of 4 m thickness takes 2 years for 50% primary consolidation when drained on both sides. Its coefficient of volume change $m_v = 1.5 \times 10^{-3} \text{ m}^2/\text{kN}$. Determine the coefficient of consolidation and coefficient of permeability. Assume $\gamma_w = 10 \text{ kN/m}^3$.
 - Appeared in: S22 (Q5b, 04 marks) - **Numerical Question**
12. Briefly explain the applications of the numerical solution.
 - Appeared in: W24 (Q14a, 03 marks), W23 (Q5c, 07 marks)
