You will not be allowed any notes, though calculators are allowed but will not be necessary. There will be six questions, each with a few parts, and a total of three hours. The topics to prepare are listed below. The final will be somewhat easier but similar in layout to the practice finals posted online.

Course notes Part I

• Section 1.7 (Induction and trees) only. Omit everything else, including combinatorial proofs/bijections.

Course notes Part II

• Sections 2.8 – 2.8.2, 2.9, 2.9.1 only. Omit all other sections. (make sure you have latest notes).
• You will be asked one problem on compositions and one problem on binary strings.
• Know how to work with sums and formal power series.
  ◦ See online notes on working with sums.
• Know how to state and use the Binomial Theorem
  ◦ See online notes on binomial coefficients.
  ◦ See online notes on working with sums.
• Know how to count compositions of various types.
  This is Section 2.8 but omit 2.8.3.
• Know how to count binary strings of various types.
  This is Section 2.9.

Course notes Part III

• Know how to solve recurrence equations (Theorem 1). Omit asymptotic behavior.
• Know how to get recurrence equations from generating functions (Section 3.2).
  ◦ See some examples for binary strings and compositions and exercises of Section 3.3.

Course notes Part IV

• Sections 4.1, 4.2, 4.4. Know statements but not proofs of the results in these sections. In particular, know how to state Menger’s Theorems. Omit 4.3 (Block decomposition).
• Be familiar with graph theoretic terminology and notation \( \Gamma(v), \Gamma(X), d(v), \delta(G), \kappa(u,v), \lambda(u,v), \kappa(G), \lambda(G). \)
Course notes Part V

- Sections 5.1, 5.2, 5.3, 5.5, 5.6, 5.7. Know statements and given proofs of all results in these sections. Omit 5.4 (Variations) and proof of Lemma 1 (Section 5.3).
  - Main proofs to know: Proof of Max-Flow Min-Cut Theorem (Theorem 2 Section 5.3), Proof of Hall’s Theorem (Theorem 7 Section 5.7).
  - Be familiar with and be able to define all terminology regarding flows: $st$-flow, $st$-cut, value of a flow, cut induced by $S$, ... (Sections 5.1–5.3)
- Be able to find a maximum flow in a given network. (Section 5.5)
- Be able to check Hall’s Condition for a given graph.
  - with and be able to define all terminology regarding matchings: $\Gamma(X)$, Hall’s Condition, maximum matching, perfect matching, ... (Section 5.7)

Course notes Part VI

- Sections 6.1, 6.2 only.
  - Main proofs to know: Euler’s Formula (Theorem 6.1.2 Section 6.1), Theorem 6.1.3
  - Be familiar with how to apply Euler’s Formula (show a graph like $K_5$ is not planar for example)
- Know how to prove the 5-colour theorem.