Complex Physics — Oral Exam

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Exam dates is ?, ? and ? of November from 9.00 am to ?.
The exam is oral, 9 minutes + 9 minutes + 2 minutes for evaluation. The 9-minute random questions directed by the teacher can be in anything covered from chapter 1 to chapter 7 in lecture notes.

For the first 9 minutes, you draw a random number between 1 and 7 and then tell us about the corresponding question. You are now allowed to use notes, but can look at some for 30 sec before starting your presentation. For the last 9 minutes, we questioned you about all the material in Pensum. Pensum is defined by the material we went through in the Lecture notes (chapter 1 to chapter 7 included). Thus exercises are included but appendixes are not included.

Importantly, each of chapters 1-7 ends with a few highlighted lessons. As a bare minimum, these should be fully understood. You likely get sub-questions in one or more of them.

The 7 exam questions relate directly to chapters in the lecture notes:

- **1) Stat. Mechanics**,Entropy, Partition function, Ising model, and Metropolis Simulations (ch 1).
- **2) Phase transitions & Critical phenomena:** Mean Field Solution to Ising mode, Mean Field Potts model, 1-d Ising model and transfer matrix method (ch 2).
- **3) Percolation and fractals:** Percolation one a Bethe lattice with some critical exponents, renormalization, fractals, equations for fractal dimensions (ch. 3)
- **4) Self-organized criticality:** First return of Random walk, critical branching, the sandpile model, the evolution model (ch. 4)
- **5) Networks:** Amplification factor, scale-free networks, analyzing patterns of networks, algorithms to make or evolve scale-free networks (ch. 5)
- **6) Agent-based models & Event-based simulation:** simulation with discrete but random changes, Gillespie algorithm, Example of agent-based simulation and its advantages (ch. 6)
- **7) Econophysics** Hurst exponent, Fear Factor model, Bet hedging approaches (ch. 7)

Obviously, you cannot cover all items under the given question during a 9-minute talk, you have to judge what is important yourself. The items mentioned under each question is stated to give you inspiration. Your presentation should NOT be an overview of the chapter, it should be your selected sub-part with some equations that illustrate that you have understood some central part of the overall topic.

The oral exam gives at max 80 points, midterm up to 24 points, and 100 points are perfect.