Q17.1 Difference between conserved and non-conserved dynamics in Ising models

Non-conserved dynamics allow spins to flip independently, changing the total magnetization. Conserved dynamics keep total magnetization constant, with spins exchanging positions instead of flipping.

Q17.2 Difference between conserved and non-conserved dynamics in surface relaxation

Non conserved dynamics occur when atoms are exchanged with a vapor, changing total surface mass. Conserved dynamics occur when atoms move along the surface without leaving it, keeping total mass constant.

Q17.3 Outline of a computer code to solve the time-dependent surface relaxation

1. Set parameters $a_1, a_2, \delta x, \delta t, T$, and grid points.
2. Initialize $h(x, 0)$ as the starting surface profile.
3. Use finite differences to calculate second and fourth derivatives.
4. Update using:
$$h_i^{n+1} = h_i^n + \delta t(a_1 h_{xx} - a_2 h_{xxxx})$$
5. Apply boundary conditions and loop until final time.

Q17.4 Neumann stability condition

For stability:

$$\delta t < \frac{\delta x^2}{2a_1}.$$

Which ill ensure the finite difference solution does not diverge.

Q19.1 Assumptions made in the envelope approximation

The envelope approximation assumes the optical field can be expressed as a rapidly oscillating carrier multiplied by a slowly varying envelope. It assumes the spectral width is narrow, the pulse varies slowly compared to the optical period, and that higher order dispersion terms are negligible.

Q19.2 Properties of the optical pulse fundamental soliton

The fundamental soliton maintains its shape and speed due to a perfect balance between group velocity dispersion and nonlinearity. It is stable, does not spread over distance, and enables long distance data transmission in optical fibers.

Q19.3 Physical processes captured by Eq. (6) and the origin of the non-linear term

Eq. (6) includes dispersion, nonlinearity, and attenuation. The nonlinear term arises from the intensity dependent refractive index, which introduces self phase modulation proportional to $|A|^2 A$.

Q19.4 Computational method to calculate the envelope of an optical pulse

1. Initialize parameters β_2, γ, α, ΔT, Δz, and set the initial pulse shape.
2. Use finite differences or a split-step Fourier method to evolve $A(z, T)$ using Eq. (6).
3. Alternate between linear and nonlinear steps for stability.
4. Output $A(z, T)$ at each propagation step to track the envelope over time.