In the name of God

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CRITICAL PHENOMENA

Exercise Set 7

(Due Date: 1401/09/30)

1. Fluctuations around Tricritical point: Exercise 3.4 Kardar's Book.

2. : Spin wave: Exercise 3.1 Kardar's Book.

3. Random magnetic field: a model for presence of impurities in matter. Suppose that we have

$$L[\phi] = \int d^d r \left[\frac{t}{2}\phi(r)^2 + u\phi(r)^4 + \frac{K}{2}(\nabla\phi(r))^2 - h(r)\phi(r) \right]$$

where $\phi(r)$ and $h(r)$ are scalar field and $u > 0$. Suppose that $h(r)$ comes from Gaussian random field, namely

$$\langle h(r) \rangle = 0$$

and

$$\langle h(r)h(r') \rangle = \delta_d(r - r')$$

and

$$p(h(r) = \exp\left(-\frac{h(r)^2}{2} \right)$$

A: Calculate free energy according to saddle point approximation.
B: Suppose $\phi = \phi_0 + \psi$ and in Gaussian approximation, compute the correction on zeroth order approximation of free energy.
C: Determine the discontinuity on heat capacity at critical point. (Hint: see the exercise 3.6 Kardar's Book)

Good luck, Movahed