Solitons and instantons I.

1. <u>The role of solitons and instantons</u> classical and quantum theory, historical review, 'mathematician' and 'physicist'definitions.
2. <u>$1 + 1$ dimensional scalar fields</u> the structure of the space of $E < \infty$ configurations for one and more components, topological charge.
3. <u>The kink model and the kink solution</u>
4. <u>The Sine Gordon model</u> topological structure, multisoliton solutions, breathers, integrability and its consequence.
5. <u>The general condition of integrability</u> zero curvature condition, non integrable phase factor, monodromia matrix, conserved quantities.
6. <u>Derrick's theorem</u> and its modification when vector fields are present.
7. <u>The $2 + 1$ dimensional $O(3)$ model</u> topological classification, the Polyakov solutions.
8. <u>The Dirac magnetic monopole</u> and its properties.
9. <u>The $d + 1$ dimensional spontaneously broken gauge theories</u> the general properties of the $E < \infty$ solutions, the 2+1 dimensional Abelian Higgs model.
10. <u>The t'Hooft Polyakov monopole</u> spherically symmetric Ansatz, $\Pi_2(G/H) \sim \Pi_1(H)$ and the non integrable phase factor.
11. <u>Bogomolny equation, BPS limit</u> BPS solutions, dyons.
12. <u>The Euclidean solutions</u> their concept, the relation between the soliton and instanton solutions, the instanton interpretation of the previous soliton solutions.
13. <u>The $3 + 1$ dimensional pure Yang Mills theory</u> the classification of finite action solutions, Pontryagin number, (anti) self- duality equations.
14. <u>The Yang Mills instanton solutions</u> the BPST solution, the t'Hooft multi instantons, Witten's $O(3)$ symmetric multi instantons.

Suggested reading

- R. Rajaraman "Solitons and Instantons" North Holland
- S. Coleman "Aspects of symmetry" CUP

Palla László