

Contents

1	Introduction	1
2	The Turing Machine	8
3	Binary System and Boolean Algebra	13
4	The Quantum Computer	20
5	The Discrete Fourier Transform	31
6	Quantum Factorization of Integers	36
7	Logic Gates	38
8	Implementation of Logic Gates Using Transistors	44
9	Reversible Logic Gates	51
10	Quantum Logic Gates	59
11	Two and Three Qubit Quantum Logic Gates	64
12	One-Qubit Rotation	69
13	A_j – Transformation	78

14	B_{jk} – Transformation	83
15	Unitary Transformations and Quantum Dynamics	85
16	Quantum Dynamics at Finite Temperature	90
17	Physical Realization of Quantum Computations	101
18	CONTROL-NOT Gate in an Ion Trap	109
19	A_j and B_{jk} Gates in an Ion Trap	116
20	Linear Chains of Nuclear Spins	120
21	Digital Gates in a Spin Chain	124
22	Non-resonant Action of π-Pulses	127
23	Experimental Logic Gates in Quantum Systems	136
24	Error Correction for Quantum Computers	143
25	Quantum Gates in a Two-Spin System	154
26	Quantum Logic Gates in a Spin Ensemble at Room Temperature	160
27	Evolution of an Ensemble of Four-Spin Molecules	167
28	Getting the Desired Density Matrix	174
29	Conclusion	178