

CONTENTS

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KEY: *N* = Notes, *B* = Book, *V* = Video, *PS* = Research Papers & Scholarly Articles,
Q = Quantum, *QME* = Q. Masters Equation, *QIS* = Q. Information Sciences, *OQS* =
Open Q. Systems, *QM* = Q. Mechanics

Numbering is just for general structure, some topics may be added/removed.

1. Select an approach and general introductions ✓ **done**
2. Review of QM and Density matrix formalism - (**N1 B4 B5 B6**) ✓ **done**
3. Quantum Information - 1.6 (**B6**) Intro to OQS from QIS perspective (**N3**) ✓ **done**
4. Classical Probability Theory - 1.1 - 1.3 (**B1**) What is quantum (**N5**) ✓ **done**
5. Distinguishability and information - 4.1, 4.2 (**B1 B7 B6**) ✓ **done**
6. Q.Statistical Mechanics - 1, 2.1 - 2.2.2 (**B2**) ✓ **done**
7. Quantum Probability - 2.1 (**B1**) ✓ **done**
8. Composite Systems - 2.2 (**B1**) 6 (**B7**) IV (**N1**) ✓ **done**
9. Theory of Measurement - 6 (**B4**) 2.4 (**B1**) 2.2.3 (**B6**) ✓ **done**
10. Quantum Entropy - 2.3 (**B1**) 19 (**B7**) 11 (**B6**) ✓ **done**
11. Open Quantum Systems, Noise, POVM & Kraus Representation - V (**N1**) 8.1 - p176 (**B2**)
12 p251 - p259 (**B4**) 5, 9.1,9.2,9.5,9.6 (**B7**) 2.2.5, 2.2.6, 8 (**B6**) ✓ **done**
12. Super Operators, Dynamical Maps, Q. Maps, Q. Channels, Positivity, Banach Space,
Linear Operators, Groups & Semigroups - 1 (**B3**) VI *B* - *G* (**N1**) 2.2, 2.3 (**N3**) 3.1 - 3.4 (**B3**)
✓ **done**
13. Markovianity and Piecewise Deterministic Processes - 1.4 - 1.5 (**B1**) 4 (**B3**) ✓ **done**
14. QME: Microscopic derivations and Models - 3.1 - 3.3 (**B1**) (**N3**) 5 (**B3**) ✓ **done**
15. Non-Markovianity 6 (**B3**) 8.1 (**N3**) ✓ **done**
16. Markovian and Non-Markovian Models - 8.2 - 8.4 (**N3**)
17. Quantum Correlation Quantifiers (Fidelity, Negativity and Discord)
18. Project 1: Depolarizing channel (**N3**) (**B6**) (**B4**)
19. Project 2: Pauli channel (**N3**) (**B6**) (**B4**)
20. Project 3: Reservoir engineering (**N3**) (**B6**) (**B4**)
21. Project 4: Amplitude damping (**N3**) (**B6**) (**B4**)
22. Decoherence and Thermodynamics
23. Noise mitigation protocols (**B4**) (**N3**)
24. Read and implement in qiskit (**PS2**)

SESSION # 01

2. Review of QM and Density matrix formalism (**N1 B4 B5 B6**)
 1. Chapters 1 and 2 from (**B5**) - (for self study will only discuss if needed)
 2. First 17 pages (**N1**)
 3. Chapters 2-5 (**B4**)

SESSION # 02

3. Quantum Information - 1.6 (**B6**) Intro from QIS perspective (**N3**)
 1. Density matrix formalism (**N1 B4 B5 B6**) ~ carried forward from S1
 2. Quantum Information - 1.6 (**B6**)
 3. Intro to oqs from QIS perspective (**N3**)

SESSION # 03

4. Classical Probability Theory (**B1 N5**)
 1. Classical Probability Theory 1.1 - 1.3 (**B1**)
 2. What is quantum (**N5**)

SESSION # 04

5. Distinguishability and information (**B1 B7 B6**)
 1. Classical Probability Theory 1.2 - 1.3 (**B1**) ~ carried forward from S3
 2. Distinguishability - 4.1, 4.2 (**B7**) 2.2.4 (**B6**)
 3. Uncertainty - 4.5 (**B7**)
 4. Distance measures for q.information - 9.1 - 9.2.3 (**B6**)

SESSION # 05

6. Distinguishability and information (**B7 RS3 RS4**)
 1. Q.Stat Mech - 1, 2.1 - 2.2.2 (**B2**)
7. Quantum Probability - 2.1 (**B1**)
8. Composite Systems - 2.2 (**B1**) 6 (**B7**) IV (**N1**)

SESSION # 06

9. Theory of Measurement - 6 (**B4**) 2.4 (**B1**) 2.2.3 (**B6**) 5 (**N4**)
10. Quantum Entropy - 2.3 (**B1**) 19 (**B7**) 11 (**B6**)

SESSION # 07

11. Open Quantum Systems, Noise, POVM & Kraus Representation
 1. Theory of Measurement - 2.4 (B1) ~ carried forward from S6
 2. Quantum Entropy - 19 (B7) ~ carried forward from S6
 3. POVM - 2.2.5, 2.2.6 (B6)
 4. Quantum Noise and Error Correction - 12 p251 - p259 (B4)
 5. Quantum noise and quantum operations - 8.1 (B6)
 6. Open System Dynamics - V (N1)

SESSION # 08

11. Open Quantum Systems, Noise, POVM & Kraus Representation ~ continued
 1. Quantum noise and quantum operations - 8.2 (B6)
 2. OQS and QIP Interface - 8.1 - p176 (B2)
 3. Quantum Dynamics - 5 (B7)
 4. Open Systems - 9.1, 9.2, 9.5, 9.6 (B7)

SESSION # 09

12. Super Operators, Dynamical Maps, Q. Maps, Q. Channels, Positivity, Banach Space, Linear Operators, Groups and Semigroups
 1. Banach Space, Linear Operators, Groups and Semigroups - 1 (B3)
 2. Super Operators, Q. Maps, Q. Channels, Positivity - VI B - G (N1) 2.2, 2.3 (N3)
 3. Dynamical Maps - 3.1 - 3.4 (B3)

SESSION # 10

13. Markovianity and Piecewise Deterministic Processes - 1.4 - 1.5 (B1) 4 (B3)
 1. Markovianity - 1.4 (B1)
 2. Piecewise Deterministic Processes - 1.5 (B1)
 3. Quantum Markov Process: Mathematical Structure - 4 (B3)

SESSION # 11

14. QME: Microscopic derivations and Models - 3.1 - 3.3 (B1) 3 (N3)
 1. Microscopic derivations - 3.1 - 3.3 (B1)
 2. Microscopic derivation of the master equation - 3 (N3)

SESSION # 12

15. Non-Markovianity, 6 (B3) 8.1 - 8.2 (N3)

1. Microscopic Description: Non-Markovian Case, 6 (B3)
2. Non-Markovian quantum dynamics, 8.1 - 8.2 (N3)

SESSION # 13

16. Markovian and Non-Markovian Models - 8.2 - 8.4 (N3)