Course Number:

Course Name: Quantum Communication Signals

Course Type: Theory	Type & Max Unit: Constant 3
Prerequisite: Nothing.	Corequisite: Nothing.
Level: Graduate	First Presentation: S2017
Group: Communications	Last Edition: Unknown.

1. **Brief Introduction to Quantum mechanics:**

   Black body radiation, photoelectric effects, Wave functions, Schrödinger's equations, operators, operators and expectation value, Eigen functions and Eigen values, particle in a box, Finite potential well, Quantum state and degeneracy, principal number, magnetic quantum number, orbital angular momentum, spin magnetic, quantum number, periodic table.

2. **Quantum Optics:**

   Elements of Theory, State vectors, Probabilities and states, operators and operation, Expectations, Quantization, Hami-Honian operator and harmonic oscillator, the quanta and coherent state of an oscillator, raising (creator) and lowering (annihilators) operators, the most natural state of an oscillator, coherent or Glauber state, properties of coherent state

   -Appendix: New field amplitude for old

3. **Quantum light:**

   Waves and oscillator, the making of a photon, quantizing the electromagnetic field, coherent state of the field pure state, packets and minimum uncertainty, coherent state minimum uncertainty state

4. **Quantum Signals:**

   Single mode coherent quantum state, coherent state minimum uncertainty state, non-orthogonality of coherent states, expansion of arbitrary states in terms of coherent state, over-completeness. A more rigorous approach in expansion of operators in terms of coherent state vectors, general properties of the density operators, P-representation of density operator, superposition law of coherent state (pure state case), superposition law for mixed state, averages with P-representation, the Gaussian density operators and Quantum thermal light, quantum vs. classical Gaussian distribution, superposition of a pure coherent signal with quantum thermal noise

   -Appendix A: Displacement operators

-Appendix B: Gaussian probability Wigner functions

5. **Quantum Phase Operators**

Dirac's Formula, Susskind and Glogower phase operators, Cosine and sine phase operators, Loudon model on quantum phase operators.

Main Book: Quantum Communication by Gianfranco Cariolaro, Springer, 2015

Supplementary Book: Quantum detection and estimation theory by Carl W. Helstrum, Academic Press, 1976

Minimum requirement: Digital Communications, Basic Linear Algebra, Basic physics, fundamental of probability