AMITY UNIVERSITY
UTTAR PRADESH

Course Title: Statistical and Quantum Optics

Credit Units: 4

Course Level: PG **Course Code: TELE707**

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	1	0	0	4

Course Objectives: The aim of this course is to provide students with theoretical skills and insight into the statistical and quantum optics. The theory of quantum optics is not only a requisite to describe realistic (non-isolated) quantum optical systems, but it also provides interesting ways of manipulating quantum information through the action of quantum measurements and possibly feedback. The course will introduce basic elements of quantum noise and will also cover advanced topics and tools that will expose students to current research problems.

Pre-requisites: Quantum Physics, Physical Optics (or Photonics and Optics Fundamentals).

Course Contents/Syllabus:

	Weightage (%)
Module I : Fundamentals of statistical optics	**25**
Descriptors/Topics : Probability theory, generating function, characteristic function; Stochastic processes, spectral properties, correlation and convolution; Analytic signal and spatial frequency analysis; Temporal, spatial and partial coherence; Propagation of coherence, Van Cittert and Zernike theorem.	
Module II : Theory of photo detection	**25**
Descriptors/Topics : Higher order correlations; Differential photo detection probability, joint probability of multiple photodetection, Mandel’s formula; Intensity interferometry; Hanbury Brown–Twiss experiments and classical intensity fluctuations, Photon bunching and antibunching, Single-photon sources.	
Module III : Fundamentals of Quantum Optics	**25**
Descriptors/Topics : Quantum theory of light, density operators; P representation, Q representation and Wigner function; Coherent states and squeezed states; Phasor diagrams and field quadratures, Photon statistics, nonclassical states and EPR paradox.	
Module IV : Spectroscopic techniques in Quantum Optics	**25**

Descriptors/Topics : Laser Doppler velocimetry, light beating and photon correlation spectroscopy; Doppler free spectroscopy, saturation spectroscopy; Laser speckle statistics.	

Student Learning Outcomes: After completion of course, students will be able:

- To explain the fundamental concepts of the statistical and quantum optics.
- To describe the quantum nature of light and the basics of photon statistics.
- To describe the detection principles of photon.
- To explain the interaction of light with matter.
- To describe the different techniques used in quantum optics.

To define the current research problems in the statistical and quantum optics.

Pedagogy for Course Delivery: Class Room Lecture, Tutorial, Group Discussion and Seminar.

Lab/ Practicals details, if applicable: NA

Assessment/ Examination Scheme:

Theory L/T (%)	**Lab/Practical/Studio (%)**	**Total**
100%	NA-	100

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					**End Term Examination**
Components (Drop down)	Class Test	Home Assignment	Seminar/Viva	Attendance	
Weightage (%)	10%	10%	5%	5%	70%

Text Reading:

- Goodman, Joseph W., Statistical optics (Wiley, New York, 1985).
- Bachor, H A., Ralph, T.C., A guide to experiments in quantum optics (2nd edn). (Wiley-VCH, Weinheim, 2004).
- Meystre, P., Sargent III, M., Elements of quantum optics (3rd edn). (Springer-Verlag, Berlin, 1999).
- Gerry, C. C., Knight, P. L. (2005). Introductory quantum optics, (Cambridge University Press, Cambridge, 2005).
- Corney, Alan, Atomic and laser spectroscopy, (Clarendon Press, Oxford, 1977).
- Fox, Mark, Quantum Optics An Introduction, (Oxford University Press, Oxford, 2001).