Quantum Technology

1. Per Week Lectures: 3 **hrs**, Credits **(3-0-0-0):9**; Duration of Course: Full semester
2. Department: **Department of Physics**

3. Other faculty members interested in teaching the proposed course: **Prof. Saikat Ghosh & Prof. Adhip Agarwal**

4. Instructor In charge (s): **Dr. Sapam Ranjita Chanu**
5. Course Description: **(Experimental & Engineering Technologies)**

A) Objectives: This course aims to introduce students with a grounding in the new discipline of quantum information and quantum computing using quantum mechanics, atomic physics, computations and engineering. Students who graduate from this program will have the knowledge to succeed as researchers or program managers in a quantum computing or quantum technologies enterprise.

B) Contents (preferably in the form of 4 broad titles):
   Lecture-wise break-up (considering the duration of each lecture is 90 minutes)

Topic	Lectures
1. **Introduction to quantum technologies** - why do we need quantum technologies and its application to understand experimental results - Various platform for implementing Quantum Technology & design robust quantum devices	4
2. **Fundamental understanding of Quantum Behaviour** - Quantum mechanics, entanglement, superposition, decoherence in open quantum systems, quantum information, quantum noise and quantum error correction theory	10
3. **Understanding engineering challenge of present developers and implementation on various sub-domain** - Quantum limited sensing - Quantum non-destructive measurement and Metrology - Quantum communication - Macroscopic quantum systems, - Quantum optics, cold atoms and ions - Quantum microwaves - Quantum materials	15
4. **Scientific limitation of quantum algorithms and simulation of physics and optimization-atoms and ions-** case studies with few literature	2

C) **Recommended pre-requisites Instructor's consent**; Quantum mechanics, Atomic and Molecular Optical Physics is preferable.

6. **Recommended text/reference books**:

A . "The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger, Springer (2016)
B. "Quantum computation and Quantum Information", Nielson & Chuang, Cambridge Press (2013)
C. "Introduction to Quantum Technologies", Alto Osada, R. Yamazaki, A Noguchi, Springer (2022)

7. **Course evaluation Policy (tentatively) :**

a. **Quiz**: 20% [2 nos, One in each term]

b. **Mid-Semester**: 30% [Examination]

c. **End-Semester**: 30% [Either project or Journal paper presentation with detail contents on quantum sensor]

d. **Assignment**: 20% [submission & frequency will be inform]

e. Missing any of the components in the course will be strictly zero in that section.

f. **Attendance**: Compulsory (Please inform the instructor in charge if you miss 2 class continuously).

For any clarification, please contact instructor in charge by email (sranjita@iitk.ac.in)