

**Research Lab:** Fiber Optics Laboratory

**Supervisor:** Prof Sunil Khijwania

**Brief Summary of the Research:** My research interest is fundamentally multidisciplinary that broadly integrates optical communication engineering (Fiber Optics), physics (especially, electrostatics & optics) and nanotechnology.

The application-oriented multidimensional research being carried out at “Fiber Optics Laboratory” (established in 2004) infuses some of the key emerging technologies e.g., nanophotonics, plasmonics, advance nanoengineering, speciality fibers and guided-wave all-optical advance devices. Currently, research & development at my research group is predominantly focused on the design and development of Smart Optical Fiber Sensors (SOFS) for real-field applications. Research is equally focused of theoretical modelling and experimental validation. Dominant multi-disciplinary applications of fundamental and advance research, being carried out by our research group, span Civil and Mechanical Engineering applications (such as, Structural-Health-Monitoring), Environmental Engineering (air/water contamination detection and monitoring, relative humidity monitoring etc.), Homeland Security (early and remote detection of explosives), Biomedical Engineering to name a few.

We have active international collaboration with eminent Fiber Optics and Photonics research groups, such as at Ecole Polytechnique de Montreal, Canada and The Hong Kong Polytechnic University, Hong Kong. Recently, we have engaged with Indian Army for research collaboration.

**Possible Research Projects for newly joined research scholars:**

- **Development of novel Optical Fiber Sensor for air pollution/water quality monitoring infusing nanophotonics and nanoengineering.**

*Environmental contamination caused by toxic heavy metal ions is a significant global concern, owing to their detrimental impact on both the environment and human health. Similarly, monitoring of relative humidity is critical in electronics engineering, food processing engineering, structural health monitoring to name a few. In this part of the research, objective will be focused on the development of remote sensing technology for real-time monitoring of the parameters concerned, infusing some of the out-of-box and organic ideas to have the end-product as deployable green sensor.*

- **Development of novel Optical Fiber Sensor employing in-fiber passive devices (e.g., Fiber Bragg Gratings/Long Period Gratings) and speciality fibers (e.g., photonic crystal fiber, dielectric nano-wire) for Structural-Health-Monitoring.**

*Parameters that will be aimed here would be tilt angle, vibration, rotation, liquid level, strain etc., which are critical parameters to be monitored for civil engineering infrastructures such as bridges, dam, high-rise buildings, under-water tunnels, railway, fluid dynamics and for the early prediction of earthquakes/tsunami etc. In this part of the research, objective will be focused on the development of remote sensing technology, employing novel methodologies to map the parameter of interest onto one or the other inherent characteristic parameters of specialty fiber, in-fiber passive device.*

- **Development of Optical Fiber Sensor for homeland security infusing novel wave-guiding methodology, nanotechnology and plasmonics as well as Terahertz Optics.**

*Explosive detection is very critical in homeland security. Specially, development of technology that will be capable of remote detection and multi-point monitoring with ultrasensitive response characteristics is not only challenging, but also very critical for the nation. In this part of the research, objective will be focused on the development of optical fiber sensor for the detection of explosives such as RDX and TNT and to explore real-field applicability.*

**Note:** Good knowledge of electrostatics (at the level of MSc) will certainly help. Prior knowledge of research topics mentioned above is not at all a must. We are looking for students who have curiosity to explore science and technology at advance level, have a deep quest of seeking knowledge, and to apply it to find the solution of an identified critical problem in her/his own novel way.

To know more, or to interact with me, you can always reach me at [skhijwania@iitg.ac.in](mailto:skhijwania@iitg.ac.in)