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Dr. Syed Salman Ahmad Warsi is an accomplished physicist, academician, and educator with extensive expertise in condensed matter physics. He currently serves as an Associate Professor in the Department of Physics at Integral University, Lucknow, and brings more than 25 years of experience in teaching, research, and academic mentorship.

Throughout his academic career, Dr. Warsi has taught undergraduate and postgraduate students, making significant contributions to physics education through his dedicated teaching and research guidance. He has successfully supervised numerous B.Sc. and M.Sc. dissertations and projects and is actively involved in mentoring doctoral scholars pursuing Ph.D. research in Physics.

His research interests include liquid-crystal systems, nanoscale materials, and contemporary topics in condensed matter physics. Dr. Warsi has published several peer-reviewed research papers in reputed journals and continues to contribute actively to scientific research and academic development.

In addition to his research contributions, Dr. Warsi has co-authored important educational books, including:

- *ICSE Physics for Class X (2025)*
 - *ISC Practical Physics for Classes XI & XII (2021)*
- He has also served as editor of the following scholarly books:*
- *Characterization of Liquid Crystals and Photonic Crystals (2022)*
 - *Advances in Contemporary Physics: High Energy, Cosmology and Soft Matter (2025)*

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CHAPTER - 11

LIQUID CRYSTALS AS ACTIVE FUNCTIONAL MEDIA FOR ADVANCED PLASMONIC APPLICATIONS

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Liquid crystals (LCs) have emerged as highly versatile active functional media for advanced plasmonic applications owing to their unique combination of optical anisotropy, tunability, and responsiveness to external stimuli. By integrating plasmonic nanostructures with liquid crystal matrices, dynamic control over localized surface plasmon resonances and surface plasmon polaritons can be achieved through electric, magnetic, thermal, or optical fields. This synergy enables the development of reconfigurable photonic devices with enhanced light–matter interactions, improved sensing capabilities, and adaptive optical functionalities. The chapter discusses the fundamental principles governing LC–plasmonic interactions, recent advances in hybrid LC–plasmonic systems, and their applications in tunable sensors, optical switches, modulators, displays, and nanophotonic devices.

INTRODUCTION:

The integration of metallic nanoparticles (NPs) with liquid crystal (LC) materials has emerged as one of the most exciting and rapidly evolving areas of modern soft-matter research. This synergistic combination, often described as a "scientific marriage" between nanotechnology and liquid crystal science, offers unique opportunities to develop advanced functional materials with properties that are unattainable in either constituent system alone. The remarkable compatibility between these two classes of materials arises from their complementary characteristics: while metallic nanoparticles exhibit exceptional optical, electronic, catalytic, and plasmonic properties, liquid crystals provide an anisotropic, responsive, and self-organizing environment capable of controlling nanoparticle arrangement at the nanoscale.