INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Due to continuous growth in global population and rapid industrial development over the years, the energy demand for cooling and heating through air conditioning systems has been increasing dramatically, contributing to a steep rise in fossil fuel consumption and consequently, leading to global warming. To counter this global challenge, designs of eco-friendly smart windows, capable of selective filtering of solar spectral radiation, could significantly reduce the energy consumption by heating and cooling systems, not only for residential buildings but also for state-of-the-art passenger vehicles. Having said that, robust and industry-standard designs of such windows, tunable for all-weather conditions, have been a challenge to date. Further, keeping in view the need for sustainable development, curbing down carbon emissions is the need of the hour. In this regard, utilization of waste heat from various solar and non-solar sources is of paramount importance to promote green energy. Hence, to address the above problems, this thesis investigates nanophotonics and metamaterials based on tunable optical devices for smart window design and solar energy harvesting. The research focuses on providing comprehensive theoretical models and design guidelines for realizing futuristic industry-standard smart windows, broadband metamaterial absorbers, radiative coolers, and solar absorbers—based on analytical and numerical methods in the realms of classical electrodynamic theory.