INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Carl Bender and S. Boettcher in 1998, showed that Hamiltonians which are invariant under the joint operation of the parity and the time-reversal operator could yield a real eigenspectra, which marked a new milestone in the foundational aspects of quantum mechanics. Not so long after, D. N. Christodoulides and his group put forward the proposition that optics could facilitate the experimental realizations of such systems. In 2010, Rüter et. al. reported the first experimental observation of PT-symmetry in optics. And since then, numerous novel phenomena such as unidirectional invisibility, route to chaos in optomechanical cavities, rogue wave dynamics, wireless power transfer, stable dark solitons in dual-core waveguides, modulation instability in nonlinear complex PT-symmetric periodic structures, etc. have been reported. In this thesis, we report on the features that arise in a PT-symmetric optical system when it is subjected to analysis from a dynamical perspective. We analyzed the nonlinear PT-symmetric dimer using the linearization Jacobian approach and found that it exhibits sensitiveness to initial conditions. Also, we have studied two configurations of the Ikeda map and found that judiciously choosing the system parameters could enable the control of chaotic dynamics as well as the generation of extreme events in the system. Furthermore, we have studied the transmission of normally incident electromagnetic waves on a multilayered structure and we found that highly amplified in the infrared spectrum is achievable via engineered S-matrix singularities. And in the last part of the thesis, we have discussed the PT-symmetric Liénard systems and from our thorough analysis of the stationary states, we discovered the emergence of blow-up dynamics, oscillation death and quasi-periodic route to chaos in our model.