Conventionally, physics-based models are used for power system state estimation, including Weighted Least Square (WLS) or Weighted Absolute Value (WLAV). These models typically consider a single snapshot of the system without capturing temporal correlations of system states. In this thesis, a Physics-Guided Deep Learning (PGDL) method incorporating the physical power system model with the deep learning is proposed to improve the performance of power system state estimation. Specifically, inspired by Autoencoders, deep neural networks (DNNs) are utilized to learn the temporal correlations of power system states. The estimated system states are checked against the physics law by a set of power flow equations. Hence, the proposed PGDL approach is both data-driven and physics-based. The proposed method is compared with the traditional methods on the basis of accuracy and robustness in IEEE standard cases. The results indicate that PGDL framework provides more accurate and robust estimation for power system state estimation.