We present a multidimensional code for solving the Magnetohydrodynamic equations for simulating plasma using computational fluid dynamics. The code has a general formulation and can be used to simulate plasma in any mixture of gases with a wide variation in Mach number ranging from very low subsonic to hypersonic speeds. We solve a full set of Navier-Stokes equations simultaneously for all species in the plasma, along with the non-equilibrium chemistry of all the reacting gases coupled with Maxwell’s equation for electrostatic potential. Electromagnetic effects due to local charge separation are included in the solver by solving the Maxwell’s equation at every time step of the flow solution. The equations have been coded in SU2, which is an open source, unstructured solver for PDE analysis and PDE constraint optimization. Applications of the plasma solver include accurate modeling of plasma at low Mach numbers for active flow control using plasma actuators, modeling of plasma occurring in the vicinity of a shock wave around space vehicles moving at hypersonic speeds and active control of heat transfer to space vehicles using applied magnetic field. We present results showing the evolution of ionization and thermal equilibrium with time in the vicinity of a hypersonic shock wave in Argon gas.