Translational, rotational, vibrational and electron temperatures of a gliding arc discharge in atmospheric pressure air were experimentally investigated using in situ, non-intrusive optical diagnostic techniques. The gliding arc discharge was driven by a 35 kHz alternating current (AC) power source and operated in a glow-type regime. The two-dimensional distribution of the translational temperature ($T_t$) of the gliding arc discharge was determined using planar laser-induced Rayleigh scattering. The rotational and vibrational temperatures were obtained by simulating the experimental spectra. The OH A-X (0, 0) band was used to simulate the rotational temperature ($T_r$) of the gliding arc discharge whereas the NO A-X (1, 0) and (0, 1) bands were used to determine its vibrational temperature ($T_v$). The instantaneous reduced electric field strength $E/N$ was obtained by simultaneously measuring the instantaneous length of the plasma column, the discharge voltage and the translational temperature, from which the electron temperature ($T_e$) of the gliding arc discharge was estimated. The uncertainties of the translational, rotational, vibrational and electron temperatures were analyzed. The relations of these four different temperatures ($T_e > T_v > T_r > T_t$) suggest a high-degree non-equilibrium state of the gliding arc discharge.