We present a SED model of dusty galaxies, in which the equation of radiative transfer is solved by assuming spherical symmetry. The temperature fluctuation of very small dust particles is calculated consistently with the radiative transfer. The adopted dust model consists of graphite and silicate grains and PAHs, whose relative fractions are determined for each MW, LMC and SMC type extinction curve. This model allows us to derive the intrinsic SEDs of stellar populations embedded in dusty ISM, which are very important indicators for the age of stellar populations. Therefore, the evolutionary phase of starburst galaxies which have frequently very dusty ISM can be investigated with this SED model. We show that the SEDs of Arp220 and M82 can both be explained by the same single stellar population, despite the significant differences in the SEDs and the infrared luminosities. The apparent difference between their SEDs is mainly caused by the difference in the optical depth. In contrast, the SED of prototypical star-forming ERO, HR10, indicates that this galaxy is relatively old comparing to Arp220 and M82. It is found that, in the case of optically thin limit like elliptical galaxies, the optical depth cannot be inferred only from the SED, due to a degeneracy between the optical depth, galactic size, and the spatial distribution of dust; the latter two are important for estimating the average temperature of dust grains in elliptical galaxies. When the observed size of elliptical galaxies is adopted for the model geometry, SEDs can be used to constrain the spatial distribution of dust in elliptical galaxies.