We show the scattering of electromagnetic radiation on a rotating cylinder and a rotating sphere using formalism of the vector spherical harmonics in this thesis. If a specific condition is satisfied then we can observe the rotational superradiance, phenomena originally discovered by Y. B. Zel'dovich in 1970s saying that the radiation can gain power by scattering on a rotating body. In this particular case there is an underlying principle of the rotational superradiance, the energy dissipation in the form of Joule heating created due to the induction of surface currents on the conductor. Superradiance can occur in the radiation scattering on the rotating black hole background, although there is no dissipation present. We summarize the results of scattering on the Kerr black hole from the literature, including an application called Black hole bomb, when the black hole is enclosed into a perfectly reflecting mirror. We show that for the lowest modes of the radiation at specific intervals the general relativity results can be approximated by scattering on the flat spacetime.