This invention relates to a method and equipment for the measurements of high cumulative doses collected under ionizing irradiations by gamma rays, leptons and hadrons. Five modifications of radiation sensors, based on a simultaneous recording of the optical and electrical signals, generated by electric current, determined by a drift of the secondary as well as the 3-rd generation electron-hole pairs, and luminescence, due to radiative recombination of the excess carrier pairs, within sensor active layers have been proposed. The proposed sensors are made as the structures of homogenous as well as the layered semi-insulating wide band-gap semiconductor materials containing both the electrical (ohmic/blocking, Schottky and junction type) and fiber-optical probes. The methods for synchronous measurement of optical and electrical signals, the measurement regimes and procedures for processing of signals as well as the measurement data are proposed in order to measure the radiation flux, to estimate the collected fluence (dose) and to track the paths of particle/radiation beams during and after irradiations. The methods and regimes of scanning of the radiation distribution within particle beams, of the stopping ranges and of particle paths for the estimation of the spectral parameters of incident radiations are proposed, which can be implemented by using the invented detectors.