كلية العلوم



A Thesis Entitled

# Neutron and Gamma Spectra Leaking Through Shielding Materials

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بسم الله الرحمن الرحيم

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# ABSTRACT

The aim of the work is to investigate the attenuation properties of steel, graphite, ilmenite concrete, ordinary concrete and hematite-serpentine concrete to fast neutrons and gamma-rays.

These materials are widly used for constructing shields for nuclear reactors and other radiation sources.

## SUMMARY

In this work , experimental studies were performed to assess the attenuation properties of some materials widely used in reactor technology for neutrons and gamma-rays. The investigated materials includes steel , graphite , ilmenite concrete , ordinary concrete and hematite-serpentine concrete. Studies were carried out for homogeneous shields of spherical geometry made of steel and graphite with Pu-α-Be neutron source placed at their geometrical central point. Also , a collimated beam of reactor neutrons and gamma-rays was used to study the leakage fast neutron and gamma-spectra behind cylindrical barriers having different thicknesses of graphite and different types of concrete. Further , the effect of exposing samples of ordinary and hematite-serpentine concretes to different temperatures on the attenuation of neutrons and gamma-rays was studied using the emitted reactor beam.

Measurements of the leakage fast neutron and gamma spectra have been carried-out with a neutron - gamma - spectrometer with a stilbene scintillator coupled to 12 stage photomultiplier tube type EMI. Discrimination between undesired pulses of recoil electrons and recoil protons was achieved with a zero cross over method based on pulse shape discrimination technique. The spectrometer linearity , energy scaling and discrimination capability were checked with neutron and gamma-rays emitted from standard sources of Pu-α-Be , $^{22}$Na , $^{137}$Cs and $^{60}$Co. The spectrometer energy scaling and stability were checked before and after each measurement by measuring pulse amplitude disritbution emitted from standard $^{22}$Na source. The obtained energy scaling was used for converting the measured pulse amplitude

distribution to neutron or gmma-energy distributions by the unfolding codes given and discussed in this work.

The measured spectra of fast neutrons and gamma-rays were normalized to the same measuring time and presented in the form of displaysed spectra which show the relation between fluxes of neutrons or gamma-rays versus energies of neutrons or gamma-rays.

The given spectra of fast neutrons and gamma-rays were used to plot groups of attenuation relations which show the fluxes of neutrons or gamma-rays versus shield thickness in cm. The attenuation relations were used to derive the neutron total macroscopic cross-sections and total gamma-rays linear attenuation coefficients for different energies of neutrons and gamma-rays.

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