The basic physical principles of MRI will be used to understand how spatial information is encoded in the MR signal in three orthogonal directions. The concept of gradient magnetic fields will be introduced and used in conjunction with RF transmitter bandwidth to describe selective excitation of a single slice (slice select direction). The use of gradient magnetic fields will then be extended to the two in-plane orthogonal directions in order to encode spatial information in the phase and frequency of the MR signal, enabling the calculation of pixel intensity through the use of the Fourier transform. The relationship between k-space and image space will be presented. The interrelationships between the static magnetic field, gradient magnetic fields and RF magnetic fields in the image formation process will be presented.

Educational objectives:

This course is designed to demonstrate to the clinical medical physicist how the basic physical principles of MRI are applied through the use of a static magnetic field, gradient magnetic fields and RF magnetic fields to produce a tomographic image.

Upon completion of this course, participants will be prepared to:

1. Describe a gradient magnetic field.
2. Define RF transmitter bandwidth.
3. Describe how gradient magnetic fields and RF transmitter bandwidth are involved in selective excitation of a single slice.
4. Explain how gradient magnetic fields are involved in the phase and frequency encoding of data in k-space.
5. Understand the use of the Fourier transform in the reconstruction of a tomographic image.