Mathematics of Medical Imaging

- **Course Number**: MATH 567, 3 Credits
- **Basic Textbook**: *Introduction to the Mathematics of Medical Imagining, Second Edition*, by Charles Epstein, SIAM Publications ISBN 978-0-89871-642-9

  (first edition published by Pearson Hall (2003) ISBN 0-13-067548-2 is still good)

Tentative Syllabus

1. A simple model problem for image reconstruction: the space of line and planes, reconstructing an object from its shadows, approximate reconstructions, uniqueness questions.
2. Infinite-dimensional linear algebra: a quick review of vector spaces and simple generalizations.
3. A basic model for tomography: Beer's law and X-ray tomography, some physical considerations.
4. The Radon Transform: definition, back-projection formula, continuity and the range of the Radon Transform, the Radon Transform on radial functions.
5. Inversion of Radon Transform: the central slice theorem, the Radon inversion formula, back projection, approximate inverses for the Radon Transform.
6. Applications of the Radon Transform: example of reconstruction of an object in X-ray tomography with simulated and experimental data (in MEC Lab).
7. Quick discussion on the Fourier Transform: localization principle, the Paley-Wiener Theorem, inversion formula, the finite Fourier Transform.
8. Sampling and Nyquist's Theorem : band limited functions, Shannon sampling, summation formula, undersampling.
9. Filtering Theory: basic definitions and examples of filters, the transfer function, resolution and some applications of filtering theory in image processing.
10. Simple models in impedance tomography: reconstructions examples in impedance tomography with simulated and experimental data (in MEC Lab)

This course is accessible to undergraduate students with knowledge in **Calculus** (Math241 and Math242 and Math243), **Linear Algebra** (Math349 or Math351 or Math 341) and **Ordinary Differential Equations** (Math302 or Math351/Math352 or Math341/Math342).