**Georgia Institute of Technology**

The George W. Woodruff School of Mechanical Engineering

Nuclear & Radiological Engineering/Medical Physics Program

Ph.D. Qualifier Exam

Spring Semester 2016

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Your ID Code

**MP Imaging (Day 3)**

 Instructions

1. Use a separate page for each answer sheet (no front to back answers).
2. The question number should be shown on each answer sheet.
3. ANSWER 4 OF 6 QUESTIONS ONLY.
4. Staple your question sheet to your answer sheets and turn in.

**NRE/MP Imaging**

**Answer 4 of the following question.**

Q1. Filtered backprojection is used to reconstruct a 2D CT image from 1D parallel projections. Assume data acquisition is sufficient and the reconstruction is exact if a ramp filter, $h$, is used. If a different filter, $h\*g$ ($\* $stands for the convolution operation), is used on each projection with other operations unchanged in the filtered backprojection reconstruction, describe the resultant reconstructed image in terms of the true original image $f$, the filter $h$ and $g$.

Q2. What is the lateral spatial resolution of ultrasound imaging system, in terms of the ultrasound wave length $λ$, the transducer size $D$ and the object depth $z$? If the ultrasound imaging system is operated at 3 MHz, and the object to be imaged has a maximum depth of 4 cm, what is the optimal size for the transducer?

Q3. Describe the characteristics of scatter artifacts on a SPECT image. List **two** scatter correction methods on SPECT. For each correction method, describe its working principle.

Q4. Spin echo pulse sequence is used for MRI imaging on an excited 2D slice. On the same plot, draw the time sequences for the RF pulse, Gz, Gx, Gy and the data acquisition window. Explain how each part is designed.

Q5. The world-wide demand of 99mTc for SPECT per year was estimated to be 12,000 Ci. Write down the governing equation(s) describing how this large amount of 99mTc is produced, and explain the physical meaning of each term of the equation(s).

Q6. (a) What is the ramp-filtered backprojection method used in X-ray CT?

 (b) Explain how the above method can improve the spatial resolution of a CT image.