The Systems, Measurement, and Control (SMAC) area examination is designed to evaluate basic knowledge of the PhD student applicants on the subject of system dynamics, measurement, and control. It is intended to provide the student with an opportunity to demonstrate his/her competence in the understanding of fundamentals of systems and control theory. The emphasis is placed upon questions that indicate basic understanding rather than complicated manipulation and solution techniques. Students are judged more on their method of approach than upon the details of the proposed solution. It is our intention to identify areas of deficiencies that the candidate needs to improve upon to develop basic understanding of systems and control.

The SMAC area examination is composed of questions and design problems related to the following topics:

- Modeling, dynamics analysis, and system response both in time and frequency domains
- Measurement systems, uncertainty, and noise
- Signal processing and Fourier series
- Filters and loading
- Root Locus based control design and system analysis
- Nyquist stability analysis
- Bode diagram and frequency-based design techniques
- Classical feedback controllers, e.g., PID control
- Design of lead-lag compensators
- Analysis of sensitivity and robustness in frequency domain
- Discrete systems and digital control
- State space system formulation and analysis
- Stability, controllability, and observability
- State and output feedback controller designs

Considering the scope of the SMAC area exam, the following points are recommended to prepare for the exam:

a. Review the materials covered in the undergraduate system dynamics, measurement and control courses, especially the video lectures in ME 36500/37500. It is especially recommended to audit ME 47500, solve all homework assignments and exams for this course.

b. Depending on the time and offering of the courses, the following graduate courses may be beneficial:
   - ME 57500, Theory and Design of Control Systems
   - ME 57800, Digital Control

c. Review the trial examination on file (ask Graduate Office for details) to gain some understanding about the type of test questions.

d. Select several control textbooks; we recommend textbooks for ME 47500, ME 57500, ME 57800. Review and test your grasp of the concepts. For further questions, please consult with the SMAC faculty members in charge of the control area exam for the semester you plan to take the exam.

Exam procedure:

- Time limit: 3 hours
- Choose 5 problems to work out of 8-10 problems
- Closed-book
- Calculator is allowed
- One 8½” by 11” crib sheet is allowed

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