# Potential Questions for Final Exam in 330: 512

Final: Friday May 8th, 7:00–10:00, SEC 220
Last update: April 28, 1998

1. Present the least square parameter estimation technique. Derive the normal equation.
2. Present the recursive least square estimation technique.
3. Present Kaczmarz's projection algorithm for recursive estimation.
4. Define precisely consistency condition and exciting signals in parameter estimation schemes.
5. Explain the pole placement problem with self tuning regulators.
6. Discuss implementation of indirect self tuning regulators for pole placement.
7. Discuss implementation of direct self tuning regulators for pole placement.
8. Present minimum variance (moving average) self tuning controllers.
9. Derive the moving average self tuning controller of order $d_0 < d \leq n$, where $d_0 = degA - degB$.
10. Present the extended least squares method.
11. Outline a method for solving the Diophantine equation.
12. Present indirect and direct implementation of stochastic self tuning regulators.
13. Discuss the gradient method ("MIT rule") for the model reference adaptive scheme and draw the corresponding block diagram.
14. Demonstrate the gradient method for the model reference adaptive scheme on an example of a linear system with known transfer function and unknown static gain (parameter) as presented in Example 5.1.
15. Demonstrate the model reference adaptive scheme on a first-order system $\dot{y}(t) = ay(t) + bu(t)$ with unknown parameters $a$ and $b$, Example 5.2.
16. Draw block diagrams for self-tuning regulators and model reference adaptive systems and discuss the relationship between these two adaptive schemes by following presentation of Section 5.9.
17. Present the design of MRAS using Lyapunov stability theory and demonstrate it on a first-order example, Example 5.7.
18. Present the feedforward adaptation technique using Example 5.1 (pages 212–215 from the text book, see also class notes).
19. Use Example 5.16 in order to demonstrate an adaptive feedback linearization technique for nonlinear systems.
20. Demonstrate the backstepping technique using Example 5.17.
21. Explain the ideas of Ziegler and Nichols how to tune parameters for P, PD, and PID controllers. Discuss both the open-loop and closed-loop methods. You do *not* need to give the corresponding tuning tables.
22. Discuss similarities and differences between adaptive control and adaptive signal processing.
23. Explain the gain scheduling adaptive control technique.