Code No: 07A7EC41 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,May 2011
ADAPTIVE CONTROL SYSTEMS
Instrumentation And Control Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the following:
   (a) Lyapunov stability
   (b) Positive definite and semi definite functions
   (c) Finding Lyapunov functions
   (d) Uniform Lyapunov stability. [4+4+4+4]

2. (a) Explain the properties of minimum variance and moving average self tuners.
   (b) Explain about linear quadratic STR. [8+8]

3. With suitable diagrams, write about different components of adaptive control system. [16]

4. Explain controller with adaptive feed forward and gain scheduling. [16]

5. (a) Explain about a linear system with relay control.
   (b) Discuss about relay oscillations. [8+8]

6. Describe in detail the design of MRAS using Lyapunov theory with an example. [16]

7. (a) Explain briefly the recursive least squares estimation.
   (b) Differentiate between recursive least square estimation and extended least square estimation. [8+8]

8. A process has the transfer function G(s) = $\frac{b}{s(s+1)}$ where b is a time varying parameter. The system is controlled by proportional controller u(t) = K(u_c(t) - y(t)). It is desirable to choose the feed back gain so that the closed loop system has the transfer function G(s) = $\frac{4}{s^2+s+16}$. Construct a continuous time indirect self tuning algorithm for the system. [16]

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Code No: 07A7EC41 | R07 | Set No. 4

IV B.Tech I Semester Examinations,May 2011
ADAPTIVE CONTROL SYSTEMS
Instrumentation And Control Engineering

Time: 3 hours | Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain about unification of direct self tuning regulators.
   (b) Explain about self tuning feed forward control. [8+8]
2. (a) Explain about indirect self tuners.
   (b) Explain STR with the help of a block diagram. [8+8]
3. (a) Explain the concept of BIBO stability.
   (b) State and prove the small gain theorem. [4+12]
4. Consider a process with the transfer function $G(s)=\frac{k}{s}e^{-sL}$. Determine a proportional regulator obtained with the Zeigler-Nichols method. [16]
5. Explain in detail any two applications of gain scheduling. [16]
6. (a) Explain the different configurations of adaptive control schemes.
   (b) Explain in detail about dual control. [8+8]
7. Consider an MRAS for adjustment of feed forward gain based on MIT rule. Let the command signal be $u_c = a_1\sin\omega_1 t + a_2 \sin\omega_1 t$ and assume that the process has the transfer function $G(s) = \frac{1}{(s+1)^3}$. Derive conditions for the closed loop system to be stable. [16]
8. Consider the discrete time system
   $y(t+1) + ay(t) = bu(t) + e(t+1)$
   where the input signal u and the noise e are sequences of independent random variables with zero mean values and standard deviation σ and 1 . Determine the covariance of the estimate obtained for large observation sets. [16]

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Code No: 07A7EC41 **R07** **Set No. 1**

IV B.Tech I Semester Examinations,May 2011
ADAPTIVE CONTROL SYSTEMS
Instrumentation And Control Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the transient response methods?
   (b) What are the several ways of auto tuning? [8+8]
2. (a) With a neat block diagram, explain robust high gain control.
   (b) State and explain MIT rule. [8+8]
3. (a) Describe gain scheduling
   (b) Explain the working principle of gain scheduling. [8+8]
4. (a) Explain Lyapunov stability. Also explain positive definite and semi definite functions
   (b) Explain the methods for constructing Lyapunov functions. [8+8]
5. Consider an integrator with a time delay τ. For the sampling period $h > \tau$, the system is given by the following equations :
   $A(q) = q(q-1)$
   $B(q) = (h-\tau)q + \tau = (h-\tau)(q+b)$
   where $b = \tau / (h-\tau)$ and $d_0 = 1$
   The noise is assumed to be characterized by $C(q) = q(q+c)$; $|c| < 1$. Compute the optimal minimum variance controller and the least attainable output variance when
   (a) $\tau = 0.4$ (the minimum phase)
   (b) $\tau = 0.6$ (the non-minimum phase) [8+8]
6. (a) Draw the block diagram of an MRAS for adjustment of a feed forward gain based on MIT rule.
   (b) Explain the properties of adaptive systems involved in it. [8+8]
7. (a) Explain about stochastic approximation algorithm.
   (b) Define random, periodic, pulse and step signals in stochastic process. [8+8]
8. Consider a process
   $G(s) = \frac{1}{s(s+a)}$
   where a is an unknown parameter. Assume that the desired closed loop system is $G_m(s)=\frac{\omega^2}{s^2+2\delta\omega s+\omega^2}$. Construct Continuous and Discrete time STR algorithms for the system. [16]

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Code No: 07A7EC41 **R07** **Set No. 3**

IV B.Tech I Semester Examinations,May 2011
ADAPTIVE CONTROL SYSTEMS
Instrumentation And Control Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the block diagram of gain scheduling.
   (b) Explain the design considerations of gain scheduling controllers. [8+8]
2. Explain the following:
   (a) Discounting factor
   (b) Projection algorithm
   (c) Parseval's theorem. [5+6+5]
3. (a) Compare explicit and implicit self tuning regulators.
   (b) Explain direct self tuning algorithm for non-minimum phase systems. [7+9]
4. (a) Explain Lyapunov theory for time varying systems.
   (b) Explain uniform Lyapunov stability and class k functions. [8+8]
5. (a) Describe the principle of minimum variance control which is used to minimize the cost function J(u,t) = E$\{y^2(t) + \rho u^2(t)\}$ where y(t) is the output of the system, u(t) is the control signal and E {} is the expectation.
   (b) Explain about indirect LQG-STR based on Ricatti equation. [8+8]
6. (a) Explain the draw backs of adaptive control.
   (b) Write about certainity equivalence principle.
   (c) Write about different steps to construct an adaptive controller. [6+5+5]
7. Explain the following:
   (a) Design parameters of MRAS
   (b) MIT rule. [8+8]
8. Consider a process with the transfer function $G(s)=\prod_{k=1}^{n} \frac{1}{(1+sT_k)} e^{-sL}$. Show that the equation $T+L=\frac{A_0}{K}$;gives $T+L = \sum_{k=1}^{n} T_k + L$ [16]

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