ELL 703 OPTIMAL CONTROL

24/3/17 MINOR TEST II Marks: 20, Time: 1 hr.

Q1 :- Consider LTI plant $\dot{x}(t) = Ax(t) + Bu(t)$, $x(t=t_0) = x(0)$. Design LQ Regulator system with Real{closed loop eigenvalues} $< -\alpha$ where $\alpha > 0$ and infinite time interval. Assume that $[A+\alpha I, B]$ Completely stabilizable. Define appropriate cost functional J and derive expression for closed loop optimal control. Use infinite time interval. (6)

Q.2 :- A second order plant

$\dot{x}_1(t) = x_2(t)$, $\dot{x}_2(t) = -2x_1(t) - 3x_2(t) + u(t)$

and $Y(t) = X(t)$, is to be controlled to minimize a PI and to keep state $x_1(t)$ close to ramp function $2t$. ~~Final~~ Final Time t_f is specified, the ~~final~~ final state $X(t_f)$ is ~~free~~ and admissible control and states are unbounded. Formulate PI, obtain optimal feedback control law. Find expressions for closed loop control. (8) trajectories of optimal states and control.

Q.3 :- (a) Prove/Disprove that "for time invariant systems and cost functions, the Hamiltonian is a CONSTANT on optimal trajectory" (*)

(b) Prove/Disprove that "Gain margin of optimal feedback control system is bounded from above." Here, consider single input and LQR for LTI system with infinite interval. (6)

(*) Use PI $\dot{x}(t) = f(x,u,t)$, $t \geq t_0$, t_0 fixed with $J(t_0) = \phi(x(T),T) + \int_{t_0}^{t} L(x,u,t)\,dt$

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