Potential Questions for Exam I — 332:510 — Spring 2000

Friday, March 24, 2000, 5:10–8:00 ELE 202 LAB

1. Derive the Euler equation for the simplest variational problem in which $t_0, t_f, x(t_0), x(t_f)$ are fixed. Note that the functional is chosen as $J = \int_{t_0}^{t_f} g(x(t), \dot{x}(t), t) dt$. (Kirk, Section 4.2, Class notes (4), p. 3–4).
2. Derive the Euler equation for the simplest variational problem in which $t_0, t_f, x(t_0)$ are fixed and $x(t_f)$ is free. Determine the boundary condition. (Kirk, Section 4.2, Class notes (4), p. 5).
3. Derive the Euler equation for the simplest variational problem in which $t_0, x(t_0), x(t_f)$ are fixed and t_f is free. Determine the boundary condition. (Kirk, Section 4.2, Class notes (4) p. 6–8).
4. Derive the Euler equation for the simplest variational problem in which $t_0, x(t_0)$ are fixed and $t_f, x(t_f)$ are free. Determine the boundary conditions. (Kirk, Section 4.2, Class notes (4) p. 8–10).
5. Present the solution to the simplest variational problem with $t_0, t_f, x(t_0), x(t_f)$ are fixed, in which piecewise continuous first derivatives of $x(t)$ are allowed (feasible), and state the Weirstrass-Erdermann corner conditions (Kirk, Section 4.4, Class notes (5), p. 1–3a).
6. Present the solution (derive the necessary condition) to a constrained minimization of a integral functional subject to equality constraints (Kirk, Section 4.5, Class notes (5), p. 4–5).
7. Present the solution (derive the necessary condition) to a constrained minimization of a integral functional subject to differential equation constraints (Sage, Section 4.5, Class notes (5), p. 6–6a).
8. Present the solution (derive the necessary condition) to a constrained minimization of a integral functional subject to integral constraints (Kirk, Section 4.5, Class notes (5), p. 7–8).
9. Derive the necessary conditions to the general optimal control problem and state them in terms of the Hamiltonian (Sage, Section 5.1, Class notes (5), p. 1–4, Bryson, p. 63–65).
10. Formulate the general optimal control problem in discrete-time domain and present the necessary conditions in terms of the discrete-time Hamiltonian (Bryson, p. 45–47, Class notes (2), p. 1–3).
11. Derive two-point boundary value problem equations for a linear discrete-time system and a quadratic performance criterion. (Bryson, p. 50–52, Class notes (2), p. 4).
12. Derive two-point boundary value problem equations for a linear discrete-time system and a quadratic performance criterion. (Bryson, p. 50–52, Class notes (2), p. 7).
13. Show that the continuous-time Hamiltonian is constant on the optimal trajectory (Bryson, p. 65, Class notes (5), last page)
14. Present Mayer's formulation of the optimal control problem in both discrete- and continuous time domains (Class notes (3), p. 1, 3).
15. Derive the necessary conditions for discrete-time optimization with terminal constraints (Bryson, p. 93–94, Class notes (3), p. 2–3).
16. Derive the necessary conditions for continuous-time optimization with terminal constraints (Bryson, p. 107, Class notes (3), p. 4).
17. Derive the necessary conditions for the discrete-time optimization problem with free final time (Bryson, p. 149–151, Class notes (3), p. 7).
18. Derive the necessary conditions for the continuous-time optimization problem with free final time (Bryson, p. 158–160, Class notes (3), p. 8).
19. Solve the linear-quadratic (LQ) continuous-time optimal control problem with soft constraints using the transition matrix approach (Bryson, p. 202, 206; Class notes (6), p. 1–3).
20. Solve the linear-quadratic (LQ) continuous-time optimal control problem with soft constraints using the Riccati equation approach (Bryson, p. 202, 206–208; Class notes (6), p. 1, 4–5).
21. Present the solution to the minimum integral square control in the case when the terminal condition matrix is nonsingular (Bryson, p. 211; Class notes (6), p. 5).
22. Derive the solution to the optimal tracking LQ tracking problem (Bryson, p. 213; Class notes (6), p. 6–8).
23. Derive the solution to the optimal LQ disturbance rejection problem (Bryson, p. 213; Class notes (7), p. 1–2).
24. Solve the linear-quadratic (LQ) discrete-time optimal control problem with soft constraints using the transition matrix approach (Bryson, p. 238–240; Class notes (7), p. 3–5).
25. Solve the linear-quadratic (LQ) discrete-time optimal control problem with soft constraints using the Riccati equation approach (Bryson, p. 238, 241–242; Class notes (7), p. 3, 6–6a).