All assignments can be uploaded on the dropbox location:

https://catalyst.uw.edu/collectit/dropbox/mesbahi/30395
by thursday midnight of the week for which it is due

1/7: Mehran out of town; will post make up lecture later into the quarter

1/9: class mechanics; introduction to optimal control, dynamic programming (DP); slides

HW#1 (Due 1/16): 1.1-1, 1.1-2, 1.1-3, 6.1-1, 6.2-2 (read example 6.2-1 on page 264)

1/14: recap of DP, example of DP in action for linear dynamics and quadratic costs; slides

(Soren Kierkegaard and DP: “Life can only be understood backwards; but it must be lived forwards.”)

1/16: Hamilton-Jacobi-Bellman equation, LQR, Riccati equation, examples; slides

HW#2 (Due 1/23): (5 problems) 6.2-1, 6.3-2, 3.3-1(a), (M1) consider the LQ problem with an objective integral_0^T (x^2+a u^2) dt for the dynamics xdot=u with initial condition x(0)=1. 
Explore the variation in optimal control/cost for values of a ranging between 0.1 to 10 when T=1. For a=1, explore how the optimal/control cost varies with T as it varies from 0.1 to 10, (M2) Consider the problem integral_0^T u^2 dt + a x(T)^2 for the dynamics xdot=u. Explore who the optimal control/cost varies as the parameter a is varied from 0 to infinity.

1/21: symmetric matrices, DRE example, solution of DRE, calculus of variations approach to optimal control; slides

1/23: aircraft control example, LQR, why is the LQR controller stabilizing; slides

HW#3 (Due 1/30): (M1) consider the aircraft example in the 1/23 lecture; for 3 choices of Q and fixing R=I, plot and comment on the behavior of the closed loop trajectories with the state feedback gain obtained from the LQR command, 3.3-3, 3.4-1, 3.4-2, 3.4-3, 3.4-7

1/28: calculus of variations, co-states, LQR, connections with HJB theory; slides

1/30: zero-input cost, optimal energy control with fixed terminal state, tracking and regulation; slides

HW#4: 3.3-4, 3.3-5, 3.4-4, (M1) For the point mass control in 2D plane discussed in the lecture, design an LQR controller that tracks the position signal with "sin(t)" along the y axis and "t" along the x-axis; so we want the point mass to oscillate as a sine signal around the x-axis and move linearly along the (positive) x-axis.

2/4: midterm 1: 8.5"x11" sheet of notes (one sided) is allowed; otherwise closed book/notes

2/6: output feedback and tracking; slides

(For numerics I recommend yalmip and cvx)
HW#5: 8.1-1, 8.1-2, 8.1-4, 8.1-5, 8.5-2, 8.5-3

2/11: midterm review, more on tracking problem; observer-based LQR separation principle; slides

2/13: introduction to robustness, classical control, sensitivity function; slides

HW#6 (due 2/27): (M1) for the single integrator plant discussed in the lecture, with a feedback gain obtained from LQR with R=1 and arbitrary psd Q, draw the nyquist plot of the loop gain and comment on stability margins of the design, 9.2-2, 9.2-3, 9.2-4, 9.2-5, 9.2-6, 9.4-1, 9.4-2, 9.4-3

2/18: singular values, infinity norm, Kalman identity, LQR robustness; slides

2/20: Kalman filtering; slides

2/25: example 8.2-1 demistyfied, example of Kalman filter, separation principle; slides

2/27: robustness issues, LQR/LTR, introduction to H2 optimal control; slides

HW#7 (due 3/11): 9.5-1, 9.5-2, replicate the results of example 9.5-1

Last day to get approval from the instructor on the project topic/paper

3/4: midterm 2: 8.5"x11" sheet of notes (two sided) is allowed; otherwise closed book/notes

Makeup lecture: Respect the unstable (G. Stein); lecture

Additional lecture: Accomplishments and prospects in Control (Astrom); lecture

3/6: H2 and H_infinity design

Makeup lecture: practical considerations

3/11: review and projects

3/13: Mehran out of town

Homework Solutions:

Homework#2
Homework#3
Homework#4
Homework#5