AE 308 – Control Theory Spring 2017 Course Plan

Topics:

- **Introduction**: Control situations & objectives, broad control tasks, open-loop & closed-loop control concept, various types of control structures, unity negative feedback control systems, basic control actions.
- **Two-position Control Systems:** On-off control concept and action of an ideal relay, 1st and 2nd order system on-off control, effect of hysteresis on the closed-loop control performance, relay modelling.
- **System response:** Response of higher order systems to standard and generic inputs in Laplace and time domains, concept of partial fractions.
- **System Stability:** Concept of stability and connection with its response, asymptotic / bounded-input bounded-output stability, role of characteristic roots in stability, Routh's criterion for absolute and relative stability analysis, including unknown parameter based stability.
- **Proportional Control Systems:** Proportional control action modelling, stability and response of proportional control systems, concept of root locus and its application to proportional control system analysis.
- **Frequency Response:** Concept of frequency domain & response, representation using bode, Nyquist, Nichol's plots, closed-loop system analysis using frequency response attributes, Nyquist stability analysis.
- **Closed-loop Response Attributes:** Transient/steady-state response, tracking control task and closed-loop error constants, integral control option for tracking, transient response and role of derivative action.
- **Closed-loop Control Elements:** PI controllers and lag compensators for tracking tasks, PD controllers / lead compensators for transient response control tasks, PID controllers / lag-lead compensators for complex tasks.
- **Design of Closed-loop Control Systems:** Closed-loop specifications, gain / phase margins concept, use of root locus, bode plots, Nyquist plots and Nichol's plots in closed-loop control design, design rules, methodologies and guidelines for different types of control tasks.

Textbooks:

1. **Ogata**, K., 'Modern Control Engineering', 5th Ed., Prentice Hall India, Eastern Economy Edition, 2010.
2. **Nise,** N.S., 'Control Systems Engineering', 7th Ed., John Wiley & Sons, 2015.
3. **Golnaraghi**, F. and Kuo, B. C, 'Automatic Control Systems', 9th Ed., John Wiley & Sons, 2010.
4. **Franklin**, G.F., David Powell, J. & Emami-Naeini, A., 'Feedback Control of Dynamic Systems', 6th Ed., Pearson, 2010.

Evaluation:

- 3 Quizzes – 5 each – Total 15
- 2 Homework assignments – 10 each – Total 20
- Mid-semester exam – 25
- End-semester exam – 35
- Attendance – 5

Quizzes:

- Each quiz will be of 1/2 hour
- Quizzes will be conducted in the last third of normal classes
- 2 quizzes before mid-sem, 1 after

Homework assignments:

- Homework will require coding (Scilab/Matlab)
- Start learning now! – no help will be given in class
- Homework will be on an individual basis – **plagiarism alert**
- Late submission (after appointed class) will attract **0 marks** (no excuses!)

Attendance policy:

- Attendance is compulsory
- Students with attendance below 80% of the total no. of classes will be given 0 out of 5 in the 'attendance' section; else students will earn the full 5 marks available in this category
- Attendance will be taken in the first 3 minutes of class
- Students entering later than 3 minutes will be marked absent (no excuses!)

Grading policy:

- Your score will be first normalized with the highest score
- Subsequently, grades will be assigned following the break-up: AA: 100 – 90, AB: 90 – 80, BB: 80 – 70, BC: 70 – 60, CC: 60 – 50, CD: 50 – 40, DD: 40 – 35, FR: Below 35
- The above assumes that actual score of at least one student is ≥ 85
- If not, then no one will be given an AA grade
- Scores will be normalized as: score = (your actual score) $\times$ 90/85
- Letter grades then will be assigned based on the split given above