Course Number: **EE 432**

Course Title: Digital Control Systems (Elective Course)

Course Description :

Introduction to digital control and discrete transform (z-transform). Discrete and hybrid Signal Flow Graphs (SFG)s. Solution of discrete-time state space. Modified z-transform. Time-response and characteristic equations. Stability concepts in discrete-systems. Root locus, Nyquist method and Bode plot applied to discrete systems. Digital lead-lag compensators applied to digital systems. Introduction to design.

Prerequisites :

EE380 - Control Engineering I

Textbook

Digital Control System Analysis and Design. (3rd Edition) Charles L. Phillips & H. Troy Nagle

Other Useful References and Material :

- Digital Control of Dynamic Systems, G. F. Franklin, J. D. Powell, and M. Workman, Addison Wesley, 1997.
- Digital Control Systems, B. Kuo (2nd Edition), Oxford University Press, 1992.
- Discrete-time Control Systems, K. Ogata, Prentice-Hall, 1987.

Website : http://www.kfupm.edu.sa/ee/bscourses.htm
Course material will be also available in electronic format on WebCT

Course Objectives :

- Know the basics of discrete discrete-time transfer function, block diagram and state-variable descriptions, pulse response, internal and external stability
- Know the essentials of sampled-data systems including analysis of sample and hold, spectrum of sampled signal, data extrapolation, block diagram analysis
- Learn how to discretize analog filters
- Know and be able to carry out design of digital control systems using transfer function techniques
- Know and be able to carry out the design of digital control systems using state-space methods.
- Develop an understanding of design issue like sampling rate selection, quantization effects

Topics Covered :

- Introduction to digital control systems
- Discrete time systems- Transform methods-Flow graphs - State variables - Transfer functions
- Solutions of the state-equation.
- Sample/Hold unit with zero-order hold
- Sampled-data control systems - Ideal Sampler - Properties & Evaluation of E*(s)
- Data Re-construction - A/D - D/A
- E(Z) & E*(Z) - Pulse TF - Open Loop Systems with digital filter-Modified Z-Transform
- Systems with time delays-Nonsynchronous sampling-Discrete state equation
- Closed-loop systems: concepts, derivation procedure-State variable models
- Time response - Characteristics Equation -Mapping S&Z Planes, Steady state accuracy
- Stability - Bilinear transformation - Routh-Hurwitz Criterion - Jury test
- Root-Locus, Nyquist Criterion, Bode diagram, Frequency Response
- Integration and Differentiation filters, PID Controller Design

Class/Laboratory Schedule :.

3 lectures per week, 50 minutes each and 3 hours lab per week.

Course Outcomes :

- Acquire a working knowledge of discrete system science-related mathematics,
- Design a discrete system, component or process to meet desired needs,
- Identify, formulate and solve discrete control engineering problems,
- Use the techniques, tools and skills related to discrete signals, computer science and modern discrete control engineering in modern engineering practice
- Communicate system-related concepts effectively

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