Digital Control System

**Course Objectives:**   
To present the basic concepts on analysis and design of sampled data   control system and to apply these concepts to typical physical processes.

1. **Introduction to discrete time control system [8 hours]**
   1. Principle features of discrete time control system
   2. Signal sampling, quantizing and coding
   3. Data acquisition, conversion and distribution system
   4. Reconstruction of original signal from sampled signal

1. **The Z-Transform [8 hours]**
   1. Fundamentals of Z-transform
   2. Important properties and theorems of the Z-transform
   3. Z-transform from the convolution integral
   4. Inverse Z-transform
      1. Direct Division
      2. Partial Fraction
      3. Inversion Integral
   5. Z-transform method for solving difference equation

1. **Analysis of discrete time control system [10 hours]**
   1. S-plane to Z-plane mapping and Vice-versa.
   2. Stability analysis of closed loop systems in the Z-plane
   3. Discrete time equivalents of continuous time systems
   4. Discrete time equivalents of analog controllers
   5. Transient and steady state response analysis

1. **Design and compensation of discrete time control system [10 hours]**
   1. Digital filters: structure, implementation, frequency response, applications
   2. Control system controllers: structure, hardware/software features, responses to control signals, use of root locus and frequency domain concepts
   3. Phase lead and phase lag compensator design for discrete time system
   4. PID controller design and selection of parameters for discrete time system

1. **Discrete time state equations [8 hours]**
   1. State space representation of discrete time systems
   2. Discretization of the continuous time state space equation
   3. Pulse transfer function matrix
   4. Stability assessment from the discretized state space equations

**Practical:**

1. Study of relay type “ON-OFF” control system
2. To familiarize the student about the feedback control system with an ON/OFF control
3. Z - transform using MATLB
4. To learn the application of MATLAB to convert the s-domain transfer function  into z-domain
5. To study the affects in transient response and frequency response of different methods and sampling time used in z- Transfer function.
6. Stability analysis of closed –loop system in z-plane
7. To learn the application of MATLAB to test the stability of a system in z-domain
8. Simulation study using simulink of MATLAB
9. To Familiarize with MATLAB Simulation
10. To study simulation of discrete time control system
11. Position control system through analog interfacing
12. To learn the use of analog interfacing technique to control the position of motor in the DC Motor module

**References:**

1. K. Ogata, “Discrete Time Control Systems”, Prentice Hall, Englewood Cliffs, New Jersey.
2. Charles L. Phillips, “Digital Control System: Analysis and Design”, Prentice Hall, Englewood Cliffs, New Jersey.

**Evaluation Scheme:**  
The questions will cover all the chapters in syllabus. The evaluation scheme will be as indicated in the table below.

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| --- | --- | --- |
| **Chapter** | **Hours** | **Mark Distribution\*** |
| 1 | 8 | 12 |
| 2 | 8 | 16 |
| 3 | 10 | 20 |
| 4 | 10 | 20 |
| 5 | 8 | 12 |
| **Total** | **44** | **80** |

**\*Note: There may be minor deviation in marks distribution.**