

# Digital Control System [DCS]

B.E. Sem. VIII [INST]

(Elective – II)

## EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 3 Hrs. | 100   |
| Practical & Oral Exam | –      | –     |
| Oral Exam             | –      | 25    |
| Term Work             | –      | 25    |

## SYLLABUS

### 1. Introduction

Block diagram of Digital Control System, Advantages & limitations of Digital Control System, comparison of continuous data & discrete data control system, Examples of digital control system.

### 2. Signal conversion and processing

Digital signal coding, data conversion and quantization, sampling period considerations, sampling as impulse modulation, sampled spectra & aliasing, Reconstruction of analog signals, zero order hold, first order hold, frequency domain characteristics, principles of discretization- impulse invariance, finite difference approximation of derivatives, rectangular rules for integration, Bilinear transformation, Mapping between s-plane & z-plane.

### 3. Representation of digital control system

Linear difference equations, pulse transfer function, input-output model, examples of first order continuous and discrete time systems, Signal flow graph applied to digital control systems.

### 4. Stability of digital control system in z-domain and Time domain analysis

Jury's method, R.H. criteria, Comparison of time response of continuous data and digital control system, steady state analysis of digital control system, Effect of sampling period on transient response characteristics.

### 5. State space analysis

Discrete time state equations, significance of Eigen values & Eigen vectors, first and second companion form, Diagonalisation, Jordan Canonical form, similarity transformation, state transition matrix, solution of discrete time state equation, Discretization of continuous state space model & its solution. Lyapunov stability analysis, definitions, theorem, concept of equilibrium state.

### 6. Pole placement and observer designs

Concept of reachability, Controllability, Constructability & Observability, Design of controller via Pole placement method, state observer design, dead beat controller design, concept of duality.

### Reference Books :

1. Digital Control and State Variable Methods (*M. Gopal*) Tata McGraw Hill, 2nd Edition, March 2003.
2. Discrete Time Control Systems (*K. Ogata*) Pearson Education Inc., 1995.
3. Digital Control Systems (*B.C. Kuo*) Saunders College Publishing, 1992.
4. Digital Control (*Richard J. Vaccaro*) McGraw Hill Inc., 1995.
5. Modern Control System Design with MATLAB (*Ashish Tewari*) John Wiley, Feb. 2002.
6. Discrete Time Control Problems using MATLAB (*Joe H. Chow, Dean K. Frederick*) Thomson Learning, 1<sup>st</sup> Edition, 2003.
7. System Dynamics and Control (*Eronini Umez*) Thomson Learning, 1999.
8. Digital Control of Dynamic Systems (*Franklin Powell*) Pearson Education, 3rd Edition, 2003.
9. Digital Control Systems vol. I & II (*Isermann*) Narosa publications

