# C. U. SHAH UNIVERSITY
## Wadhwan City

**FACULTY OF**: - Technology & Engineering
**DEPARTMENT OF**: -Electrical Engineering
**BRANCH:** Electrical & Electronics Engineering
**SEMESTER**: VII
**CODE**: 4TE07DCS1
**NAME** – Digital Control System

---

### Teaching & Evaluation Scheme

| Subject Code | Name of the Subject | Teaching Scheme (Hours) | | | | Credits | Evaluation Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | | | Practical (Marks) | | | Total |
| | | | | | | | Sessional Exam | | University Exam | | Internal | | University | |
| | | Th | Tu | Pr | Total | | Marks | Hrs | Marks | Hrs | Pr/Viva | TW | Pr | |
| 4TE07DCS1 | Digital Control System | 4 | 0 | 2 | 6 | 5 | 30 | 1.5 | 70 | 3 | -- | 20 | 30 | **150** |

### Objectives:

- The purpose of the proposed course is to present control theory that is relevant to the analysis and design of computer-controlled systems, with an emphasis on basic concepts and ideas. The control-system design is carried out up to the stage of implementation in the form of computer programs in a high-level language. Knowledge in stability analysis of digital control systems.

- To understand the basics of Z- Transform & the stability analysis of digital control system & To equip the basic knowledge of digital process control design.

### Prerequisites

- Basic of Control Theory and Engineering Mathematics

### Course Outlines

| Sr. No. | Course Contents | Hours |
|---|---|---|
| 1 | **Mathematical Background** :<br>Fourier Series and Fourier Transform. Laplace and Z transforms. Computer based control – History and recent trends. Configuration of basic Digital Control scheme. Basic discrete time signals. Time domain models for discrete time systems. Transfer function models. Sampling, sampled spectra. | 08 |
| 2 | **Principles of Discretization**:<br>Impulse Invariance, Step Invariance, Finite Difference approximation to derivatives, Bilinear Transformation. Jyry's stability criterion on z-plane and Routh's criterion | 10 |

| | | |
|---|---|---|
| | on r-plane. | |
| 3 | **Discreet Modelling**:<br>Z domain description of sampled-data systems. Systems with Dead time – Modified Z-Transform, Implementation of Digital controllers. Recursive and non-recursive realizations. Direct, Cascade and Parallel recursive realizations. | 10 |
| 4 | **Pole Placement Design**:<br>Concept of pole placement, Ackermann's Method of Pole placement, Designing observer based systems via Pole Placement. Dead Beat Control by SVF. | 10 |
| 5 | **Linear Quadratic Regulator:**<br>Performance Index, Control configuration, State regulator via Lyapunov Equation. | 06 |
| 6 | **Design of Digital controllers:**<br>z-plane specifications of control system design – stability, steady-state accuracy, transisut accuracy, disturbance rejection, insensitivity and robustness. Digital compensator design using Frequency response plots and Root-locus plots | 12 |

**Learning Outcomes:**

Students will be able to develop mathematical models for controlling system behaviour, digital control the systems with nonlinear behaviours. Students will learn fundamentals and applications of digital control for multidisciplinary engineering problems. They will understand fundamentals of intelligent/smart control systems used for industrial automation. Students should be able to design digital controllers, assess their design through the constraint specifications, and decide whether their initial design is acceptable or can be improved.

**Books Recommended**


1. "Digital Control Systems" by B. C. Kuo, Oxford University Press, 2/e, Indian Edition, 2007.
2. "Discrete Time Control Systems" by K. Ogata, Prentice Hall, 2/e, 1995.
3. "Digital Control and State Variable Methods", by M. Gopal, Tata Mcgraw Hill, 2/e, 2003.
4. "Digital Control Systems : Theory, Hardware, Software" by 5. C. H. Houpis & G. Lamont , McGraw Hill, 1992.
5. "Modern control systems," by Richard C. Dorf, Robert H. Bishop, Pearson Education inc, New Delhi, 2008