SCHEME OF COURSE WORK

Course Details:

Course Title	**:Advance Digital Control Systems**		
Course Code	**: 13EE2107**	**L T P C**	**:4 1 0 3**
Program:	**: M.Tech.**		
Specialization:	**: Power System Control and Automation**		
Semester	**:I Sem**		
Prerequisites	**: Control Systems, Digital Control Systems**		
Courses to which it is a prerequisite	**: To all Digital Control Courses**		

Course Outcomes (COs):

1	Solve problems related to State space representation of discrete time systems and determine the stability of discrete time systems using different techniques like Jury stability, bilinear transformation and Liapunov.
2	Solve problems related to design of discrete time control system by conventional methods.
3	Apply knowledge in designing Controllers and Observers.
4	Explain the concepts of kalman filter, Regulators and adaptive control.
5	Develop adequate knowledge in the digital simulation concepts and expose to the custom designed chips.

Program Outcomes (POs):

A graduate of M.Tech (Power System Automation and Control) will be able to

1	Acquire in depth knowledge in the area of power system control and automation.
2	attain the ability to think critically and analyze complex engineering problems related to power system control and automation
3	Obtain the capability of problem solving and original thinking to arrive at feasible and optimal solutions considering societal and environmental factors
4	Extract information through literature survey and apply appropriate research methodologies, techniques and tools to solve power system problems.
5	Use the state-of-the-art tools for modelling, simulation and analysis of problems related to power systems
6	Attain the capability to contribute positively to collaborative and multidisciplinary research to achieve common goals
7	Demonstrate knowledge and understanding of power system engineering and management principles and apply the same for efficiently carrying out projects with due consideration to economical and financial factors.
8	Communicate confidently, make effective presentations and write good reports with engineering community and society
9	Recognize the need for life-long learning and have the ability to do it independently
10	Become socially responsible and follow ethical practices to contribute to the community for sustainable development of society.
11	Independently observe and examine critically the outcomes of his actions and reflect on to make corrective measures subsequently and move forward positively by learning through mistakes

Course Outcome versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO-1			S			S			M		
CO-2			M	S							
CO-3		S		S		M					M
CO-4		S		M	S						
CO-5			M	S	S	M					

S - Strongly correlated, *M - Moderately* correlated, *Blank - No correlation*

Assessment Methods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties	CO-1	Pulse Transfer Function State transition matrix	▫ Lecture ▫ Problem solving	Assignment (Week 2 - 4)
2	Methods for Computation of State Transition Matrix, Discretization of continuous time state Space equations	CO-1	Methods for Computation of State Transition Matrix	▫ Lecture ▫ Problem solving	Mid-Test 1 (Week 9)
3	Stability Analysis of closed loop systems in the Z-Plane, Jury stability test	CO-1	Jury stability test	▫ Lecture ▫ Problem solving	Quiz (Week 2 - 4)
4	Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion, Stability analysis using Liapunov theorems.	CO-1	Stability analysis using Liapunov theorems.	▫ Lecture Problem solving	
5	Design of digital control systems based on Root locus techniques	CO-2		▫ Lecture Problem solving	
6	Design of digital control based on the frequency response methods-Bilinear transformation, design procedure in the w-plane, lead, lag and Lead-lag compensators,	CO-2	lead, lag and Lead-lag compensators,	▫ Lecture Problem solving	
7	digital PID controllers, Design digital control through dead beat response methods.	CO-2		▫ Lecture Problem solving	
8	Concept of controllability and observability	CO-3			
9					
10	Design of state feedback controller through pole placement-Necessary and sufficient conditions, Ackerman's formula	CO-3	state feedback controller through pole placement-	▫ Lecture ▫ Problem solving	Mid-Test 2 (Week 18)
11	State observers-Full order,	CO-3		▫ Lecture Problem solving	Assignment (Week 11-13)
12	Reduced Order observer	CO-3	observers	▫ Lecture Problem solving	Quiz (Week 12 -1 4)
13	Min/Max principle, Linear Quadratic Regulators	CO-4		▫ Lecture Problem solving	
14	Kalman Filters, State Estimation through	CO-4		▫ Lecture	

	kalman Filters, Introduction to adaptive controls			Problem solving	
15	Introduction, Digital Simulation- Digital Modeling with Sample and Hold Devices, State Variable Formulation, Numerical Integration,	CO-5	Kalman Filters, State Estimation through kalman Filters,	▫ Lecture Problem solving	Assignment (Week 15)
16	Rectangular Integration, Frequency Domain Characteristics-Frequency Warping, Frequency Prewarping.	CO-5	Frequency Warping, Frequency Prewarping.	▫ Lecture Problem solving	
17	Introduction, Microprocessor Control of Control Systems, Single-Board Controllers with Custom-Designed Chips, The Galil DMC-105 Board, Digital Signal Processors- The Texas Instruments TMS320 DSP's, Development Systems and Support Tools.	CO-5	The Galil DMC-105 Board, Digital Signal Processors-	▫ Lecture Problem solving	
18	**Mid-Test 2**				
19/20	**END EXAM**				

Model Question Paper

UNIT-I

1 Obtain the state transition matrix of the following discrete time system

$$\begin{bmatrix} x1(k+1) \\ x2(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix} \begin{bmatrix} x1(k) \\ x2(k) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(k) \text{ and } y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x1(k) \\ x2(k) \end{bmatrix}$$

Then obtain the state x(k) and output y(k) where input u(k) = 1 for k=0,1,2,…… (12 Marks)

OR

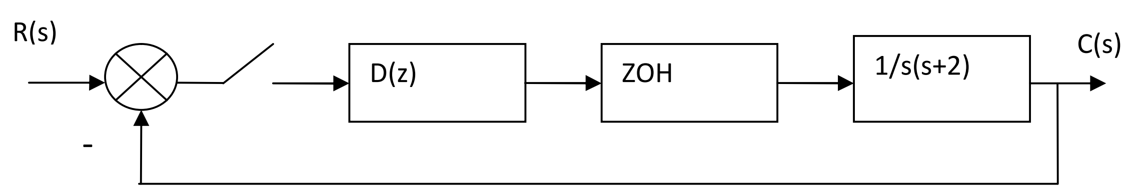
2(a) Consider the discrete-time unity feedback control system (with sampling period T=1Sec) whose open loop transfer function is given by

$G(z) = \dfrac{k(0.3679z+0.2642)}{(z-0.3679)(z-1)}$. Determine the range of gain K for stability by using Jury's stability test? (7 Marks)

(b) Consider the characteristic polynomial $\Delta(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1 = 0$ determine the stability of the system. (5 Marks)

UNIT-II

3 Consider the feedback control system the plant transfer function is G(s) = k/s(s+2)



Design a lag compensator to satisfy the following specifications.

(i) $K_v \geq 4$ (ii) Phase margin = 40^0 (iii) GM $\geq$ 10dB assume T=0.4 sec. (12 Marks)

OR

4 a) Explain the dead beat response characteristics (4 Marks)

(b) The plant transfer function of a digital control system is given by

$G(z) = \frac{z+0.5}{z^2-z-1}$ design a digital controller so that a dead beat response is obtained when the input is a unit step function? (8 Marks)

UNIT-III

5. A discrete time system is described by the state model

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} r(k)$$

Design a state feedback controller which will place the closed loop poles at z= -0.5 $\pm$ j 0.5 and z=0. Verify the result by applying Ackermann's formula. (12 Marks)

OR

6. Consider the system described by the state model x(k+1) = F x(k) and y= c x(k), where

$F=\begin{bmatrix} -1 & 1 \\ 1 & -2 \end{bmatrix}$; and $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$ design a full order observer. The desired Eigen values for the observer matrix are M1= -5 and M2= -5 (12 Marks)

UNIT-IV

7. a) Explain the state estimation through kalman filters? (6 Marks)
b) Derive the matrix reccati equation? (6 Marks)

OR

8.(a) Explain Discrete –Time Linear Quadratic State Regulator? (8 Marks)
(b) Write short notes on adaptive control? (4 Marks)

UNIT-V

9(a) Write a short note on frequency warping and prewarping? (6 Marks)

(b) Explain in detail digital simulation through ample and hold devices? (6 Marks)

OR

10 (a) Write a short note on single board controllers with custom designed chips? (6 Marks)

(b) With a neat diagram explain microprocessor control of control systems? (6 Marks)

***************************ALL THE BEST******************************