Cyber security in Power system (3-0-0)

Sub Code: MPS2E305 **CIE: 50% Marks**
Hrs/Week: 03 **SEE: 50%Marks**
SEE Hrs: 03 **Max.: 100Marks**

Course outcomes:

On successful completion of the course the students will be able to:

1. Discuss the importance of cyber security in power systems.
2. Apply the cyber security standards for electricity sector.
3. Analyze the cost of cyber security management and controls.

MODULE 1:Introduction: Transformation, Dependence on the ICT, Cybersecurity, Priority Critical Infrastructure.State of Cyber security in the Electricity Sector: Introduction, Vulnerabilities, Threats, Challenges, Initiatives**.**

09 Hours

SLE: Future Directions

MODULE 2:Cybersecurity Standards Applicable to the Electricity Sector: Introduction, Literature Search, Literature Analysis, Standards Selection and Evaluation Criteria, Results, Most Relevant Standards, Standards Implementation and Awareness.

06 Hours

SLE: Standards Limitations

MODULE 3: A Systematic Approach to Cybersecurity Management: Introduction, Cybersecurity Management Approaches in Standards, The Systematic Approach to Cybersecurity Management in the Electricity Sector.

09 Hours

SLE: Cybersecurity Assessment, Monitoring and Improvement.

MODULE 4: **Cost of Cybersecurity Management**: Introduction, Economic Studies, Organisation Management Studies, CostBenefit Analysis, Cost Calculators, Costing Metrics, CAsPeA. Cybersecurity Assessment: Introduction, Security Assessment Methods for the Electricity Sector, Cybersecurity Test beds for Power Systems, JRC Cybersecurity Assessment Method, Laboratory Infrastructure.

08 Hours

SLE: MAlSim

MODULE 5: Cybersecurity Controls: Introduction, Standard Technical Solutions, Information Sharing Platform on Cybersecurity Incidents for the Energy Sector.

07 Hours

SLE: Situation Awareness Network.

Text book:

1. RafalLeszczyna "**Cybersecurity in the Electricity Sector"**, Springer, 2019

Digital Control Systems (3-0-0)

Sub Code: MPS1E204 **CIE: 50%Marks**
Hrs/week: 3+0+0 **SEE:50%Marks**
SEE Hrs: 3 **Maxmarks : 100**

Course Outcomes
On successful completion of the course, students will be able to:

1. Understand, analyze and apply knowledge of control engineering and mathematics in industrial problems
2. Analyze digital control systems using transform techniques
3. Analyze digital control systems using state-space methods.
4. Design, digital control systems using transform techniques and state-space methods
5. Analyze the concepts of nonlinear digital control systems.

MODULE 1: Introduction to digital control systems and Z- Transform Techniques: Introduction, Discrete time system representation, data conversion and quantization, sample and Hold devices, mathematical modeling of the sampling process, data reconstruction and filtering of sampled signals, zero-order hold, the first-order hold, aliasing and folding, choice of the sampling period – Z-transform, Inverse Z-transform, pulse transfer and z-transfer function, pulse transfer function of the ZOH, solution of difference equation, response of discrete-data control system.

08 Hours

SLE: Choice of the sampling period

MODULE 2: Analysis using Z- Transform Techniques: Comparison of time responses of continuous data and discrete data systems, steady state error analysis of digital control systems, correlation between time response and root locations in the s-plane and the z-plane, constant damping factor and constant damping ratio loci, dead beat response at the sampling instants, root loci for digital control systems, effect of adding poles and zeroes to the open-loop transfer function

08Hours

SLE: Practical issues with deadbeat response design

MODULE 3: Discrete state space model: State equations of discrete-data systems with sample and hold devices, state equations of digital systems with all digital elements, different state variable models, digital simulation and approximation, state transition equations, state diagrams of digital systems, Decomposition of discrete data transfer functions, Controllability and observability of discrete data systems, relation between observability, controllability and transfer functions, Controllability and observability versus sampling period.

08 Hours

SLE: Stability of discrete state space models

MODULE 4: Discrete state space model- Controller Design: Controller Design using Discrete-time state model, Pole placement design by state feedback, Full order and reduced order observer design, design of digital control systems with state feedback and dynamic output feedback, realization of state feedback by dynamic controllers. Introduction to Multivariable & Multi-input Multi-output (MIMO) Digital Control Systems

08 Hours

SLE: Set point tracking controller

MODULE 5: Nonlinear Digital control systems: Discretization of nonlinear systems, Extended linearization by input redefinition, input and state, Equilibrium of nonlinear discrete-time systems, Lyapunov stability theory, Lyapunov functions, Stability theorem, Rate of convergence, Lyapunov stability of linear systems, Lyapunov's linearization method, Instability theorems, Discrete-time nonlinear controller design

07 Hours

SLE: - Extended linearization using matching conditions

Text Books

1. Benjamin C. Kuo, ***Digital control systems***, Second *edition (Indian), Oxford University Press, 2012.*
2. *Franklin, Powell, Workman, Digital* Control of Dynamic Systems, Pearson Education Third, 2006.
3. M. Gopal, ***Digital Control and State Variable Methods***, Tata McGraw Hill Publication Limited, 2008.

References

1. Ogata, ***Discrete-time Control Systems***, Prentice hall, Second edition, 2005.
2. M. Gopal, ***Digital Control Engineering*** New Age International,2006.
3. R. J. Vacaro, ***Digital Control: A State Space Approach***, McGraw-Hill Higher Education, 1995

Digital Control Systems (3-0-0)

Sub Code: MCD2E404 | **CIE: 50%Marks**
Hrs/week: 3+0+0 | **SEE:50%Marks**
SEE Hrs: 3 | **Maxmarks : 100**

Course Outcomes

On successful completion of the course, students will be able to:

6. Understand, analyze and apply knowledge of control engineering and mathematics in industrial problems
7. Analyze digital control systems using transform techniques
8. Analyze digital control systems using state-space methods.
9. Design, digital control systems using transform techniques and state-space methods
10. Analyze the concepts of nonlinear digital control systems.

MODULE 1: Introduction to digital control systems and Z- Transform Techniques: Introduction, Discrete time system representation, data conversion and quantization, sample and Hold devices, mathematical modeling of the sampling process, data reconstruction and filtering of sampled signals, zero-order hold, the first-order hold, aliasing and folding, choice of the sampling period – Z-transform, Inverse Z-transform, pulse transfer and z-transfer function, pulse transfer function of the ZOH, solution of difference equation, response of discrete-data control system.

08 Hours

SLE: Choice of the sampling period

MODULE 2: Analysis using Z- Transform Techniques: Comparison of time responses of continuous data and discrete data systems, steady state error analysis of digital control systems, correlation between time response and root locations in the s-plane and the z-plane, constant damping factor and constant damping ratio loci, dead beat response at the sampling instants, root loci for digital control systems, effect of adding poles and zeroes to the open-loop transfer function

08Hours

SLE: Practical issues with deadbeat response design

MODULE 3: Discrete state space model: State equations of discrete-data systems with sample and hold devices, state equations of digital systems with all digital elements, different state variable models, digital simulation and approximation, state transition equations, state diagrams of digital systems, Decomposition of discrete data transfer functions, Controllability and observability of discrete data systems, relation between observability, controllability and transfer functions, Controllability and observability versus sampling period.

08 Hours

SLE: Stability of discrete state space models

MODULE 4: Discrete state space model- Controller Design: Controller Design using Discrete-time state model, Pole placement design by state feedback, Full order and reduced order observer design, design of digital control systems with state feedback and dynamic output feedback, realization of state feedback by dynamic controllers. Introduction to Multivariable & Multi-input Multi-output (MIMO) Digital Control Systems

08 Hours

SLE: Set point tracking controller

MODULE 5: Nonlinear Digital control systems: Discretization of nonlinear systems, Extended linearization by input redefinition, input and state, Equilibrium of nonlinear discrete-time systems, Lyapunov stability theory, Lyapunov functions, Stability theorem, Rate of convergence, Lyapunov stability of linear systems, Lyapunov's linearization method, Instability theorems, Discrete-time nonlinear controller design

07 Hours

SLE: - Extended linearization using matching conditions

Text Books

4. Benjamin C. Kuo, ***Digital control systems***, Second *edition (Indian), Oxford University Press, 2012.*
5. *Franklin, Powell, Workman, Digital* Control of Dynamic Systems, Pearson Education Third, 2006.
6. M. Gopal, ***Digital Control and State Variable Methods***, Tata McGraw Hill Publication Limited, 2008.

References

4. Ogata, ***Discrete-time Control Systems***, Prentice hall, Second edition, 2005.
5. M. Gopal, ***Digital Control Engineering*** New Age International,2006.
6. R. J. Vacaro, ***Digital Control: A State Space Approach***, McGraw-Hill Higher Education, 1995

Finite Element Method of Analysis of Electric Machines (3-0-0)

Sub Code: MCD2E304 | **CIE: 50%Marks**
Hrs/week: 3+0+0 | **SEE: 50%Marks**
SEE Hrs: 3 | **Max marks:100**

Course Outcomes
On successful completion of the course, students will be able to:

1. Know about characteristics parameters of Electromagnetic fields
2. Maxwell equations
3. Principle of finite element method(FEM)
4. Application of FEM to 2 dimensional fields
5. Analysis Procedure using Finite element method

UNIT 1: Outline of Electromagnetic Fields: Vector Analysis, Electromagnetic Fields-Electric Charge Density, Electric Displacement Field, Current Density Field, Magnetic flux density field, Electromotive force, Vector Magnetic Potential and magnetic field strength.

08 Hours

SLE: Poyinting Vector and Maxwell Stress tensor

UNIT 2: Maxwell Equations: Laplace Equation, Poisons equation

08 Hours

SLE: Helmholtz equation

UNIT 3: Principles of Finite element method: Introduction, Field Problem with boundary condition, Finite element method, Partition of domain, Choice of Interpolating function, Formulation of system

08 Hours

SLE: Classical Methods for Field Problem solution

UNIT 4: Applications of the finite element method to 2 dimensional fields: Introduction, Linear Interpolation of function, Simple description of electromagnetic field.

08 Hours

SLE: Integration in triangular elements

UNIT 5: Analysis Procedure using Finite element method: Introduction, Reduction of the field Problem to a 2 dimensional problem, boundary conditions and computation of solved structure, analytical study of magnetic device**,** Finite element analysis, Computation of solved structure

07 Hours

SLE: Statement of problem for Electro Magnetic devices

Text Book

1. Nicolola Bianchi ***"Electric machine Analysis using finite elements"***,Taylors and Francis, 2005.

Reference Books

1. D.C White and H.H. Woodson, ***Electromechanical Energy Conversion***, John Wiley & Sons, New York, 1959.

2. I.J. Nagrath and D.P. Kothari, ***Electric Machines***, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1985.