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(A80233) ADAPTIVE CONTROL SYSTEMS

(Elective-III)

UNIT-I:

Introduction - use of Adaptive control - definitions - essential aspects – classification - Model Reference Adaptive Systems - different configurations - classification - mathematical description - Equivalent representation as a nonlinear time varying system - direct and indirect MRAC.

UNIT-II:

Continuous time MRAC systems - Model Reference Adaptive System Design based on Gradient method, Design of stable adaptive controllers based on Kalman - Meyer - Yakubovich Lemma, Lyapunov theory, Hyper stability theory - Narendra's error model approach. Discrete time MRAC systems - Hyper stability approach - Narendra's error model approach - Introduction - stability theorem - Relation to other algorithms - hybrid adaptive control.

UNIT-III:

Self Tuning Regulators (STR) - different approaches to self tuning - Recursive parameter estimation - implicit STR - Explicit STR. hybrid STR, hybrid predictor design and algorithms. STR design based on pole - placement technique and LQG theory - Gain scheduling - Stability of adaptive control algorithms.

UNIT-IV:

Adaptive control of nonlinear systems - Adaptive predictive control - Robustness of adaptive control systems - Instability phenomena in adaptive systems. Concept of learning control systems. Different types of learning control schemes. LTI learning control via parameter estimation schemes. Convergence of learning control. Fuzzy logic adaptive control ,stochastic adaptive control –multi decision problems-dual control.

UNIT-V:

Case Studies: Robotic manipulators, Aerodynamic curve identification, Electric drives, Satellite altitude control, regulators, power system and electrical generator.

TEXT BOOKS:

1. K.J.Astrom and Bjorn Witten mark, Adaptive control, Pearson Edu., 2nd Edn.
2. Sankar Sastry, Adaptive control

REFERENCE BOOKS

1. V.V.Chalam, Adaptive Control System - Techniques & Applications, Marcel Dekker Inc.
2. Miskhin and Braun, Adaptive control systems, MC Graw Hill
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, Adaptive Control, Filtering and Signal Processing.
4. G.C. Goodwin, Adaptive control.
5. Narendra and Anna Swamy, Stable Adaptive Systems.

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(A80243) SCADA & DISTRIBUTED CONTROL SYSTEMS

(Elective - III)

Course Objective:

To make students learn about the theoretical concepts of HMI and distributed network.

UNIT- I:

Introduction to SCADA: Definition of SCADA, applicable process, Elements of SCADA system, Limited two way system, Real time system, communication access and master slave, scan interval, Murphy's law and remote control, safety instrumented system, regulatory requirement. Communication: long distance, protocol, modem, synchronous and asynchronous.

UNIT- II:

RTU,MTU and sensors and wiring: Communication interface, protocol details, Control: Discrete ,Analog, Pulse and serial. Monitor of analog ,pulse count signal, serial signal, Non RTU functions.

Configuration of any process. Applications ,data storage. Sensors, Actuators and wiring: standardinzation and maintenance.

UNIT- III:

Distributed Control System Evolution – Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities.

UNIT- IV:

Interfaces in DCS Operator interfaces - Low level and high level operator interfaces – Operator displays - Engineering interfaces – Low level and high level engineering interfaces – General purpose computers in DCS.

UNIT- V:

HART and Field Bus Evolution of signal standards – HART communication protocol – Communication modes – HART networks – Control system interface – HART and OSI model – Filed bus introduction – General field bus architecture – Basic requirements of field bus standard – Field bus topology – Inter operability.

TEXT BOOKS

1. SCADA by Stuart .A. Boyer, 3 rd Edition, ISA.

2. Michael P. Lukas, 'Distributed Control System', Van Nostrand Reinhold Co., Canada,1986.

REFERENCE:

1. A.S. Tanenbaum, 'Computer Networks', 3rd Edition, Pearson Education, 1996 / PHI.

Course Outcome:

Upon completion of this course the student shall be able to understand HMI and DCS architecture.

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(A80149) HYDRAULICS AND PNEUMATIC CONTROL SYSTEMS
(Elective-III)

Objectives: To study hydraulic and pneumatic control systems

UNIT – I:

Introduction to Fluid Power, merits and utility of Fluid Power in industries. Difference between Hydraulic Systems & Pneumatic Systems. Fluid Power Components: Construction and operation of – Pump, Relief valve, Non-return valve, Pilot operated relief valve, Series and Parallel compensator of flow valve, Pressure compensated pump, motor, actuators, Seals used in the control systems.

Symbolic representation of Hydraulic and pneumatic Elements. Compressor and air line installations. Various types of Pumps used in hydraulic systems. Hydraulic Fluid and Effective contamination control. Purpose of Air-filters and types in Pneumatic systems.

UNIT – II:

Transmission System: Transmission of Fluid Power through various type of cylinders. Compressibility and inertia loading. Hydraulic stiffness, stiffness of pneumatic system. Component effectiveness, breakage, constant torque load, constant power load, inertia load, viscous damping.

Valve controlled Systems: Flow through a single speed control valve, Series Pressure Compensation, combined directional and flow rate control valve, Steady reaction and Transient Reaction force.

UNIT –III:

Hydraulic and pneumatic circuits for different controls like – Sequencing circuit, counter balancing, indexing, linear motion, rotation & Hydro copying circuit. Electro-Pneumatics & Electro-Hydraulic controls, Hydro-Pneumatics, Cartridge valve design.

Analysis of Accumulator Systems: Accumulator system dynamics, Thermodynamics, Thermodynamics consideration. Accumulator as Absorber of pressure shocks. Construction, operation and applications of Intensifier.

UNIT – IV:

Feed back Systems: Pressure control, Position control, Pump/motor systems. Control with variable capacity pumps. Pump stroke mechanisms. Position control using metering valve Double acting actuators.

UNIT – V:

Speed control, Inertia Load position control systems. Programmable sequential control using modular elements. Servo control systems. Trouble shooting and remedial measures in Hydraulic & Pneumatic Systems.

TEXT BOOKS:

1. Fluid Power Systems, by A.B. Goodinain, McMillan Press Ltd.
2. The Control of Fluid Power, by McCloy & Martin, Longman Publications.

REFERENCES:

1. Mechatronics, by Prof. C.V. Venkataramana, SBS Publishers and Distributors.
2. Production Drawing Practice, by Dr.P.Narsimha Reddy, T.A.Janardhan Reddy & C. Srinivas Rao, The Hi-Tech Publishers.

Outcome: Upon completion of this subject the students shall give the solution to problem relating to system identification.

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(A80239) OPTIMAL CONTROL SYSTEMS

(Elective-IV)

UNIT-I:

Optimal control law, the principal of optimality, application of their optimality principle to decision making, an optimal control system. Recurrence relation of dynamic programming, computational procedure for solving control problem, characteristics of dynamic programming solution.

UNIT-II:

Discrete linear regulator problem. Hamilton –jocobi-bellman equation. Continuous linear regulator problems, necessary and sufficient conditions examples. The calculus of variations & Pontrygin's minimum principle: Fundamental concepts, functional of a single function, functional involving several independent functions, necessary conditions for optimal control, linear regulator problem.

UNIT-III:

Pontrygin's minimum principle and state inequality constrains, minimum time problems, minimum control effort problems. Iterative numerical techniques for finding optimal controls and trajectories: Two point boundary value problems, method of steepest descent algorithm, variation of extremalas, variation of extremal algorithm, gradient projection algorithm.

UNT-IV:

The nature of the state estimation problem, non-statistical estimation design with full estimator dimension, non-statistical estimation with reduced estimator design.

UNIT-V:

Description of plants noise statistics, statement of optimal estimation problem, information of the optimal estimation problem as an optimal regulator problem, solution to the regulator problem in feedback form, explicit solution of the optimal estimation problem.

TEXT BOOKS:

1. Jasbir S. Arora, Introduction to optimum design, Elesevier, 2005.
2. A Ravindran, K.M. Ragsdell, and G.V. Reklaitis, Engineering optimization: Methods and applications, Wiley India Edition.
3. Donald E.Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series - First edition, 1970.

REFERENCE BOOKS:

1. D.S. Naidu, Optimal control systems, CRC Press, First edition, 2002.
2. Arturo Locatelli, Optimal control: An Introduction, Birkhauser Verlag, 2001.
3. S.H.Zak, Systems and Controll, Indian Edition , Oxford University, 2003.
4. Niclas Anreasson, Anton Evgrafov and Michael Patriksson, An introduction to continuous optimization, Overseas Press (India) Pvt. Ltd.
5. Optimal control systems-A.P. Sage.
6. Optimal Theory and application – Dr.S.S.Rao-eastern Willy- First Edition.

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(A81005) PC BASED INSTRUMENTATION

(Elective-IV)

Course Objective: To introduce interfacing data acquisition systems to PC and introducing PLCs with their classification, operation and programming.

UNIT –I

Introduction to Computer Instrument Communication: Personal Computer, overview of operating System, I/O Ports, Plug-in-slots, PCI bus, Operators Interface. Computer Interfacing for Data Acquisition and Control – Interfacing Input Signals, Output system with continuous actuators. Data Acquisition and Control using Standard Cards: PC expansion systems, Plug-in Data Acquisition Boards; Transducer to Control room, Backplane bus – VXI.

UNIT –II

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies and isolators.

Basic PLC programming: Programming On-Off inputs/ outputs. Creating Ladder diagrams Basic PLC functions PLC Basic Functions, register basics, timer functions, counter functions.

UNIT – III

PLC intermediate and advanced functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Analog PLC operation, networking of PLC.

UNIT –IV

Application of PLC: Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating.

UNIT – V

Related Topics: Alternate programming languages. Auxiliary commands and functions. PLC installation, troubleshooting and maintenance. Field bus: Introduction, concept. HART protocol: Method of operation, structure, and applications. Smart transmitters, smart valves and smart actuators.

TEXT BOOKS

1. Programmable Logic Controllers – Principles and Applications, John.

W .Webb Ronald A Reis , Fourth edition, Prentice Hall Inc., New Jersey, 1998.

2. Computer Control of Processes – M.Chidambaram. Narosa 2003.

REFERENCES

1. PC Based Instrumentation and Control Third Edition by Mike Tooley; Elsevier.

2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation and Control. By Kevin James; Elsevier.

3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve Mackay.

4. Distributed Control Systems, Lukcas M.P, Van Nostrand Reinhold Co., New York, 1986.

5. Programmable Logic Controllers, Second edition, Frank D. Petruzella, Mc Graw Hill, Newyork, 1997.

6. Programmable Logic Controllers Programming methods and applications-Prentice Hall by John R. Hackworth and Frederick D. Hackworth, Jr.

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(A80238) NEURAL NETWORKS AND FUZZY LOGIC

(Elective-IV)

Objective:

This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

UNIT – I:

Introduction & Essentials to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT–II:

Single & Multi Layer Feed Forward Neural Networks : Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications, Credit Assignment Problem, Generalized Delta Rule, and Derivation of Back-propagation (BP) Training, Summary of Back-propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT-III:

Associative Memories-I: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory).

UNIT-IV:

Associative Memories-II: Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hopfield

Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network Summary and Discussion of Instance/Memory Based Learning Algorithms, Applications.

UNIT – V:

Fuzzy Logic: Classical & Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, De-fuzzification to crisp sets, De-fuzzification methods.

TEXT BOOKS:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, Rajasekharan and Pai, PHI.
2. Neural Networks and Fuzzy Logic, C. Naga Bhaskar, G. Vijay Kumar, BS Publications.

REFERENCE BOOKS:

1. Artificial Neural Networks, B. Yegnanarayana, PHI.
2. Artificial Neural Networks, Zaruda, PHI.
3. Neural Networks and Fuzzy Logic System, Bart Kosko, PHI.
4. Fuzzy Logic and Neural Networks, M. Amirthavalli, Scitech Publications India Pvt. Ltd.
5. Neural Networks, James A Freeman and Davis Skapura, Pearson Education.
6. Neural networks by satish Kumar., TMH, 2004.
7. Neural Networks, Simon Hakins , Pearson Education.
8. Neural Engineering, C.Eliasmith and CH.Anderson, PHI.

Outcome:

After going through this course the student gets a thorough knowledge on, , biological neurons and artificial neurons, comparative analysis between human and computer, artificial neural network models, characteristics of ANN's, different types of activation functions, learning strategies, learning rules, perceptron models, single and multi layer feed-forward and feed-back neural networks, back-propagation algorithm, Kolmogorov Theorem, different types of associative memories and basics of fuzzy logic, concept of classical and fuzzy sets, fuzzy logic system components fuzzification and defuzzification, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.

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(A80241) RELIABILITY ENGINEERING

Unit - I

Basic Concepts of Reliability: Introduction, Reliability and quality, Failures and failure modes, Causes of failures and reliability, Maintainability and availability, History of reliability ,reliability literature.

Unit-II

Reliability Mathematics: Introduction, Random experiment, Probability, Random variables, Distribution functions, Discrete distribution, Continuous distribution, Numerical characteristics of random variables, Laplace transform.

Component Reliability and Hazard Models: Introduction, Component reliability from test data, Mean time to failure, Time – dependent hazard models, Stress- Dependent hazard models , Derivation of reliability function using Markov, Treatment of field da

Unit-III

System Reliability Models: Introduction - Systems with series components - Systems with parallel components - k-out – of- m systems - Non series parallel systems - Systems with - mixed - mode failures - Fault- tree technique.

Unit-IV

Maintainability and Availability Concepts: Introduction - Maintainability function - Availability function - Frequency of failures - Two-unit parallel systems with repair - k-out-of-m systems - Preventive maintenance.

Reliability Improvement: Introduction - Improvement components - Redundancy - Element redundancy - Unit redundancy - Stand by redundancy - Optimization - Reliability – cost trade – off.

Unit-V

Economics of Reliability Engineering: Economic issues -Manufacture's cost- Customer's cost - Reliability achievement cost - models - Reliability utility cost models - Depreciation cost models - Availability – cost – model of parallel systems.

Reliability Management: Reliability programming - Management policies and decision - Reliability management by objectives - Reliability group - Reliability data : Acquisition and analysis - Managing people for reliability.

TEXT BOOKS :

1. Reliability Evaluation of Engineering Systems. R. Billington, RN Allan, BS Publications 2007.
2. Reliability, Maintenance and safety Engineering - Dr. A.K. Gupta, Laxmi Publications.

REFERENCE BOOKS:

1. Reliability Engineering- Patrick DTO-Wiley India.
2. Reliability Engineering and life testing –Naikan-PHI.
3. Engineering Maintenance a Modern Approach, B.S.Dhillon,2002 CRR Publications.
4. Maintenance Engineering and Management – RC Misra, PHI.
5. Reliability Engineering – Balaguruswamy- TMH.
6. Reliability Engineering- L.S.Srinath.

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(A80087) INDUSTRY ORIENTED MINI PROJECT

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	-	-/6/-	2

(A80089) SEMINAR

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(A80088) MAJOR PROJECT

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	-	-/-/-	2

(A80090) COMPREHENSIVE VIVA