

SYSTEM DESIGN AND ANALYSIS

ME: 503

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**SYSTEM COMPONENTS:** The environment for system concept; system structure; system inputs and outputs; system approach to macro problems; problem definition with system concepts and approach.

**SYSTEM MODELING:** Model formulation; Representation of dynamics signal and system flow graph; System interactions; System compatibility; Sub-systems and inter-connections; Functional and equipment structuring. Linear graph approach. Time models.

**SYSTEM SIMULATION:** Basic philosophy of simulation; Analog and Digital Computers; System with feedback. Discrete system simulation.

**SYSTEM DYNAMICS :** Dynamic analysis of systems; Dynamic behavior of organization; Total flow of man, information and materials; Dynamic analysis of the models for capital equipment and orders; Derivation of the policies for management based on system models.

**OPTIMIZATION:** Optimization of system performance; Perturbation analysis of system parameters; Criteria for optimization, Gradient method; Dynamic programming method.

**SYSTEM DESIGN:** Elements of Decision analysis; Game theory; Application of game and decision theory to system design. Techniques for creative design; Elementary sensitivity analysis.

**Recommended Books:**

1. Chestnut, System Engg. Tools, John Wiley, New Delhi.
2. Gosling, Design of Engg. Systems, John Wiley, New Delhi.
3. A.D.Hall, System Engg., Van Nostrand, U.K.
4. Machol, System Engg. Handbook, McGraw Hill Inc., New York.
5. G.M.Sandquist, Introduction to System Science, Prentice-Hall , N.J.
6. Nagrath & Gopal, System Modeling and Analysis, Tata McGraw Hill, New Delhi.
7. Geoffrey Gordon, System Simulation, Prentice Hall of India, New Delhi.
8. Forester, Industrial Dynamics, MIT Press, Cambridge Mass: U.S.A.
9. Warren E. Wilson, Concepts of Engineering System Design, McGraw Hill, New York.
10. Philip A. Laplante, Realtime System Design and Analysis (Engg. Handbook), Prentice Hall of India, New Delhi.
11. Avadh, System Design & Analysis, Galgotia Publishers, New Delhi.

MECHATRONICS

ME-514

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Sensors: Strain gauge, Potentiometers, Tachometers, Linear variable differential transformer, Piezoelectric accelerometer, Hall effect sensors, Optical Encoders, Resolver, Inductosyn, Tactile and Force sensors.

Actuators: Pneumatic and Hydraulic Actuators, Electrical actuators, stepper motors, DC motors, AC motors.

Electronics fundamentals: Brief review of some semiconductor devices. The operational Amplifier, Binary variable and logic, Boolean Algebra, Logic circuits, Digital-to-analog converters, analog-to-Digital converters.

Microprocessor and computers: Introduction to 8085(8 bit microprocessor), architecture programming, I/O, Computer and interfacing, Programmable logic controller.

Control systems: Mathematical modeling of physical systems, sensors and actuators, System equations, controllability, observability, pole placement technique, PID Controller.

Applications: Case studies of control of hydraulic, pneumatic, mechanical and electrical system, Application of CNC machines & Robotics.

References:

1. Analytical Robotics and Mechatronics, Wolfram Stadler, McGraw Hill
2. Robotic engineering, Rafter, PHI.
3. Mechatronics, AMT
4. Automatic Control System, B.C. Kuo, Ogata, PHI
5. Introduction to Digital computer electronics, A.P. Mahind, TMH
6. Measurement Systems, E.O. Doebelin, McGraw Hill.

ADVANCED MATHEMATICS

AM-501

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Tensor Analysis: Introduction to Tensors, Algebra, Symmetric and unsymmetrical Tensors, Line element and Metric Tensor, Associated Tensor, Physical components, Covariant Differentiations, Christoffel Symbols of first and second kind.

Statistics: Statistical Distributions like Binomial, Normal and Poisson, Sampling, Design of Experiment-basic, Principles, Replication, Experimental error, Confounding Randomization, Local control Balancing, Blocking and Group

Conformal Mapping: Analytic Function, Bilinear Mapping, Conformal Mapping, Schwarz Christoffel Transformation, Application to fluid Flow and Heat Transfer problems.

Matrices and Linear Systems of Equations: Direct method, Gauss method and its modifications, Method of Factorization, Iterative methods, Gauss Seidel method, Jacobi's method, Eigenvalues and Eigenvectors.

Ordinary & Partial Differential Equations: Homogenous linear equations of the second order, General solution, Initial value problem, Cauchy equation, existence and uniqueness of solution, Non-homogenous linear equation, modeling of forced oscillations, Resonance Modeling of vibrating string, 1-D wave equation, vibrating membrane, 2-D, wave equation, rectangular membrane.

Books Recommended:

1. Vector analysis and introduction to Tensor analysis: Spiegel, Schaum publishers
2. Statistics in Research, Barnard Ostle, Oxford and IBH
3. Complex Variables, Spiegel, Schaum publishers
4. Advanced Engineering Mathematics: Wylie, McGraw Hill
5. Introductory methods of numerical analysis: S.S. Sastry Prentice Hall of India
6. Advanced Engg. Math. Erwin Kreyszig, New Age Int. (P) Ltd.

MANAGEMENT OF PRODUCTION SYSTEM

ME-516

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System Theory and Concepts: System defined, functional elements of a system, general systems theory, systems theory and organization, systems concept and management, the system approach, planning and system concepts. Control and system concepts, information and system concepts.

Quantitative Techniques of System Analysis: System analysis, problem solving, scientific method, mathematical analysis models, computers, techniques of analysis, linear programming input output analysis queuing monte cargo techniques, simulation, industrial dynamics.

Behavioural Aspect of System Design: The motivation factor in system design, leadership factor in systems design. The need for systematic human relationships, the need for systems change, resistance to change, behavioural consequence of system changes, microanalysis of complex, man-machine open systems concept as a basis of human integration, meeting the human and social problems.

Flow System: Increasing complexity in distribution and production, increasing cost of a distribution, the total flow system, planning the transformation, the service system integration systems.

Program Management: Impact of advancing technology, large scale integrating systems. Program-management concept functional stage of program-management organizational medications, matrix organization applications of program-management.

Management Cybermatics: Management cybermatics in controlling a manufacturing firm, production and inventory control systems, production, inventory and employment control system, the enterprise control systems.

Recommended Books:

1. Strategic Management of Technology and Innovation by Rober A. Burgelmen & A. Maidique, McGraw Hill
2. Logistical Management by Donald Bowerson and David Closs, McGraw Hill
3. Production and Operations Management by James Dilworth, McGraw Hill
4. Global Operations Management by M. Therese Flaherty, McGraw Hill

INSTRUMENTATION & CONTROL ENGG.

EC-501

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INTRODUCTION: Review of basic principles of measurement & process control systems; Elements of instrumentations.

MEASUREMENT: Principles of dynamic measurement; Transducers, amplifiers and recording systems; measurement of physical variables, i.e. motion, strain, force, torque, temperature, pressure and flow etc. Principles of optical, eddy current based and ultrasonics based measurement devices for metrological applications; Interferometers; Principles of Holography; Calibration its importance and general principles.

CONTROL SYSTEMS: Concepts, Controller characteristics. Transfer functions of mechanical, electrical, pneumatic and hydraulic systems; Transients and frequency response; types of control action.

STABILITY : Concept, criterion and determination by analytical and graphical methods Routh, Hurwitz, Bode and Niquist.

Adaptive control systems; Applications to mechanical systems and CNC machines.

## Recommended Books:

1. Doebelin, Measurement Systems, McGraw Hill, New Delhi (Pub. at Singapore).
2. Nagrath & Gopal, Control System Engg.,
3. Moore, Theory & Applications of Mechanical Engg. Measurements, Affiliated East West, New Delhi.
4. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, New Delhi.
5. K.Ogata, Modern Control Engg., Prentice Hall of India, New Delhi.
6. Krstic, Kandlakopoulos, Kokotovic, Non linear and Adaptive Control Design, Wiley interscience Publishers, New York..
7. Holman, Experimental Methods for Engineers, McGraw Hill, New Delhi.
8. Gupta & Syal, Introduction to Metrology, Dhanpat Rai & Sons, New Delhi.
9. Bechwith & Buck, Mechanical measurements, Addison-Wesley.
10. D.S. Kumar, Mechanical measurements, Metropolitan, New Delhi.
11. George J. Thaler, Design of Feedback Systems, Jaico Publishers, Bombay.

ARTIFICIAL INTELLIGENCE

CS-502

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Basic concepts of AI. Problem formulation and solution techniques. Expert systems. Knowledge representation, Knowledge acquisition, inference mechanisms. Introduction to machine learning, Intelligence for manufacturing tools, manufacturing brain, eye and hand. Trends in robot intelligence. Case studies in the application of AI in manufacturing.

Recommended Books:

1. E.Rich, Artificial Intelligence, Tata McGraw Hills, New Delhi.
2. G.F Luger and W.A. Stubblefield, AI and the design of Expert Systems Bengamin/Cummins.
3. Dan W. Patterson, AI and Expert Systems, Prentice Hall of India, New Delhi.
4. Omidvar.O and Smagt.P., Neural Systems for Robotics, Academic Press, San Diego.
5. P. Radhakrishnan, S. Subramanyam, CAD/CAM/CIM, New Age International Pub, New Delhi.

DIAGNOSTIC MAINTENANCE AND MONITORING

ME-517

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Introduction to maintenance techniques, Preventive and predictive maintenance, signature analysis

Observational and Estimation Techniques. Non-destructive and Destructive testing, Malfunction Analysis of Materials

Wear Analysis through Thermography and Ferrography.

Various Techniques of Condition Monitoring.

Application of Diagnostic Maintenance to Industrial Machines and Plants such as Sugar Industries, Textile Mills, Thermal Power Plants and Railways.

Recommended Books:

1. Creating customer Value through Industrial Maintenance by G.K. Gureja, McGraw Hill
2. Power Station Engineering by Skrotzki, McGraw Hill
3. An Introduction to Reliability and Maintain-ability Engineering by Charles Ebneling, McGraw Hill
4. Maintenance Engineering by Lindley R. Higgins, McGraw Hill

COMPUTER INTEGRATED MANUFACTURING SYSTEMS

ME-506

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INTRODUCTION: Types of production systems and their automation. CAD/CAM integration. Concept of FMS and CIMS.

ELEMENTS OF A GENERAL CIM SYSTEM: Types of CIM systems. CAD-CAM link for CIMS. Manufacturing data base in a CAD/CAM system. Benefits of CAM, FMS and CIMS. Automated material handling systems, equipment and their functions. Integration of Robots in CIMS, Automatic Storage and Retrieval Systems (AS/RS), Carousel. Palletization and fixtures. In process interfacing of storage with manufacture.

GROUP TECHNOLOGY: Concept and terminology, part family formation, classification and coding systems for components, Group Technology machine cells.

Computer Aided Process Planning and route sheet development, CAPP system, Computer aided plant layout.

COMPUTER AIDED PRODUCTION PLANNING AND CONTROL: Inventory control and MRP, Computer aided cost estimation. Computer aided shop floor control, process monitoring. Computer aided Inspection and Quality Control, SQC, SPC.

NETWORKING: Introduction to fundamentals of computer communications, networking, computer-machine-personnel communication links. Network architectures & techniques. Information flow in networks, network standards.

CIM DATABASE AND DATABASE MANAGEMENT SYSTEMS: Types, Management Information System, Manufacturing data preparation. Shop floor data collection systems, shop floor control, sensors used, Tool management system, automatic identification systems, Barcode system.

CIMS configurations, DNC based factory management and control, Integrated CAD/CAM system and shared database, Factories of the future. Impact of implementing CIMS on society.

Introduction to rapid prototyping, and rapid tooling

Introduction to the concept of concurrent engineering.

Recommended Books:

1. M. P. Groover and E. W. Zimmers, CAD/ CAM, Prentice Hall of India, New Delhi.
2. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice Hall of India, New Delhi.
3. S Kant Vajpayee, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi.
4. P. N. Rao, N. K. Tewari, T. K. Kundra, Computer Integrated Manufacturing, Tata McGraw Hill, New Delhi.
5. Besant and Lui, CAD/CAM, Tata McGraw Hills, New Delhi.
6. H. Mitchell, CIM Systems -An Introduction to Computer Integrated Manufacturing, Prentice Hall, New Jersey.
7. P. Radhakrishnan and S. Subramanyan, CAD/CAM/CIM, New Age International Pub, New Delhi.
8. Dr. Surender Kumar and Dr. A. K. Jha, CAD/CAM, Dhanpat Rai and Sons, New Delhi.
9. John Hartley, FMS at Work, IFS Pub UK and North Holland, New York.

Charles S. Knose, CAD/CAM System Planning & Implementation, Marcel Dekker, New York.



## DESIGN OF EXPERIMENTS

MCE 522

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**INTRODUCTION**

Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation.

**SIMPLE COMPARATIVE EXPERIMENTS**

Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Inferences about the Differences in means, Paired comparison Designs, Inferences about the Variances of Normal Distributions.

**RANDOMIZED BLOCK DESIGNS**

Randomized complete block design, Latin square design, Balanced incomplete block design.

**INTRODUCTION TO FACTORIAL DESIGN**

Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and surfaces, Blocking in a factorial design.

**FITTING REGRESSION MODELS**

Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, Testing for lack of fit

**TAGUCHI METHOD OF DESIGN OF EXPERIMENTS**

Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean(ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study.

**ANALYSIS OF VARIANCE (ANOVA)**

Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test.

**Books Recommended**

1. Design and Analysis of Experiments, Douglas C Montgomery, John Wiley
2. Statistical Design and Analysis of Experiments, John P.W.M., Macmillan,
3. Introduction to Linear Regression Analysis, Montgomery D.C., Runger G. C.,
4. Response Surface Methodology: Process Ang Product Optimisation Using Designed Experiments, Myres R.H., Montgomery D. C., Wiley, New York
5. Introduction to Quality Engineering, Taguchi , G., Asian Productivity Organisation, UNIPUB, White Plains, New York

ME-552

CAD/CAM Lab-II

Practical to be conducted covering various aspects of CIMS including:

1. Automatic material handling system
2. Automatic Storage and Retrieved System (AS/RS)
3. Computer aided process planning
4. Computer aided Production planning and control
5. CIMS Database management Systems
6. Computers basic Networking.

In addition to above a visit to some facility where any of the above is actually used and to prepare report of that.

ME-553

CAD/CAM Lab-III

Practical to be conducted covering various aspects of Computer control in M/C tools and robotics including:

Study of structure of NC System

Introduction and use of NC Codes

NC part programming of various parts

Tool and zero pre setting

Flexible tooling

Different types of NC motions

Study of various drives, feedback devices, counters. ADC and DAC DEVICES ETC.

In addition to above a visit to some facility where any of the above is actually used and to prepare report of that.