

COMPUTER CONTROL IN MACHINE TOOLS

ME-504

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INTRODUCTION: Fundamental concepts in numerical control. Need of N.C. in machines tools, its advantages. Structure of NC System . Economics of NC for m/c tools.

NUMERICAL CONTROL OF M/C TOOLS : NC, CNC, DNC, Adaptive control – types, uses & benefits; Problems with conventional NC. Advantages of CNC, DNC their structure, combined CNC/DNC systems.

N.C. M/C TOOLS :Types, definition and designation of control axes, Constructional details of N. C. m/c tools, MCU structure and functions, Methods of improving accuracy and productivity using NC.

SYSTEM DEVICES: drives, feedback devices, counting devices, DAC and ADCs, Interpolator systems, Control loop circuit elements in PTP system, contouring system. Incremental and absolute systems,

CLASSIFICATION OF N. C. M/C TOOLS: Control systems for positional control and tool changing systems, Optical, pneumatic, hydraulic, electro-mechanical, and electromagnetic control systems, The digital computer and its functioning for m/c control, microprocessor in CNC.

TOOLING FOR N. C. MACHINES: Tool and zero presetting, Work holding and setting up of CNC M/c.

PART PROGRAMMING: Block format and codes, tool length and radius compensation, flexible tooling, tool path simulation on lathe and milling, Advanced programming features. Computer assisted part programming, the APT language - geometric, motion, post processor and auxiliary statements, Compilation control commands, repetitive macro programming.

GEOMETRIC MODELING FOR NC MACHINING: Machining of surfaces, Automatic NC program generation from CAD models, Mould, Casting and Die design and manufacture using CAD/CAM software.

Recommended Books:

1. Manuals of CAD/CAM software package on CAM module and CNC machines.
2. Yoram Koren, Computer Control of Manufacturing systems, McGraw Hill, Singapore.
3. T. K. Kundra, P. N. Rao, N. K. Tewari, Numerical Control and Computer Aided Manufacture, Tata McGraw Hills, New Delhi.
4. S. Pabla, M. Adithan, CNC Machines, Willey Eastern, New Delhi.
5. Y. Koren and J. Benuri, Numerical Control of Machine Tools, Khanna Publishers, New Delhi

INTERACTIVE COMPUTER GRAPHICS

ME-518

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COMPUTER HARDWARE: Introduction to architecture of graphics workstation. Graphic input Devices-Pointing and positioning devices, Graphic Display Devices, Line and point plotting systems; Display processors, Character Generators, Hard copy output devices.

DISPLAY DESCRIPTION: Screen coordinates, user coordinates; Graphical data structures, Display code generation; Graphical functions. Two- and three- dimensional transformations, mapping and projections.

INTERACTIVE GRAPHICAL TECHNIQUES AND TOOLS: Geometric modifiers, dragging, rubber-banding, names, Layers, Colours, Grids, Groups. Interactive computer programming. Graphic User Interface features, design and use.

GRAPHIC MANIPULATIONS AND EDITING: Object selection methods, manipulation and editing operations.

GRAPHICS SOFTWARE PACKAGE DESIGN : Primitive (constants, actions, operators, variables), plotting and geometric transformations. viewing, windowing and clipping algorithms.

3-D GRAPHICS: Hidden line and Surface elimination, Transparent solids, shading, colouring.

COMPUTER ANIMATION: Conventional and computer animation, Animation systems, types, and techniques.

MECHANICAL ASSEMBLY: Assembly modeling, Representation schemes, Assembly sequences, Assembly analysis.

Recommended Books:

1. Ibrahim Zeid, CAD/CAM, Tata McGraw Hill, New Delhi.
2. P.Radhakrishnan & C.P.Kothandaraman, Computer Graphics & Design(CADD), Dhanpat Rai Pub, New Delhi.
3. Giloi, W.K., Interactive Computer Graphics, Prentice Hall, New Delhi.
4. Harrington, S., Computer Graphics. A Programming approach, Tata McGraw- Hill, New York.
5. Newman. W.& Sproul R.F., Principles of Interactive Computer Graphics, McGraw Hill, Auckland.
6. Roy. A. Plastock and Gordvan Kally, Computer graphics (Scheme Series), McGraw Hills, New Delhi.
7. C.S.Krishnamoorathy, J.S.Rajeev. Computer Aided Design (Software and Analysis Tools), Narosa Pub House, New Delhi.
8. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill, New York.
9. Foley. J.D. & Van Dam. A., Fundamentals of Interactive Computer Graphics, Addison-Wesley.
10. Hearn. D. & Baker P.H., Computer Graphics, Prentice-Hall of India, New Delhi.
11. Tosijasu, L.K., Computer Graphics, Springer-Velag, Berlin.
12. Adan and Rogers, Mathematical Element for Computer Graphics, Tata McGraw Hill, New Delhi.
13. Daniel L. Ryan, Computer Aided Graphics and Design, Marcel Dekker, New York.
14. R.G.S. Asthana and N.K. Sinha, Computer Graphics, New Age Internatioal Publishers, New Delhi.

MODELLING & SIMULATION OF MANUFACTURING SYSTEMS

ME-519

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Introduction and overview, concept of system, system environment, element of system, system modeling, types of models, Monte Carlo method, system simulation, simulation-management laboratory, advantages limitations of system, simulation, continuous and discrete systems.

Simulation of continuous systems: characteristics of a continuous system, comparison of numerical integration with continuous simulation system, Simulation of an integration formula.

Simulation of discrete system: Time flow mechanism, discrete and continuous probability

Density function, Generation of random numbers. Testing of random numbers for randomness and for auto correlation, generation of random variates for continuous probability distributions-binomial, normal, exponential and beta distributions, combination of discrete event and continuous models.

Simulation of queuing systems: Concept of queuing theory, characteristics of queues, stationary and time dependent queues, queue discipline, time series analysis, measure of system performance, Kendall's notation, auto covariance and auto correlation function and effects in queuing systems, simulation of single server queues, multi server queues, queues involving complex arrivals and service times with blanking reneging.

Simulation of inventory systems: Rudiments of inventory theory, MRP, in process inventory, Necessity of simulation in inventory problems, forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variates, simulation of complex inventory situations.

Design of simulation experiments: Length of run, elimination of initial bias. Variance reduction techniques, stratified sampling, antipathetic sampling, common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, regenerative techniques.

Simulation of PERT: Simulation of- maintenance and replacement problems, capacity planning production system, reliability problems, computer time sharing problem, the elevator system,

Simulation languages: continuous and discrete simulation languages, block structured continuous languages, special purpose simulation languages, SIMSCRIPT, GPSS, SIMULA, importance and limitations of special purpose languages.

Reference Books:

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| 1. Simulation and modeling | Loffick Tata McGraw Hill |
| 2. System Simulation with Digital computer | Deo Narsingh Prentice Hall of India |
| 3. System Simulation | Dr. D. S. Hira S.Chand & Co. |
| 4. Computer Simulation and Modeling | Meelamkavil John Willey |
| 5. System Simulation | Gordon Prentice Hall of India |

COMPUTER AIDED PROCESS PLANNING

ME-520

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Introduction: Traditional process planning; process planning elements; product design evaluation; selection of tooling and process parameters; operation sequence evaluation.

Group Technology: Introduction; advantages; part families; classification and coding systems; production flow analysis; design of machine cells.

Production Systems at Operation Level: Manufacturing support systems and concepts at the level of production processes; computer generated time standards; machinability data system; cutting condition optimization.

Production Systems at Plant Level: Communication oriented production information and control system (COPICS); material requirements planning; capacity planning; shop floor control and operation scheduling.

Automated Process Planning: Advantages of automated process planning; standardization of manufacturing process plans; variant process planning; its features; and different stages; different variant systems; advantages and limitations of variant process planning; generative process planning; its features; design strategies; planning modeling and coding scheme; decision mechanism for software; decision trees for process; process information; artificial intelligence; overview & application; search strategies for AI production systems; resolution and reduction systems; knowledge acquisition; machine selection, cutting tool selection; software; various generative process planning systems; advantages of generative process planning systems; case studies.

List of Recommended Books

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| 1. An Introduction to the Automated Process Planning | Chand & Wysk | Prentice Hall |
| 2. Computer Aided Design & Manufacturing | Groover & Zimmers | Prentice Hall |
| 3. Group Technology; Prod. Method in Manufacturing | Gallagher & Knight | Ellis Hosewood |
| 4. Principle of Artificial Intelligence | Nilson | Springer Verlag |
| 5. Automation; Production System & Computer | Groover | Prentice Hall |

Integrated Manufacturing.

MCE 516 PRODUCT DESIGN AND DEVELOPMENT

ME-521

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Introduction: to Product Design: Design by Evolution and Innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in Production consumption cycle, The Morphology of Design, Primary design phases and flowcharting, Role of Allowances, process capability and tolerances in detailed design and assembly

Product Design and Industry: The Designer- his role, myth and reality, the industrial design organization, basic design considerations, Role of Aesthetics in product design, Functional design practice

Design for Production: Producibility Requirements in the design of machine components, Forging design, Pressed component design, Casting design for economical molding, eliminating defects and features to aid handling, Design for machining ease, the role of process Engineer, Ease of location and Clamping, Some additional aspects of production design, Design of powder metallurgical parts

Economic Factors Influencing Design: Product value, Design for safety, reliability and Environmental considerations, Manufacturing operations in relation to design, Economic analysis, profit and competitiveness, break even analysis, Economics of a new product design(Samuel Eilon Model)

Value Engineering and Product Design: Introduction, Historical perspective, Value, Nature and measurement of value, Maximum value, Normal degree of value, Importance of value, The value Analysis Job Plan, Creativity, Steps to problem solving and value analysis, Value Engg. Idea generation check list, Cost reduction , materials and process selection in value engineering

Modern Approaches to product Design: Concurrent Design, Quality Function Deployment, reverse engineering,

Rapid Prototyping: Stereo lithography, Solid ground cutting, Selective laser sintering, Laminated object manufacturing, data transfer to RPT, Constraints on the Model, RPT in manufacturing, tooling, RPT in Industrial Design, Medical applications verses conventional technologies

Books Recommended

1. Product Design and Development by Kail T Ulrich and Steven D Eppinger
2. Product Design and Development by AK Chitale and Gupta
3. Design of Systems and Devices by Middendorf Marcel Dekker

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

6. System of Experimental Design: Engineering Methods to Optimize Quality and Minimize Cost, Taguchi, G. UNIPUB, White Plains, New York
7. Statistical Analysis for Engineers And Scientists, J. Wesley Barnes, McGraw Hill Inc.

COMPUTER AIDED MACHINE DESIGN

ME-523

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1. Fundamentals of CAD: Introduction: Design Process: Application of computers in design: Creating manufacturing database: benefits of CAD. Computer Hardware; Graphic input devices; display devices; Graphics output devices; Central processing unit (CPU)
2. CAD software and Database: Software configuration of a graphics system: functions of a graphics package: geometric modeling: Database structure and control;
3. Geometric Transformations: Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation: Concatenation of transformation matrices. Application of geometric transformations.
4. Computer aided design of Transmission Belts (Flat & V) using C++/VC.
5. Computer aided design of Journal Bearing.
6. Application programs for selection of Ball and roller bearings using C++/VC
7. Computer aided design of Knuckle joint using C++/VC.
8. Computer aided design & drafting of spur gear using C++/VC.
9. Introduction to Design and Engineering Applications- geometry and mass property formulations, design projects with CAE focus

Books Recommended

1. CAD/CAM Ibrahim Zeid
2. Principles of computer aided design- J Rooney and P Steadman
3. Computer Aided Graphical Design – Daniel L Rayan
4. Computer Graphics and Design- P Radhakrishnan and Kothandaraman

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.