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(A70352) OPERATIONS RESEARCH

UNIT – I

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT – II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT – III

Sequencing – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT – V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming:

Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming

problem.

Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages- applications of simulation to queuing and inventory.

TEXT BOOK :

1. Operations Research /J.K.Sharma 4e. /MacMilan
2. Introduction to O.R/Hillier & Libermann/TMH

REFERENCE BOOKS :

1. Introduction to O.R /Taha/PHI
2. Operations Research/ NVS Raju/ SMS Education/3rd Revised Edition
3. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research / Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K, Vijaya Kumar Reddy, J. Suresh Kumar/ Cengage Learning.

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(A72004) MECHATRONICS AND ITS APPLICATIONS

UNIT – I

Introduction : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface, Simulation).

Signal Conditioning : Introduction – Hardware - Digital I/O , Analog input – ADC , resolution , sped channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering

UNIT – II

Precision Mechanical Systems : Pneumatic Actuation Systems - Electro-pneumatic Actuation

Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts - Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

Electronic Interface Subsystems : TTL, CMOS interfacing - Sensor interfacing - Actuator

interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation.

UNIT – III

Electromechanical Drives : Relays and Solenoids - Stepper Motors - DC brushed motors - DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly.

UNIT – IV

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram - Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

Unit – V

Programmable Motion Controllers : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical

Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal - S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , Go to Position - Applications : SPM, Robotics.

TEXT BOOKS :

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
2. Mechatronics/M.D.Singh/J.G.Joshi/PHI

REFERENCES :

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publisers.
3. Mechatronics System Design / Devdas shetty/Richard/Thomson.

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(A70328) CAD / CAM

UNIT – I

Fundamentals of CAD/CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD ,Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT-II

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions,parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems : Numerical control, Elements of NC system, NC part programming : Methods of NC part programming, Manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Syste

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning.

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM /Groover M.P./ Pearson education
2. CAD/CAM Concepts and Applications/ Alavala/ PHI

REFERENCE BOOKS :

1. CAD/CAM Principles and Applications/P.N.Rao/ TMH
2. CAD / CAM Theory and Practice/ Ibrahim Zeid/TMH
3. CAD / CAM / CIM/Radhakrishnan and Subramanian/ New Age
4. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
5. Computer Numerical Control Concepts and programming/Warren S Seames/ Thomson.

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(A70343) INSTRUMENTATION AND CONTROL SYSTEMS

UNIT – I

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, Classification and elimination of error.

UNIT – II

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

Measurement of Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

Measurement of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT – III

Measurement of Level: Direct method – Indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubbler level indicators.

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Non- contact type of tachometer.

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle.

UNIT – IV

Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.

Measurement of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

Measurement Of Force, Torque And Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V

Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems.

TEXT BOOKS:

1. Measurement Systems: Applications & Design / D.S Kumar/Anuradha Agencies
2. Instrumentation, measurement & analysis /B.C.Nakra & K.K.Choudhary/ TMH

REFERENCE BOOKS:

1. Principles of Industrial Instrumentation and Control Systems/ Chennakesava R Alavala/ Cengage Learning
2. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies
3. Experimental Methods for Engineers / Holman/McGraw Hill
4. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
5. Mechanical Measurements / Sirohi and Radhakrishna / New Age
6. Instrumentation &Mech. Measurements /A.K. Tayal /Galgotia Publications.

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(A70355) ROBOTICS

(Elective – I)

UNIT – I

Introduction, Automation and Robotics – An overview of Robotics – classification by coordinate system and control systems - **Components of the Industrial Robotics:** Degrees of freedom – End effectors: Mechanical gripper – Magnetic – Vacuum cup and other types of grippers – General consideration on gripper selection and design, Robot actuator and sensors.

UNIT – II

Motion Analysis: Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.

Manipulator Kinematics: D-H notations - Joint coordinates and world coordinates - Forward and inverse kinematics – problems.

UNIT – III

Differential Kinematics: Differential Kinematics of planar and spherical manipulators - Jacobians – problems.

Robot Dynamics: Lagrange – Euler formulations – Newton-Euler formulations – Problems on planar two link manipulators.

UNIT IV

Trajectory Planning: Joint space scheme – cubic polynomial fit – Avoidance of obstacles – **Types of motion:** Slew motion - joint interpolated motion – straight line motion – problems.

Robot actuators and Feed back components: Actuators: Pneumatic.

UNIT V

Robot Application in Manufacturing: Material handling - Assembly and Inspection – Work cell design, work volume, Robot screan.

TEXT BOOKS :

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control / JJ Craig/ Pearson/ 3rd edition.

REFERENCES :

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klaftez/ Prentice Hall
3. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4. Robot Dynamics & Control/Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pvt. Ltd.
5. Robotics and Control / Mittal R K & Nagrath I J / TMH

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(A71402) COMPUTER INTEGRATED MANUFACTURING
(Elective – I)

Objectives:

1. To understand the basic concepts and evolution of CIM.
2. To learn about the functioning of flexible manufacturing system, automated storage and retrieval systems.
3. To study differences in variant and generative process planning.
4. To understand the concepts of lean production, JIT and concurrent engineering.

UNIT – I

CIM system, Basic concepts and evolution, manufacturing automation protocol (MAP), Technical office protocol, Island of automation, challenges and trends.

Basic layouts, product and process layout, Block and relation ship diagram, line balancing, opitz and MICLASS coding system.

UNIT – II:

Flexible manufacturing system, major elements of FMS and its problems, ERP, cell technology and FMS, Automated storage and retrieval system.

UNIT-III:

Computer aided process planning, planning for production, scheduling, quality control, computer aided process planning, variant and generative process planning

UNIT – IV:

Lean production, Historical development, JIT Kanban Concepts of supply chain, characteristics and benefits.

Concurrent engineering need & it's importance, evaluation risks of concurrent engineering integrated product development.

UNIT-V

CIM data model, open manufacturing systems and its feature, networks ,protocols and standards, data basing CIM, Product data management.

TEXT BOOK:

Computer Integrated manufacturing - A.Alavudeen, N.Venkateshwara, PHI 2013.

REFERENCES:

1. Research in Engineering Design : Theory, applications, and concurrent engineering : Vol. 7, No. 1, 1995.
2. Managing Concurrent Engineering. – Jon Turino.

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(A70337) CNC TECHNOLOGIES

(Elective – I)

Objectives:

1. Understand basic features of NC and CNC Machines and their Design Considerations.
2. To study various system devices hardware and software interpolations.
3. To know various tooling systems used in CNC Machines.
4. Understand both Manual and Computer Aided Programming for Generating Various Contours.
5. To study about the DNC systems and Adaptive Control used for various machining process.

UNIT I:

Features of NC Machines, Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, Features of NC Machine Tools, design consideration of NC machine tool, methods of improving machine accuracy.

UNIT II:

CNC Machines Elements: Machine Structure- Guideways - feed drives-spindles - spindle bearings.

System Devices: Drives, feedback devices, counting devices.

Interpolators for manufacturing systems: DDA integrator, DDA hardware interpolators, CNC software interpolators.

UNIT III:

Tooling for CNC Machines: Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers.

UNIT IV:

NC Part Programming: Manual programming-Basic concepts, Point-to-Point contour programming, canned cycles, parametric programming.

Computer-Aided Programming: General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path

generation.

UNIT V:

DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, grinding.

TEXT BOOKS:

1. Computer Control of Manufacturing Systems - Yoram Koren ,Tata Mc Graw Hill, 2009.
2. Computer Aided Manufacturing - Elanchezhian, Sunder Selvan and Shanmuga Sunder, University Science Press, Second edition.

REFERENCE BOOKS:

1. Machining Tools Hand Book Vol 3, (Automation & Control)/ Manfred Weck / John Wiley and Sons, 1984.
2. Mechatronics – HMT, TMH.
3. Computer Numerical Control-Operations and Programming – Jon Stenerson and Kelly Curron Pul, 3rd Edition.

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(A70344) MACHINE TOOL DESIGN

(Elective-I)

Objectives:

- To study comprehensive description of machine tools, drives and mechanisms.
- To know about selection of cutting speed, feed rates and general recommendations for design of feed box and gear box.
- To study criteria of various machine tool structures.
- To understand the design criteria and calculation of different guideways and power screws.
- To study the basic design principles of spindles and support systems.

UNIT – I

Introduction to Machine Tool Drives and Mechanisms : General Principles of Machine Tool Design: Working and Auxiliary Motions in Machine Tools, Parameters Defining, Working Motions of a Machine Tool, Machine Tool Drives, Hydraulic Transmission and its Elements, Mechanical Transmission and its Elements, Techno-Economical Prerequisites for Undertaking the Design of New Machine Tool, General Requirements of Machine Tool Design, Engineering Design Process Applied to Machine Tools, Layout of Machine Tool.

UNIT – II

Regulation of Speed and Feed Rates: Aim of speed and feed rate regulation, Stepped regulation of Speed, Design of speed box. – Design of Feed Box – Machine Tool Drives using Multiple Speed Motions – Special Cases of Gear Box Design – General Recommendations for Developing the Gearing Diagram – Stepless Regulation of Speed and Feed Rates.

UNIT-III

Design of Machine Tool Structures: Function of Machine Tool Structures and their requirements – Design criteria for machine tool structures – Materials of machines Tools structures – Static and Dynamic stiffness – Profiles of machine tool structure – Basic Design procedures of machine tool structures – Design of Beds – Design of Columns – Design of Housings – Design of Bases and Tables – Design of Cross Rails, Arms, Saddles and carriages – Design of Rams – Model Technique in design of machine tool structures.

UNIT-IV

Design of Guideways and Power Screws: Functions and types of Guideways – Design of Slideways – Design criteria and calculations for slideways – Guideways operative under liquid friction conditions – Design of Aerostatic slideways – Design of Anti-Friction Guideways – Combination Guideways – Protecting devices for slideways – Design of power screws.

UNIT-V

Design of Spindles and Spindle Supports : Functions of Spindle Unit and requirements – Materials of Spindles – Effect of machine tool compliance on machining accuracy - Design calculations of spindles – Anti friction bearing – Sliding bearings.

TEXT BOOK:

1. Machine Tool Design and Numerical Control - N.K. Mehta, Tata Mc Graw Hill, 3rd Edition.

REFERENCES:

1 Principles of Machine Tools - Sen G.S. & Bhattacharya, New Central Book Agency, Calcutta.

2. Design of Machine Tools - Basu S.K., Allied Publisher, 1989.

3. Machining Technology-Machine Tools and Operations – Helmi A. Yousuf and Hassan El-Hofy, CRC Press.

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(A70340) ENGINEERING OPTIMIZATION

(Elective-I)

UNIT – I

Introduction: Optimal Problem formulation: Design variables-Constraints-Objective function-Variable bounds. Engineering Optimization problems: Classification& Some examples (just theory & discussion)

Single variable non-linear optimization problems: Local minimum Global minimum & Inflection point. Necessary & Sufficient conditions theorems, some problems based on this. Numerical methods: Exhaustive Search methods- Fibonacci method, Golden section method & comparison. Interpolation methods: Quadratic.

UNIT – II

Multivariable constrained non-linear optimization problems Classical optimization techniques: Constraints-equations-Lagrangian method-inequalities-Kuhn-Tucker necessary and sufficient conditions-Quadratic problem-Statement- Wolfe's and Beale's methods.

UNIT – III

Multivariable unconstrained non-linear optimization problems: Numerical methods part a: Direct Search methods: Univariate method, Pattern Search methods: Powell, Hook-Jeeve's, Rosen Brock's search and Simplex methods.

Multivariable unconstrained non-linear optimization problems: Numerical methods part b: Gradient methods: Gradient of a function-Importance-Gradient direction search based methods: Steepest descent/ascent method, Conjugate gradient method and variable meteric method.

UNIT – IV

Geometric Programming: Posynomials – arithmetic – geometric inequality – unconstrained G.P- constrained G.P(? type only)

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – branch and bound method

UNIT – V

Sensitivity Analysis: Linear programming – Formulation – Simplex method and Artificial variable techniques-Big-M & two-phase methods- Change in the cost coefficients, coefficients & constants of the constraints, addition of variables.

Simulation-Definition-Steps involved- Types of simulation Models-Advantages

and disadvantages- Simple problems on queuing & inventory.

TEXT BOOK:

1. Engineering Optimization: Theory & Practice-S.S.Rao-New Age International Publications- Thir Edition-2003

REFERENCES:

1. Optimization for Engineering Design- Kalyanmoy Deb-Prentice-Hall of India Pvt.Ltd, NewDelhi-2005.
2. Engineering Optimization: Modern Approach – Ranjan Ganguli, University Press, 2011.
3. Operations Research- S.D.Sharma- Kedar Nath & Ram Nath Co., New Delhi
4. Operations Research: A.P.Verma. S.K.Kataria & Sons, New Delhi-110006
5. Fundamentals of Optimum in Engineering – S.S. Bhavikatti, New Age International.

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(A70359) UNCONVENTIONAL MACHINING PROCESSES

(Elective – II)

Objectives:

- To understand the need and importance of non traditional machining methods.
- To know the basic principle, equipment, process variables and mechanics of metal removal in abrasive jet machining and water jet machining.
- To study the fundamentals of tool design, surface finishing and metal removal rate of electro chemical grinding, electro chemical machining and electro chemical honing.
- To understand principles of operation, types of electrodes and process parameters and machine tool selection in EDM and Electric discharge grinding and wire cut process.
- To know the basics of Electron Beam Machining and comparison of thermal and non thermal processes.
- To study the various process parameters and applications of Plasma in manufacturing industries.

UNIT – I

Introduction: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT – II

Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

Electro – Chemical Processes : Fundamentals of electro-chemical machining, electro-chemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.

UNIT - III

Thermal Metal Removal Processes : General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM-principle and applications.

UNIT – IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes – General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT-V

Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining-principle- maskants – etchants- applications.

TEXT BOOK:

1. Advanced machining processes - VK Jain, Allied publishers.

REFERENCES :

1. Modern Machining Process - Pandey P.C. and Shah H.S., TMH.
2. New Technology - Bhattacharya A, The Institution of Engineers, India 1984.
3. Unconventional Machining Processes - C. Elanchezhian,, B. Vijaya Ramnath and M Vijayan, Anuradha Publications, 2005.
4. Unconventional Manufacturing Processes – M.K. Singh, New Age International Publishers.

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(A72005) PRECISION ENGINEERING

(Elective – II)

Objectives:

- To understand concepts of accuracy and errors due to numerical interpolation.
- To know about tolerance zone conversions, form controls, orientation controls and logical approach to tolerancing.
- To learn about design and distribution of tolerances.
- To understand the relationship between tolerance grades, machining processes and related cost aspects.

Unit-I:

Concepts of Accuracy: Introduction-Concepts of Accuracy of Machine Tools-Spindle and Displacement Accuracies-Accuracy of Numerical Control Systems-Errors due to Numerical Interpolation Displacement Measurement System and Velocity Lags

Unit-II:

Goemetric Dimensioning and Tolerancing: Tolerance Zone Conversions-Surfaces, Features of Size, Datum features-Datum Oddly Configured and Curved Surfaces as Datum Features, Equalising Datums-Datum Feature of Representation-Form Controls, Orientation Controls-Logical Approach to Tolerancing.

Unit-III:

Datum Systems: Design of Freedom, Grouped Datum systems-Different types, Two and Three mutually perpendicular grouped datum planes, Grouped Datum System with spigot and recess, pin and hole, Grouped Datum System with spigot and recess pair and Tongue-Slot Pair-Computation of Transnational and Rotational accuracy, Geometric Analysis and Application.

Unit-IV:

Tolerance Analysis: Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost Aspects, Feature Tolerances, Geometric Tolerances.

Surface Finish, Review of relationship between attainable tolerancegrades and different Machining Process. Cumulative effect of Tolerances sure fit law, normal law and truncated normal law.

Unit-V:

Tolerance Charting Techniques: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different Operations, Tolerance Worksheets and centrally analysis, Examples. Design features to facilitate Machining: Datum Features-functional and Manufacturing. Components design-Machining considerations, Redesign for Manufactured Examples.

TEXT BOOK:

1. Precision Engineering in Manufacturing – Murthy R.L., New Age International (p) Limited, 1996.

REFERENCE BOOKS:

1. Geometric Dimensioning and Tolerancing – James D. Meadows, Marcel Dekker Inc. 1995.
2. Precision Manufacturing – David Dorifield, Dae Eur Lee, Springer Publishers, 2008.

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(A70336) AUTOMATION IN MANUFACTURING

(Elective – II)

UNIT – I

Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

UNIT – II

Automated flow lines : Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT – III

Assembly system and line balancing : Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT –I V

Automated material handling : Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – V

Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing

Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing : M.P. Groover 3e./PE/PHI, 2009

REFERENCES:

1. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Pearson, 2009
2. Automation by W. Buekinsham.

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(A71403) DESIGN FOR MANUFACTURING AND ASSEMBLY

(Elective - II)

Objectives:

- To understand various general design rules for manufacturability and criteria for material selection.
- To study various machining process and tolerance aspects in machining.
- To know the design considerations for casting and welding process.
- To understand the conceptual design factors to be considered in forging, extrusion and sheet metal work.
- To study the general design guidelines for manual assembly and development of DFA Methodology.

UNIT I:

Introduction: Design philosophy – Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design.

Materials: Selection of Materials for design – Developments in Material Technology – Criteria for material selection – Material selection interrelationship with process selection – process selection charts.

UNIT II:

Machining Process: Overview of various machining processes – general design rules for machining - Dimensional tolerance and surface roughness – Design for Machining ease – Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts

UNIT III:

Metal Casting: Appraisal of various casting processes, Selection of casting process, General design considerations for casting – casting tolerances – Use of Solidification Simulation in casting design – Product design rules for sand casting.

Metal Joining: Appraisal of various welding processes, Factors in design of weldments – General design guidelines – pre and post treatment of welds – Effects of thermal stresses in weld joints – Design of brazed joints.

UNIT IV:

Forging: Design factors for forging – Closed die forging design – parting

lines of dies – Drop forging die design – General design recommendations

Extrusion, Sheet Metal Work: Design guidelines for Extruded sections - Design principles for Punching, Blanking, Bending, Deep Drawing – Keeler Goodman Forming Limit Diagram – Component Design for Blanking.

UNIT V:

Design for Assembly: General design guidelines for Manual Assembly- Development of Systematic DFA Methodology- Assembly Efficiency- Classification System for Manual handling- Classification System for Manual Insertion and Fastening- Effect of part symmetry on handling time-.

TEXT BOOK:

1. Product design for Manufacture and Assembly - Geoffrey Boothroyd, Peter Dewhurst and W.A. Knight, CRC Press.

REFERENCE BOOKS:

1. Product design and Manufacturing - A.K Chitale and R.C Gupta, Prentice – Hall of India, New Delhi, 2003.
2. Design and Manufacturing - Surender Kumar & Goutham Sutradhar , Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
3. Product Design- Kevin Otto and Kristin Wood, Pearson Education

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IV Year B.Tech. M.P.-I Sem

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(A72909) NANOTECHNOLOGY

(Elective-II)

Objective:

Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness and efficiency. The objective here is impart the basic knowledge in Nano Science and Technology.

Unit-I:

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

Unit-II:

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials:Dislocations, Twins,stacking faults and voids, Grain

Boundaries, triple and disclinations, **Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility, **Magnetic Properties**: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Unit-III:

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Unit-IV:

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

Unit-V:

Applications of Nanomaterials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wiley India Edition, 2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T.Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

Outcome:

The present syllabus of "Introduction to Nano Technology" will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

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IV Year B.Tech. M.P.-I Sem	L	T/P/D	C
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(A70390) COMPUTER AIDED DESIGN AND MANUFACTURING LAB

1. **Drafting:** Development of part drawings for various components in the form of orthographic and isometric. Representation of Dimensioning and tolerances scanning and plotting. Study of script, DXE AND IGES FILES.
2. **Part Modeling :** Generation of various 3D Models through Protrusion, revolve, shell sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling surface and Assembly Modeling. Study of various standard Translators. Design simple components.

3. a). Determination of deflection and stresses in 2D and 3D trusses and beams.
   b). Determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axisymmetric components.
   c). Determination of stresses in 3D and shell structures (at least one example in each case)
   d). Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
   e). Steady state heat transfer Analysis of plane and Axisymmetric components.

4. a). Development of process sheets for various components based on tooling Machines.
   b). Development of manufacturing and tool management systems.
   c). Study of various post processors used in NC Machines.
   d). Development of CNC part program for turnig components and milling components.
   e). Machining of simple components on NC lathe and Mill by transferring NC Code / from a CAM package. Through RS 232.
   f) Quality Control and inspection.

Any Six Software Packages from the following:

Use of Auto CAD, Micro Station, CATIA, Pro-E, I-DEAS, ANSYS, NISA, CAEFEM, Gibbs CAM, Master CAM etc.

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(A70391) PRODUCTION DRAWING PRACTICE AND INSTRUMENTATION LAB

(A) PRODUCTION DRAWING PRACTICE

UNIT – I

CONVENTIONAL REPRESENTATION OF MATERIALS: conventional representation of parts – screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits – methods of indicating notes on drawings.

Limits, Fits and Tolerances: Types of fits, exercises involving selection / interpretation of fits and estimation of limits from tables.

UNIT – II

FORM AND POSITIONAL TOLERANCES: Introduction and indication of form and position tolerances on drawings, types of run out, total run out and their indication.

UNIT – III

SURFACE ROUGHNESS AND ITS INDICATION: Definition, types of surface roughness indication – Surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components. Heat treatment and surface treatment symbols used on drawings.

UNIT – IV

DETAILED AND PART DRAWINGS: Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc.

UNIT – V

PRODUCTION DRAWING PRACTICE: Part drawings using computer aided drafting by CAD software

TEXT BOOKS:

1. Production and Drawing /K.L. Narayana & P. Kannaiah/ New Age
2. Machine Drawing with Auto CAD/ Pohit and Ghosh, PE

REFERENCES:

1. Geometric dimensioning and tolerancing/James D. Meadows/ B.S Publications
2. Engineering Metrology/ R.K. Jain/Khanna Publications

(B) INSTRUMENTATION LAB

1. Calibration of Pressure Gauges
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of Mcleod gauge for low pressure.

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IV Year B.Tech. M.P.-II Sem	L	T/P/D	C
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(A80366) PRODUCTION PLANNING AND CONTROL

UNIT-I

Introduction: Definitions – objectives of production planning and control-functions of production planning and control-elements of production control-types of production- organization of production planning and control – internal organizations department

UNIT-II

Forecasting – Importance of forecasting – types of forecasting, their uses-general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT-III

Inventory management – Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems

Introduction to MRP And ERP, LOB(Line of balance), JIT inventory, Japanese concepts.

UNIT- IV

Routing – Definition – routing procedure- Route sheets – Bill of material-factors affecting routing procedure. Schedule – definition – difference with loading.

Scheduling polices – techniques, standard scheduling methods- job shop, flow shop,.

Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT-V

Dispatching – Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

TEXT BOOKS:

1. Production Planning and Control/ M.Mahajan/ Dhanpati rai & Co
2. Production Planning and Control/ Jain & Jain/ Khanna publications

REFRENCE BOOKS :

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.

2. Production and operations Management/ R.Panneer Selvam/PHI
3. Operations Management/Chase/PHI
4. Operations management/ Heizer/Pearson
5. Production and Operations Management(Theory and Practice)/Dipak Kumar Bhattacharyya/University Press
6. Operations Management/S.N. Chary/TMH