Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded
Department of Production Engineering

M. Tech. Mechanical - CAD/CAM

Part - I and II
With effect from 2018-19

COURSE CODE	COURSE	TEACHING CREDITS			
		Credits	**L**	**T**	**P**
PCC-DM-501	Advanced Machine Design	3	3	--	--
PCC-DM-502	CAD/CAM	5	3	--	04
PCC-DM-503	Computing tools and Programming	5	3	--	04
PEC-DM-504 to 510	Students can register for any two courses from the list provided	3	3	--	--
		3	3	--	--
OEC-8*	Open Elective	3	3	--	--
AUD-9@	Audit Course – II	--	2	--	--
SUB-TOTAL		**22**	**23**	**--**	**08**
PCC-DM-511	Computer Aided Analysis	5	3	--	04
PCC-DM-512	Customization of CAD/CAM Software	5	3	--	04
PEC-DM-513 to 518	Students can register for any two courses from the list provided	3	3	--	--
		3	3	--	--
MCC-590	Research Methodology and IPR	2	2	--	--
MAC-591	English for Research Paper Writing	--	2		
SEM-DM-519	Seminar/ Mini Project	2	--	--	4
SUB-TOTAL		**20**	**16**	**--**	**12**

* - Form the given list of courses student has to appear for one of the course which is run at institute level.
@- Form the given list of courses student has to appear for one of the course which is run at institute level

List of Courses for Elective I & II	
PEC-DM-504	Enterprise Resource Planning
PEC-DM-505	System Dynamics
PEC-DM-506	Sheet Metal Modelling and Manufacturing
PEC-DM-507	Lean Manufacturing
PEC-DM-508	Reliability Engineering & Life Testing
PEC-DM-509	New Product Design
PEC-DM-510	Robotics and Material Handling

List of Courses for Elective III & IV	
PEC-DM-513	Computational Fluid Dynamics
PEC-DM-514	Product Lifecycle Management
PEC-DM-515	Project Management
PEC-DM-516	Robust Design of Products/Processes
PEC-DM-517	Digital Manufacturing
PEC-DM-518	Micro and Nano Fabrication Techniques

List of courses for Open Elective

OEC-801 Business Analytics

OEC-802 Industrial Safety

OEC-803 Operations Research

OEC-804 Cost Management of Engineering Projects

OEC-805 Composite Materials

OEC-806 Waste to Energy

List of Audit Courses

AUD-901 Project Management

AUD-902 Disaster Management

AUD-903 Sanskrit for Technical Knowledge

AUD-904 Value Education

AUD-905 Constitution of India

AUD-906 Pedagogy Studies

AUD-907 Stress Management by Yoga

AUD-908 Personality Development through Life Enlightenment Skills

Part - III and IV

Sr. No.	SUBJECT	TEACHING CREDITS			
		L	T	P	Credits
DIS-DM-601	Dissertation Part - I	--	--	32	14
	Sub Total	--	--	32	14
DIS-DM-602	Dissertation Part - II	--	--	32	14
	Sub Total	--	--	32	14

Advanced Machine Design

(Credits Theory-03)

Course Code: PCC-DM-501 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

To impart knowledge related to advance topics in mechanics of solids, analysis of structural members made from composites. Problem solving abilities are improved through study of techniques for dynamic and transient analysis.

Course Contents:

UNIT I

Solid Mechanics: Analysis of stress and strain, multidimensional stress-strain relationship, plane strain, plane stress, and axisymmetric analysis. Introduction to elastic stability, energy methods, displacement method and force method.

UNIT II

Analysis of Plates: Introduction, Love-Kirchoff's theory, stress resultants. Deflection of plates, governing equation, support conditions. Laminated composite plates, first order shear deformation theory, higher order shear deformation theory, stress- strain relationships.

UNIT III

Transient Analysis: Introduction, single degree of freedom system, multi degree of freedom system, explicit schemes, and implicit schemes of solution.

UNIT IV

Dynamic Analysis: Introduction, basic concepts of Eigen value problems, basic properties of Eigen values and Eigen vectors, iterative methods, transformation methods, approximate methods, subspace iteration method.

UNIT V

Fracture Mechanics: Introduction, Fracture mechanics approach to design, the energy criterion, the stress intensity approach, effect of material properties on fracture, dimensional analysis in fracture mechanics. Fundamental concepts: Stress concentration effect of flaws, the Griffith energy balance, the energy release rate, instability and the R curve, stress analysis of cracks, K as a failure criterion.

UNIT VI

Stress Intensity Factor: Introduction, LEFM, stress and displacement fields in isotropic elastic materials, stress intensity factor, background for mathematical analysis, approach of Westergaard,

Test methods: General considerations, K_{Ic} testing, K-R curve testing, J_{Ic} testing, G_{Ic} testing, CTOD testing.

Reference books:

1. Advanced solid mechanics: **L.S. Srinath**, Tata McGraw Hill publishers.
2. Theory of plates and shells: **Timoshenko and Goodiar**, Tata McGraw Hill international.
3. Mechanics of composite materials: **R.M. Jones**, Wiley international
4. CAD and Design of machine elements: **M.A. Rao, R. Bhatt Rao**, New Age publishers.
5. Fracture mechanics, fundamentals and applications: **T.L. Anderson**, CRC Press, 2nd edition.

Course Outcomes:

At the end of course students will able to;

1. Determine the stresses and strains in 3D domain.
2. Analyze isotropic and composite laminated plates for different loading and support conditions.
3. Solve time dependent and dynamic problems in solid mechanics using different methods.
4. Interpret modes of fracture failure and apply concepts of energy and SIF approach.

CAD/CAM

(Credits Theory-03)

Course Code: PCC-DM-502 **Contact Hours: Th. 03 T- 00 Pr. 04**

Unit I

CAD/CAM Overview, CAD/CAM product life cycle, Computer hardware and software for CAD/CAM applications, Software modules in CAD/CAM systems, CAD/CAM Software classification

Unit II

Computer Aided Design, Design and computer applications, Solid modeling techniques

Unit III

Mathematics for CG, Transformations, Storage and representations for wireframe modeling, solid modeling, Curves and surface representations

Unit IV

CAD Software, Sketching, Solid and surface Modeling, Assembly, Drafting

Unit V

Computer applications for Production planning and control, shop floor control, Process planning, Group technology, Facility layout, Quality control, AI and Simulation, MRP-I, MRP-II

Unit VI

CNC and part programming, NX CAM, CAD data exchange and CAD standards, Key enabling technologies, Integration of CAD/CAM

References

[1] C. R. Alavala, CAD/CAM Concepts and Applications, 3rd ed., New Delhi: Prentice Hall of India Learning Private Limited, 2011, p. 539.

[2] A. Alavudeen and N. Venkateshwaran, Computer Integrated Manufacturing, 3rd ed., New Delhi: Prentice Hall of India Learning Private Limited, 2011, p. 420.

[3] Rogers and Adams, Mathematical aspects of computer graphics, 2nd ed., New Delhi: McGraw Hill Publishing, 2017, p. 632.

[4] I. Zeid, Mastering CAD/CAM, 2nd ed., New Delhi: Tata McGraw-Hill Publishing Company Limited, 2008, p. 932.

[5] M. P. Groover and E. W. Zimmers, CAD/CAM: Computer-Aided Design and Manufacturing, 5th ed., New Delhi: Prentice-Hall of India Private Limited, 2008, p. 512.

[6] C. McMahon and J. Browne, CAD/CAM: Principles, Practice, and Manufacturing Management, 2nd ed., Addison Wesley Publication Co. Inc., 1999, p. 624.

[7] Schaefer, Dick; Editor, Cloud-Based Design and Manufacturing (CBDM) - A Service-Oriented Product Development Paradigm for the 21st Century, Switzerland: Springer International Publishing, 2014.

[8] X. Xun, Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control: Principles and Implementations, New York: InformatIon Science reference, 2009.

Term Work:

At least 8 assignments based on following softwares

Solid modeling, assembly modeling, drafting assignments using software like UNIGRAPHICS, Solid Works, CATIA, Pro/Engineer, Autodesk Inventor, etc and study of the various facilities in these software

Computational tools and Programming

(Credits Theory-03)

Course Code: PCC-DM-503 **Contact Hours: Th. 03 T- 00 Pr. 04**

Unit I – Computational tools

Octave/MatLab, MathCAD and its applications; Spreadsheet software and their use for data management and problem solving

Unit II – Structured Programming and IDEs

Problem solving and algorithms/flowcharts; C programming fundamentals – Data types, Functions, Arrays, pointers, structures and file handling, Memory management; Integrated development environments IDEs, Editor, Compiler, Linker, Debugging, Libraries

Unit III – Programming applications development

Algorithm and Program development for various topics in data structures, numerical methods, mechanical design and manufacturing, Costing and estimation

Unit IV – DBMS and SQL

Database management system concepts and Structured Query Language (SQL)

Unit V – DBMS software and programming

Study of any one DBMS software like Oracle/MS Access/Visual FoxPro/My SQL/MS SQL Server; Programming using Structured Query Language

Unit VI – OOP and C++/C#

Object oriented programming concepts and programming in C++/C#

References

[1] Turbo C User's Guide, Scotts Valley, CA: Borland International.

[2] E. Balagurusamy, Programming in ANSI C, 6th ed., New Delhi: McGraw Hill Education (India) Private Limited, 2015, p. 558.

[3] A. Silberschatz, H. F. Korth and S. Sudarshan, Database System Concepts, 6th ed., McGraw Hill Education, 2013, p. 1376.

[4] Y. Kanetkar, Let us C, 5th ed., New Delhi: BPB Publications, 2004, p. 746.

[5] J. W. Eaton, D. Bateman, S. Hauberg and R. Wehbring, GNU Octave - A high-level interactive language for numerical computations, 4th for Octave version 4.0.3 ed., 2016.

[6] S. C. Chapra and R. P. Canale, Numerical Methods for Engineers, 6th ed., New York: McGraw Hill Companies Inc., 2010.

[7] B. Maxfield, Engineering with Mathcad - Using Mathcad to create and organize your engineering calculations, Burlington: Butterworth-Heinemann publications, 2006.

[8] Y. Kanetkar, Let us C++, 2nd ed., New Delhi: BPB Publications, 2017, p. 633.

[9] D. Clark, Beginning C# Object-Oriented Programming, New York: Apress Publishers, 2011.

[10] J. Walkenbach, Microsoft Excel VBA Programming, 3rd ed., New Jersey: John Wiley and Sos Inc., 2013.

Term Work:

Study of Programming in following languages:

At least eight assignments based on following syllabus

C++ using following IDEs,

Visual C++ (Visual Studio 2008 or Later)

Study of DBMS

DBMS Software: Oracle/ MS SQL Server/ Visual FoxPro / MS Access/ My SQL

Installation and overview of the DBMS Software

Use PL/SQL – For Table definition/creation and modification, using tables, insertion and modification of data, manipulating data, sorting data, displaying data from multiple tables, sub-queries, constraints, creating views, controlling user access, triggers.

Enterprise Resource Planning
(Credits Theory-03)

Course Code: PEC-DM-504 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

a. Describe the concept of ERP and the ERP model; define key terms; explain the transition from MRP to ERP; identify the levels of ERP maturity.

b. Describe the elements of a value chain, and explain how core processes relate; identify how the organizational infrastructure supports core business processes; explain the effect of a new product launch on the three core business processes.

c. Identify the international issues that impact a worldwide implementation of ERP; identify the key technological considerations and infrastructure concerns in ERP implementation; describe the strategic use of technology for ERP.

Course Contents

Unit I:

Introduction to ERP: Introduction, Evolution of ERP, Reasons for growth of ERP, Advantages / disadvantages of ERP, Evaluation of ERP, Various Modules in ERP

Unit II:

Modules in ERP: Finance and Controlling, Sales and Distribution, Materials Management, Production Planning and Control, Quality Management, Planet Maintenance, Human Resource

Unit III

Business Processes: Order To Cash, Procure To Pay, Plan To Produce, Make To Stock, Make To Order and Assemble To Order, Difference in Discrete and Process industries

Unit IV

ERP Projects: Project types, Implementation methodology, Various steps in the project Implementation, Project Preparation, Business Blueprinting, As Is – To Be Study, Gap Analysis, Realization, Final Preparation, Go Live and Support, User Training, Issues during implementation

Unit V

ERP and Related technologies: Business Process Re – engineering, MIS, Executive Information System, Decision Support System

Unit VI

ERP Market: ERP packages like SAP, BAAN, Oracle Apps, JD Edwards, Comparison Study, Evaluation and Selection

Unit VII

Future Directions in ERP: Current trends in ERP, Changes in the ERP Implementations, Faster implementation methodologies, Web enabling

Integration of ERP with SCM, SRM, CRM and PLM, system architecture, landscape and licensing

Reference Books

1. **Alexis Leon**, Enterprise Resource Planning
2. **V.K. Garg & N.K. Venkitakrishnan**, ERP Ware: ERP Implementation framework
3. **V.K. Garg & N.K. Venkitakrishnan**, ERP Concepts and Planning
4. APIC's material on ERP

System Dynamics
(Credits Theory-03)

Course Code: PEC-DM-505 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

The aim of this course is to study any industrial or organizational issue as a system problem. After understanding the system behavior the limiting factors are identified. Thus system dynamics helps study, analyse and resolve any issue as system.

Course contents:

UNIT 1: INTRODUCTION TO SD

Introduction and Overview: Purpose, Tools and Concepts of System Dynamics, Problem Definition and Model Purpose

UNIT 2: BUILDING A MODEL

Building Theory with Causal Loop Diagrams, Mapping the Stock and Flow Structure of Systems

UNIT 3: DYNAMICS IN SD MODEL

Dynamics of Stocks and Flows, Linking Feedback with Stock and Flow Structure, Understanding the dynamics of simple systems, Analyzing Systems and Creating Robust Policies

UNIT 4: GROWTH STRATEGIES

Modeling Innovation Diffusion and the Growth of New Products, Network Externalities, Complementarities, and Path Dependence

UNIT 5: DYNAMICS OF GROWTH

S shaped growth, path dependence, delays. Modeling, decision making, formulating nonlinear relationship, model testing.

UNIT 6: CASE STUDIES

Reference Books:

1. **Sterman, J.** Business Dynamics: Systems Thinking and Modeling for a Complex World. Irwin/McGraw Hill
2. **Kim Warren**, Strategic Management Dynamics, John Wiley & Sons, Ltd
3. Books by **Jay Forrester**
4. System Dynamics Review Volumes

Course Outcomes:

At the end of course students will able to;

1. Apply brainstorming for solving of various case studies of system dynamics.

2. Utilize different software commands in creation of process flow for real life problems to improve the quality of the product and reduce time to bring the product in market.
3. Carry out inter relationship of dependent parameters by considering different cases like internet users, product inventory, and oscillatory system

Sheet Metal Modelling and Manufacturing

(Credits Theory-03)

Course Code: PEC-DM-506 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

To study strain and stress developed during sheet metal forming, volume constancy principle in sheet metal forming, elastic and plastic deformation, modes of deformations-deep drawing, bending, stretching and combination of types of forming.

Course contents

UNIT I:

Sheet Metal Modeling:

Sheet Metal Methods, Stages in the Process, Designing with Sheet Metal Features, Miter & Edge Flanges, Bend Angles, Adding a Tab, Flat Pattern, Cuts, Sheet Metal Parts in Drawings, Sheet Metal Forming Tools, Edge Flanges and Closed Corners, Hems, Curved Edge Flanges, Designing in Flat, Existing Rounds, Using Symmetry, Manual Relief Cut, Break Corner, Jog Feature, Lofted Bends, Sheet Metal Topics, Recognize Bends Method, Opening IGES Files, Using the Rip Feature, Adding Bends in Place of Sharp, Corners, Sheet Metal Features, Making Changes, Adding a Welded Corner, Sheet Metal from Shelled Parts, Unrolling Cones and Cylinders, Process Plans,

UNIT II:

Plastic Deformation in Metals:

The flow curve, true stress, true strain, yielding criteria for ductile metals, plastic stress – strain relations, strain hardening coefficient, normal anisotropy coefficient, formability evaluations, drawability tester, high strength, low alloy steels developed for formability: HSLA steels, Dual phase steels, DQAK steels, CHR-X steels, two- dimensional plastic, flow – slip line field theory, Mechanics of metal working, Temperature in metal working, strain rate effects, metallurgical structures, Friction and lubrication, lubricants for hot and cold working, Deformation zone geometry, workability and residual stresses

UNIT III:

Forming Equipment:

Forming Equipment - types and press construction, Principle of working of Mechanical, Hydraulic and Pneumatic press. Press control system in forging equipments, Presses for hydro forming, selection of presses

UNIT IV:

Sheet Metal forming:

Press tool operations - classification based on type of stresses, Shearing operations (blanking and piercing), and effect of clearance, Calculation of punching force, Trimming, Shaving, Nibbling and Notching operations, Drawing and Deep drawing, redrawing, limiting draw ratio, forming limit criteria draw die design. Bending, spring back in bending. Spinning, stretch forming, Embossing, Coining, Rubber forming. Defects in formed parts. Sheet Metal Forming Dies – progressive die, compound and combination die. Die Construction, Center of pressure calculation, Stock strip layout, Strip development

UNIT V:

MEASUREMENT OF INTRINSIC PROPERTIES:

Measurement of strain hardening exponent, nvalue, Measurement of strain-rate, sensitivity; m value, measurement of plastic strain ratio, r value.

UNIT VI

QUALITY EVALUATION METHODS FOR RAW MATERIALS USED IN METALFORMING APPLICATIONS:

what is formability, need for formability test, and classification of formability tests: bending, drawing, stretching, combined mode test, critical assessment of formability test, forming limit diagram: Determination of forming limit diagram

UNIT VII:

Innovations in sheet metal forming:

Hydro forming, tailor welded blank forming, hot stamping, spring back effects and micro forming. Defects in sheet metal forming, and remedial solutions.

Reference Books

1. **Dieter G. E. Bacon David**, Mechanical metallurgy, McGraw Hill, ISBN-0-07-100406-8
2. **Grobh Schuler**, Metal forming handbook, Springer Verlag Berlin, Heidelberg, 1998, ISBN-3-540-61185-1
3. **Cyril Donaldson, George H. Locain, V. C. goold**, Tool Design, Tata McGraw Hill, ISBN-0-07-099274-6
4. **Frank w. Wilson**, Fundamentals of tool design, ASTME, prentice Hall of India, New Delhi ISBN-0-87692-058-10
5. **Roy A. Lindberg**, Processes and materials of manufacturing, Prentice Hall of India, New Delhi, ISBN-81-203-0663-5
6. **Prakash H. Joshi**, Press tools: design and construction, Wheeler Publishing, New Delhi, ISBN-81-85814-46-5

Course Outcomes:

At the end of course students will able to;

1. Identify modern software tools for sheet metal forming analysis.
2. Classify various modes of deformation and defects involved in sheet metal forming Processes.
3. Apply formability criteria for sheet metal component manufacturing.
4. Analyze critical conditions involved in complex sheet metal components forming.
5. Evaluate various materials suitable for sheet metal component manufacturing.

Lean Manufacturing
(Credits Theory-03)

Course Code: PEC-DM-507 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

a. To provide conceptual understanding of JIT Logic along with Pull and Push production system. Implementation of JIT principles to waste elimination along with understanding of Japanese approaches.
b. To emphasis on Kanban system to counter problems & dealings of both suppliers and contractors with the help of related Kanban cards.
c. To make understanding of the rise of lean production along with birthplace, concrete example, company as community, final assembly plant, product development and engineering, changing customer demand and future of lean production.
d. To promote people for creating an organization and installing business system to encourage lean thinking

Course Contents

Unit I:

Just In Time Production System: JIT Logic -Pull system, Japanese approach to production elimination of waste, JIT implementation requirements, JIT application for job shops

Unit II:

Kanban System: Kanban rules supplier Kanban and sequence schedule used by supplier, Monthly information & daily information, Later replenish system by Kanban sequenced withdrawal P system by sequence schedule table -problems & counter measures in applying Kanban system to subcontractors -Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office.

Unit III:

The Rise & Fall of Mass Production: Mass production, work force, organization, tools, product –logical limits of mass production, Sloan as a necessary compliment to Ford

Unit IV:

The Rise of Lean Production: Birthplace, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production.

Unit V:

Shortening of Production Lead Times: Reduction of setup times, practical procedures for reducing setup time. Standardization of operations, Machine layout, multi-function workers and job rotation, Improvement activities to reduce work force and increase worker morale, foundation for improvements. Elements of Lean Production. Managing Lean Enterprise Finance, Career ladders, geographic spread and advantages of global enterprise.

Unit VI:

An action plan: Getting started, Creating an organization to channel your streams, install business system to encourage lean thinking, the inevitable results of 5-year commitment.

Reference Books

1. **Chasel Aquilino**, "Productions and Operations Management"
2. **Yasuhiro Monden**, "Toyoto Production System -An integrated approach to Just in Time", Engineering and Management Press, Institute of Industrial Engineers, Norcross Georgia.
3. **James P Womack, Daniel T Jones, and Daniel Roos**, "The Machine that changed the World. The Story of Lean Production", Harper Perennial edition, 1991.
4. **James Womack**, "Lean Thinking".
5. **Richard Schourberger**, "Japanese Manufacturing Techniques. The Nine Hidden Lessons by simplicity".
6. **James Bossert**, "Quality Function Development", ASQC Press 1991.
7. **Launshy and Weese**, "Straight talk on design of experiments".

Course Outcomes:

At the end of course students will able to;

1. Recognize the importance of Just In Time Production System
2. Analyze and evaluate problems related to Kanban system
3. Apply lean manufacturing tools to reduce lead time
4. Use elements of lean production to manage lean enterprise
5. Understand the background behind the rise of lean production

Reliability Engineering and Life Testing

(Credits Theory-03)

Course Code: PEC-DM-508 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

The aim of this course is to understand various components or products or systems through its life cycle. The course helps perform the probabilistic time analysis of products' successes and failures. Thus the course helps to predict reliability of any component or system which is essential before we put it into any use.

Course Contents

UNIT 1: Basic concepts in Reliability

Risk and Reliability, Bath tub curve, Failure Mechanism of mechanical components: causes, modes, function of mechanical elements, failure theories.

UNIT 2: Component Reliability

Failure data analysis, reliability function, hazard rate, failure rate, and their relationship, MTTF, mean failure rate, MTBF.

UNIT 3: System Reliability

Series, parallel, mixed configuration, r-out of-n structure, solving complex systems, reliability logic diagrams (RLD). Techniques of Reliability Estimation: Fault Tree analysis, tie sets and cut-sets, Boolean algebra.

UNIT 4: System Reliability Improvement

Use of better components, simplification, derating, redundancy, working environment control, maintenance, etc. Case Application of complex systems: Marine power plant, computer system, Nuclear power plant, combats aircraft, etc.

UNIT 5: Reliability Testing

Introduction, objectives, assumption, different types of test. Life testing in practice: Methodology, problems and difficulties. Economics of Reliability engineering.

UNIT 6: Acetated Life Cycle Testing

Intro, basic concepts, data qualification. Accusations faster, stress combination methods, limitations, step stress method for AST, various AST models, recent development recommended approach. Highly accelerated life testing (HALT), HASS

Reference Books

1. Mechanical Reliability by **Srinath LS**, Affiliated East-West Press Pvt Ltd, New Delhi.

2. Reliability Engineering Third Ed. by **Srinath LS**, Affiliated East-West Press Pvt Ltd, New Delhi.
3. Reliability Engineering and Life Testing by **V.N.A. Naikan**, PHI Learning Pvt. Ltd. New Delhi.
4. Reliability Engineering by **E. Balagurusamy,** TMH, New Delhi

Course Outcomes:

At the end of course students will able to;

1. Decipher multiple roots of failure that lead to Root Cause Analysis (RCA).
2. Represent failure data statistically and to plot density function, survival probability and hazard rate by using appropriate probability distribution.
3. Compute system reliability using Reliability Block Diagrams.
4. Compute reliability, MTTF and MTBF from accelerated life testing data using failure rate models.
5. Carry out FMEA and FTA to improve machine or equipment or product reliability.

New Product Design
(Credits Theory-03)

Course Code: PEC-DM-509 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

In view of appealing lead time benefits in design and manufacturing of product the course aims with the following objectives: To understand the product design process steps and their significance in terms of concurrent actions like: participative approach, e-manufacturing, use of PDMs use of PLM platforms and so on. Students are able to apply the concepts for material/process selection and design cost estimation.

Course contents

Unit I:

Introduction: Types of design, importance of design, design considerations, product life cycle, technology life cycle, benchmarking and mass customization. Concurrent design team its elements.

Unit II:

Product Design Process: Steps in design, Functional requirement analysis, Axiomatic design, Product design specifications, concurrent design model

Unit III:

Material And Manufacturing Process Selection In Design: Factors influencing material and process selection, approaches, tools and software used in selection.

Unit IV:

Design For 'X': An introduction: Design for manufacturing, assembly and dissemble, an overview of DF'X'. Deign for maintainability and serviceability, design for environment, design for aesthetic, design for packaging, design for handling, design for safety, etc.

Unit V:

Design Cost Estimation: Need, cost indexes, categories; cost-capacity factors; design to cost and life cycle costing.

Unit VI:

Product Development Approaches: Concurrent engineering, partnership with supplier, collaborative and Internet based design

Unit VII:

Design Project Management: PDM, PLM and related software tools.

Introduction to VRML, modular product design, mechanical and electronic products design. Concurrent and collaborative product development case studies

Reference Books

1. Engineering Design by **Dieter George** E. McGraw Hill Pub. Company, 2000.
2. Product design and development by **Ulrich Karl T and Eppinger Steven D**., McGraw Hill Pub. Company 1995.
3. Product Design and Manufacture by **Chitale AK and Gupta RC**, Prentice-Hall of India, New Delhi
4. Handbook of Product Design for Manufacturing, **Bralla, James G**., McGraw Hill Pub. 1986

Course Outcomes:

At the end of course students will able to;

1. Identify and analyses the Product Design and Development processes in manufacturing industry.
2. Define the components and their functions of Product Design and Development processes and their relationships from concept to customer over whole product lifecycle.
3. Analyze, evaluate and apply the methodologies for Product Design, Development and Management.
4. Apply creative thinking skills for idea generation that satisfy the customer needs.
5. Utilize different tools in Product Design and Development processes to enhancing the quality of the product and reduce time to bring the product in market.
6. Carry out cost and benefit analysis through various cost models.

Robotics and Material handling

(Credits Theory-03)

Course Code: PEC-DM-510 **Contact Hours: Th. 03 T- 00 Pr. 00**

OBJECTIVES:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To discuss about the various applications of robots, justification and implementation of robot.

UNIT I: INTRODUCTION

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems Hydraulic, Pneumatic and Electric system.

UNIT II- ROBOTS END EFFECTORS AND CONTROLS

Classification of End effectors – Tools as end effectors. Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

UNIT III- ROBOT KINEMATICS AND DYNAMICS

Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics of Six Degree of Freedom Robot Arm – Robot Arm dynamics

UNIT IV-ROBOT TRANSFORMATIONS AND SENSORS

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

UNIT V-ROBOT CELL DESIGN AND APPLICATIONS

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

UNIT VII PATHPLANNING & PROGRAMMING:

Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion – straight line motion-Robot languages -.computer control and Robot software.

REFERENCES:

1. Deb S. R. and Deb S., "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010.

2. John J.Craig , "Introduction to Robotics", Pearson, 2009.

3. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.

4.Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.

5.Ray Asfahl. C., "Robots and Manufacturing Automation", John Wiley & Sons Inc.,1985.

6.Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008

7. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987

Course Outcomes:

At the end of course students will able to;

1. Understand the complete design procedure of the robot.
2. Design Grippers for specific task to be done in the work cell & robot controls for
3. Design robot assisted automatic manufacturing cells.
4. Select correct mechanism for operation of the robot.
5. Select necessary sensors, control for satisfactory performance of the robot.
6. Understand the need of robot application in any industry.
7. Proper sensors, controller feature and programming skill for a work cell.

Computer Aided Analysis

(Credits Theory-03)

Course Code: PCC-DM-511 **Contact Hours: Th. 03 T- 00 Pr. 04**

Objectives:

The objective of this subject is to teach numerical methods like finite element analysis, finite difference technique and computational fluid dynamics, which are used in the industries extensively. The topics on shape functions, element formulation, assembly procedure, and solution techniques help understand commercial FEA soft wares and its effective utilization. The subject improves the problem solving capabilities and useful for research in future.

Course Contents

UNIT I

Finite Difference Method: Introduction, One dimensional and two dimensional problems, Boundary conditions, Method of solving simultaneous algebraic equations, Explicit method, Implicit method, Application of FDM to steady and unsteady heat conduction.

UNIT II

Finite Element Method: Introduction, Overview of FEM, Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM. Discretization, Bandwidth and its minimization, Interpolation models, Pascal triangle, Convergence requirements, Shape functions,

UNIT III

Derivation of element stiffness matrices and vectors:

Introduction, variational approach, solution of equilibrium problems using variational approach, Rayleigh-Ritz (RR) method, equivalence of FEM and variational (RR) method, derivation of finite element equations using variational approach Weighted residual approach, solution of equilibrium problems using weighted residual approach, Galerkin method, derivation of finite element equations using weighted residual method, Introduction to strong and weak form formulation

UNIT IV

Higher Order and Isoperimetric Elements: Natural Coordinates, Higher Order elements in terms of Natural Coordinates and Classical Interpolation Polynomials, Isoperimetric elements, 2D elements, Computation of element stiffness matrix, Gauss quadrature, Convergence criteria.

Assembly of finite element equations, Application of boundary conditions, Solution techniques

UNIT V

Formulation of Plate Bending Elements: Introduction to CPT, FSDT, HSDT and formulation of rectangular elements, Application to composite laminated plates.

UNIT VI

Application of FEA to fluid mechanics Problems: Theory and formulation of elements

Application of FEA to heat transfer Problems: Theory and formulation of elements

Use of software for the solution of above

Reference Books

1. "Text Book of Finite Element Analysis", **P. Seshu,** PHI Publishing, 2003
2. "Finite Element Procedures, **K. J. Bathe** PHI Publishing, 1997
3. "The Finite Element Method in Engineering" **S.S. Rao**, Pergamon Press.
4. "Finite Element Method", **J.N. Reddy**, McGraw Hill Int.
5. "Heat Transfer A Basic Approach", **Ozisik M. N.,** McGraw Hill Int. edition 1985

Term Work:

Assignments on mesh generation, and discretization of domain. Solution of problems related to structural mechanics, heat transfer and fluid mechanics using standard software like ANSYS, Hyperform etc.

Course Outcomes:

At the end of course students will able to;

1. Describe the concept, procedure and applications of FEM.
2. Derive and compute shape functions for different finite elements.
3. Solve numerical problems using simple finite elements.
4. Use variational approach to formulate finite elements by computing stiffness matrix and load vector.
5. Apply professional-level finite element software's to solve engineering problems in Solid mechanics and heat transfer.
6. Solve 1D and 2D heat transfer problems using finite difference methods.

Customization of CAD/CAM Software

(Credits Theory-03)

Course Code: PCC-DM-512 **Contact Hours: Th. 03 T- 00 Pr. 04**

Objectives:

a. Understand rapid development concepts, SDLC and prototyping
b. Learn to add more features and function to the existing command, CAD template designing, CAE analysis template customization.
c. Study User Interface customization, e. g icon/menu, naming and arrangement.
d. Learn AutoCAD/CATIA and VBA customization
e. Study API in UG/NX
f. Program development to control and link between CAD, CAE and EXCEL data.

Course Contents

Unit I:

Introduction To Customization: Customization, Application Programming Interface (API), macros, scripts

Unit II:

Tools For Customization: Object Oriented Programming (OOP), OLE interfaces in CAD/CAM software; Use of General programming interfaces like VB, VBS, VC++, OpenGL programming and System dependent programming interfaces like Visual LISP (AutoCAD), GRIP (Unigraphics), Pro-Programming (Pro/Engineer)

Unit III:

Computer-Based System Engineering: System Engineering process, Software product development life cycle, software processes, software development project management, software prototyping.

Unit IV:

Rapid Development: Core issues in rapid development, rapid development languages, lifecycle planning and customer oriented development.

Unit V:

Solid Modeling Algorithms: Euler operations, basic solid modeling algorithms

Unit VI:

Automated Solid Modeling Using Customization: Creating 2D, 3D and solid entities through API, Editing 2D, 3D and solid entities through API, Design and development of user interfaces - icons, menus, dialog boxes, Integrating databases with CAD; creating BOM or part lists,

Automated Assembly modeling through customization, Automated drafting and dimensioning using customization, Creating Automated Animations using API and animation software.

Reference Books

1. Rapid development; **Steve McConnel**, Microsoft Press
2. Software Engineering; **Ian Sommerville**, Pearson Education
3. Computer graphics; **Foley, van Dam, et al**, Pearson Education
4. OpenGL Programming guide; **Mason Woo, et al**;
5. Advanced AutoCAD; **George Omura**
6. Customizing AutoCAD; **Sham Tickoo**, Thomson learning
7. Solid Modeling; **Martti Mantilya**; Computer Science Press
8. Solid Works API using VB and C++; Custom Programming Unlimited LLC
9. GRIP programming manuals for Unigraphics (Vol. 1 and 2)
10. User Function Programming manuals for Unigraphics (Vol. 1, 2, 3)

Term Work:

Assignments based on above syllabus.

Course Outcomes:

At the end of course students will able to;

1. Identify custom software development requirements related to CAD, CAM applications
2. Design and develop the following for custom tool development in CAD software like NX, CATIA, AutoCAD, AIP, etc.
    a. User friendly and complete UIs
    b. Algorithms and programs for modeling and drafting parts, assemblies
3. Design and develop custom software for CAM applications using DBMS like MS access, VFP, Oracle.

Computational Fluid Dynamics

(Credits Theory-03)

Course Code: PEC-DM-513 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

The objective of this to study basic concepts of fluid dynamics. To study Navier stroke equations, Euler's equations. To have hands on practice on CFD software's by solving various problems which helps student in their research work

Course Contents

Unit I:

Introduction: CFD as the third dimension of fluid mechanics. Numerical Discretization methods such as Finite Difference, FEM and FVM, Why FVM as preferred method in CFD.

Unit II:

Basic Equations of Fluid Dynamics: Potential flow, Nonlinear Potential flow, Inviscid flows and viscous flows, Navier Stokes Equations, Primitive variable vs. conservation form, Dimensional form vs. Non dimensional form

Unit III:

Numerical methods for Convection - Diffusion equations: Upwinding and central difference schemes, Stability condition in terms of Courant number

Unit IV:

Numerical Methods for Inviscid Flows: Characteristic form of equations, Flux difference splitting, Application to 2-D flows such as flow through a nozzle

Unit V:

Numerical methods for Incompressible flows: The continuity equation divergence constraint. Poisson equation for pressure, Schemes such as SIMPLE due to Patankar and Spalding

Reference Books

1. **Veersteeg** and **Malalasekara,** CFD: The Finite Volume Method, Prentice Hall, 1996
2. **Anderson, Tannehill and Pletcher**, Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishers, 1984.
3. **C A J Fletcher**, Computational Methods for Fluid dynamics: Vol 1 and 2.Springer Verlag, 1987
4. **C. Hirsch**, Numerical Computation of Internal and External Flows Vol.1 and 2.
5. **D C Wilcox**, Turbulence Modeling for CFD, DCW Industries.

Course Outcomes:

At the end of course students will able to;

1. Define real life problems using various numerical methods of CFD.
2. Derive the basic/governing equations for computational domain.
3. Describe the various numerical methods required for solving CFD related problems.
4. Apply the step wise methodologies for analyzing the real life/industry problems of fluid analysis of components/ assembly in CAE software like ANSYS^{TM} Fluent.
5. Determine the nature of fluid flow in various situations of real life problems.
6. Compare analytical technique of CFD with software process for simple 1D/2D fluid flow analysis.

Product Lifecycle Management
(Credits Theory-03)

Course Code: PEC-DM-514 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

a. To present the latest material on PLM and its impact on the organization.
b. To provide an overview of the current thinking on the principles, strategies, practices, and applications of Product Lifecycle Management followed by an in-depth look at specific areas of PLM that are the focus of today's innovative organizations.
c. To provide conceptual underpinnings of PLM, along with the newest industry views on PLM applications.
d. To present frameworks which provide economic justifications for PLM projects and explain the pitfalls of a piecemeal approach to PLM.

Course Contents:

Background, overview, Need, Benefits, Concept of product Lifecycle, Components of PLM, Emergence of PLM, Why PLM is important, Customer Involvement.

The Product Lifecycle Environment, Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's PLM Vision, The PLM Strategy.

Product Lifecycle Activities, Organizational Structure, Human Resources in the Product Lifecycle, Methods, Techniques, Interfaces, Information, Standards, Vendors of PLM Systems and Components, Examples of PLM in use.

PDM basics, PDM Systems, Importance of PDM, Resolving Data Issues, A Multi-user, Multi-organization Environment, Multiple Data Definition, Justification of PDM, Reasons for implementing a PDM System.

Reference Books

1. Product Lifecycle Management by **Antti Saaksvuori** and **Anselmi Immonen**, Springer; 1 edition (November 5, 2003).
2. Relevant recent technical articles, research papers, key note addresses, etc.

Course Outcomes:

At the end of course students will able to;

1. Understand the concept and components of PLM
2. Recognize the benefits and importance of PLM in industry
3. Integrate Product Data and Product Workflow with help of PLM software package

4. Arrange the human resources in the product lifecycle
5. Prepare the product workflow and organizational structure.

Project Management
(Credits Theory-03)

Course Code: PEC-DM-515 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

The aim of this course is to inculcate the knowledge that is required to implement various projects. It develops the vision for identification and formulation of the projects. Various tools and techniques which are essential for smoother execution of projects are taught in the course. Succinctly, this course imparts the knowledge that can be applied to optimize time and resources in project implementation.

Course Contents:

Unit 1: Project Management:

Concept of Project Management, Principles of Project Management, Functions of Project Management: Planning, Organizing, Staffing, Directing & Controlling, Project Scope Verification , Functional & Matrix Organization Structure.

Unit 2: Project Network Analysis:

Project Network Diagram: Precedence Diagramming Method (PDM), Activity-on-Node (AON) & Arrow Diagramming Method (ADM), Work Breakdown Structure (WBS), Gantt Chart, Milestone Chart, Project Network Analysis (Critical Path Method and PERT), Cost Analysis of Project, Resource Allocation, Resource Smoothening & Leveling, Resource Histograms, Use of Computer Software (PRIMAVERA & MICROSOFT PROJECT) in Project Network Analysis.

Unit 3: Project Network Case Studies:

Thermal Power Project, Fertilizer Project, Turnkey Construction Project, Software Creation & Installation Project, Project Related to Mechanical Industry, Projects Related to Electronic & Communication Industry.

Unit 4: Project Economics & Project Value Analysis: [

Project Formulation, Project Plan, Project Appraisal Techniques: Net Present Value, Internal Rate of Return, Payback Period, Benefit Cost Ratio, Value Engineering job plan, Project Life Cycle Costs.

Unit 5: Project Quality, Risk & Procurement Management:

Project Quality Planning, Assurance & Control, Project Quality Management Techniques: Kaizen & Just-in-Time, Total Quality Management, Risk-Management Plan, Uncertainty, Risk Factors and Risk Tolerances, Project Quantitative Risk Analysis (Monte Carlo Analysis & Decision Tree),

Project Risk Monitoring & Control, Procurement Management Plan, Project Contract Administration.

Unit 6: Computerized Project Management:

Project Information Cell, Management Information System, Software Project Management, Categorization of Software Projects , Project portfolio Management, Software Process and Process Models, Choice of Process Models: Mental Delivery, Rapid Application Development, Agile Methods, Extreme Programming, SCRUM, Software Estimation, Effort and Cost Estimation Techniques, COSMIC Full Function Points, COCOMO II A Parametric Productivity Model, Project Tracking, Software Configuration Management, Staffing Pattern, Methods of staff selection, The Oldham-Hackman job characteristic model.

Reference Books

1. **P. Gopalakrishnan and V. E. Rama Moorthy**, Project Management, Macmillan India Ltd., New Delhi, 1993.
2. **Prasanna Chandra,** Projects: Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.
3. **B. B. Goel**, Project Management: Principles and Techniques, Deep & Deep Publications, New Delhi, 1986.
4. **UNIDO Series** on Project Management.

Course Outcomes:

At the end of course students will able to;

1. Evaluate feasibility of a project by applying relevant criteria.
2. Compute deadlines and milestones of a project.
3. Compute critical path and floats for a project by using CPM.
4. Compute uncertainties in lifecycle of a project by using PERT.
5. Learn effective resource allocation in lifecycle of a project.
6. Track project and control deadlines while creating Gantt and CPM/PERT chart in Microsoft Project.

Robust Design of Products/Processes

(Credits Theory-03)

Course Code: PEC-DM-516 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

a. To Introduce to Robustness Design Strategies and its primary tools.

b. To study Taguchi's Scheme of Experiment Design.

c. To understand Quality Loss Function, Signal to Noise (S/N) Ratios, and Steps in Robust Parameter Design.

d. To study other techniques of optimization for robust design.

Course Contents

Unit I:

Introduction to Robust Design: Robustness Strategy & its primary tools: P-Diagram, Quality Measurement, Quality Loss Function, Signal to Noise (S/N) Ratios, Orthogonal Arrays, Steps in Robust Parameter Design. Robust design and Six-Sigma for Lean Enterprises.

UNIT II:

Introduction to Taguchi's Experiment Design: Criteria for the use of experiment Design Methods: Applying Experiment Design Methods according To Situation; Problem Analysis and Empiric Parameter Reduction. Orthogonal Arrays, Graphical representation of factor combinations, Linear graphs, Variance Analysis (ANOVA), Inner-Outer arrays Design.

UNIT III:

Parameter Design According to Taguchi: Direct product design, indirect variance analysis, Product design with characteristic values, taking cost into account, Signal-to-noise ratio according to Taguchi.

UNIT IV:

Experiment Design According to Shainin: Multi-variate charts, components search, paired comparisons; Determining decisive parameters (variable search), scatter plots, randomization of experiments, B versus C test, full factorial.

UNIT V:

Response Surface Methodology (RSM): Linear experiment designs, quadratic experiment designs.

Reference Books

1. Optimizing Engineering Design - **J. Krottmaier**; McGraw Hill Ltd.

2. Taguchi Techniques for quality engineering - **Philip J. Ross** McGraw Hill Ltd.
3. Quality Control and Improvement– **A. Mitra**, Pearson Publications.
4. TQM and Taguchi Methods – **Logothetis**.

Course Outcomes:

At the end of course students will able to;

1. Interpret robust design for product and processes, Six-Sigma for Lean Enterprises
2. Identify and interpret the cost of poor quality. Apply Concept of Quality Circles and other QC tools for quality improvement.
3. Solve numerical based on ANOVA and assignment of factors to O. A.
4. Solve numerical for parameter optimization using concepts of robust design, response plots, S/N ratios.
5. Design for a Multi-variate charts, components search, paired comparisons according to Shainin.
6. Solve a case example for designing a product using response surface methodology and genetic algorithm.

Digital Manufacturing
(Credits Theory-03)

Course Code: PEC-DM-517 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objectives:

a. To understand the challenges faced by manufacturing
b. To understand the importance of digital manufacturing for business processes
c. To understand the importance of DM in PLM

Course contents

Unit I:

Introduction to Digital Manufacturing: A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing

Unit II:

Process simulation and validation: Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and OLP

Unit III:

Plant design, simulation & optimization: Station / work-cell layout design, Throughput simulation, Discrete event simulation, Optimization of material flow and logistic

Unit IV:

Manufacturing process simulation solution customization: Functionality enhancements as extensions of OOTB software solution, Reports customization, User interface customization.

Unit V:

Special Topics: Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customization, Managing collaborative process planning activities through extended enterprise, rapid product development, desktop assembly factories, Information sharing in digital manufacturing based on STEP and XML

Reference Books

1. Collaborative Design and Planning for Digital Manufacturing, Springer, 2009

Course Outcomes:

At the end of course students will able to;

1. Interpret digital manufacturing and its advantages
2. Understand and develop the digital work environment
3. Appreciate the need of DM for the Indian manufacturing industry.

MICRO AND NANO FABRICATION TECHNIQUE
(CREDITS THEORY-03)

Course Code: PEC-DM-518 **Contact Hours: Th. 03 T- 00 Pr. 00**

Objective of the course:

a. To know the use of futuristic enabling technology, "Micro and Nano" as gaining much importance in technology development,
b. To understand the potential of available technologies to scale down their responses to suit the requirements of micro/nano technology
c. To appeal the technology pull based on unit removal/deposition mechanisms with the available techniques, and map the recent applications for appropriate product development
d. To motivate student's for contribution the enabling technology of future.

Course contents

Unit I:

Introduction: Need, evolution, fundamentals and trends in micro and nano technologies; Consequences of the technology and society; Moore's law , challenges to manufacturing technology; evolution of precision in manufacturing, tooling and current scenario; micro- nana fabrication tool, requirements, scales and size effect.

Unit II:

Mecahnical Micro Machining: Introduction, principle, tools and application of : Micro - Drilling, Turning, Milling, Diamond turning, Grinding, honing, lapping, and super finishing.

Unit III:

Non-conventional micro-nano manufacturing and finishing approaches: Manufacturing and finishing approaches like, WAJM,USM, AFM, MAF micro: ECM, EDM, WEDM, LBM, EB, Focused ion beams, Hybrid processes, ELID- process principle, application and technological information, chemical machining and mechanochemical finishing.

Unit IV:

Generative and other processing routes: Lithography techniques, PVD, CVD, Electro and Electroless deposition; nano structured films and coatings.

Unit V:

Characterization and metrology tools: Introduction and example of SEM, XRD,AFM, TEM, indentation, scanning tunneling microscope, etc, on machine measuring devices, micro CMM, accuracy and precision introductory treatment and awareness.

Applications: General/industrial applications examples to micro-nano technologies

References

1. Micromachining of Materials, Joseph Mcgeough, Marcel Deccor, 2011
2. Fundamentals of Machining Processes, Hassan El-Hofy, Taylor and Francis, 2007.
3. Introduction to Micromachining, V. K. Jain, Narosa Publications, 2010
4. Nontraditional Manufacturing Processes – G.F.BENEDICT (MARCEL DEKKER JNC.)
5. Non-conventional machining by – P.K. MISHRA (NAROSA PUBLICATIONS)
6. Advanced Machining Processes, by V. K. Jain, Allied Publishers Pvt. Ltd, (2005)
7. Private communications: lecture notes of STTP on Micromachining, held at IIT Kanpur; June 2007
8. Private communications: lecture notes of SERC school on Micromachining, held at IIT, Bombay, Mumbai; June 2008.

Course Outcomes:

At the end of this course the student will be able to

1. apply knowledge in micro and nano manufacturing methods, synthesis of nano materials and characterization techniques
2. Possess knowledge and understanding of miniaturization technology.
3. Familiarity with MEMS and NEMS fabrication technology.
4. To create and understand micro and nano materials.
5. To provide knowledge of various industrial applications of nano-technology.
6. To characterize properties of Nanomaterials and know the basic types structural and different types of spectroscopic.

MCC-590 RESEARCH METHODOLOGY AND IPR

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"

4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

5. Mayall , "Industrial Design", McGraw Hill, 1992.

6. Niebel , "Product Design", McGraw Hill, 1974.

7. Asimov , "Introduction to Design", Prentice Hall, 1962.

8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Seminar/Mini Project I

(Credits Practical-02)

Course Code: SEM-DM-519 **Contact Hours: Th. 00 T- 01 Pr. 02**

Objectives:

a. To study and conduct mini projects/case studies.

b. To study different types of recent technical research papers.

c. To increase the presentation skills.

Course contents

The Seminar/Mini Project shall consist of few particulars amongst the following:

Literature review from sizable number of publications. Design / Development / Synthesis related to a particular area. Implementation of existing theory for applications, pilot experiments etc. Each student is required to prepare a report and deliver a talk based on the work carried out in mini-project under the guidance of a faculty member(s). The work carried out should be preferable related to his/her dissertation topic.

Dissertation-I
(Credits -22)

Course Code: DIS-DM-601 **Contact Hours: Th. 00 T- 00 Pr. 10**

Objectives:

The component of proficiency development builds the computational, analytical, and programming skill. Also, being proficient in any software makes a student ready with software skill that is normally required in industries. The component of part implementation prepares students for dissertation work where they identify the initial component and thus they initiate a big task. The component of term paper improves writing skill of the students that is helpful in thesis writing as well as drafting skill which is essential as a part of a career.

The dissertation Part – I has the following three components:

1. **Term Paper:**
   - ✓ The student has to select an advanced topic in field of CAD/CAM/CAE/PLM etc.
   - ✓ Collect the literature in the form of research paper/articles/case studies.
   - ✓ Prepare a term paper/review paper based on literature.
2. **Part Implementation:**
   - ✓ Problem definition of project work
   - ✓ Schedule of project
   - ✓ Part implementation of project work
3. **Proficiency Development**
   - ✓ Selection of suitable software module related to project work.
   - ✓ Development of teaching/learning aid for the software.
   - ✓ Demonstration of software module.

Each component carries weightage and every student has to comply to all theses components. The students will be evaluated separately for each of these components and shall be considered for collective performance in the score as Dissertation Part – I.

Dissertation-II
(Credits -22)

Course Code: DIS-DM-602 **Contact Hours: Th. 00 T- 01 Pr. 10**

Objectives:

Dissertation work is immensely helpful as it develops independent problem solving skill. As dissertation work requires knowledge from different streams, it enhances the empirical abilities of the students. Also, while dissertation work is going on, a student has to interact with many people that make him ready for real job environment. As far as possible the dissertations are done in industries which improve the association with industries. Ultimately this helps to enhance the employability of the students.

Dissertation Part – II may consist of the following:

The dissertation work may consist of an extensive work, study or analysis of field/industrial problems with appropriate solutions or remedies. It includes like:

1. Fabrication of model, machine, prototype on the basis of innovative ideas.
2. Modeling and/or simulation of a system and improvements in the system.
3. Design of experiments, experimental setups, fabrication of test equipment/rigs, experimentation and statistical analysis, comparison with the existing data.
4. Renovation of machines, testing equipments.
5. Extensive analysis of some problems solved with the help of suitable software.
6. Design, modeling, analysis and so on as deemed fit.

The bonafide work carried out for Dissertation Part – II should be potentially rich in terms of academics.

Dissertation Report

The project report shall be hard bound. It is a report on the work done by the student. It should have literature review, problem definition and formulation, adopted methodology, experimentation plan if any, results, conclusions, discussion and its relevance to the further work.

Examination

The viva-voce examination of the Dissertation Part – II shall consist of a presentation by the candidate and demonstration of the work, model and software.