SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR
(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

MASTER OF TECHNOLOGY

COMPUTER AIDED DESIGN AND MANUFACTURING (ME)

COURSE STRUCTURE (FOR I& II YEAR)

I YEAR I SEMESTER

S. No	COURSECODE	SUBJECT	L	T	P	C
1.	19HS0823	Research Methodology and IPR	2	-	-	2
2.	19HS0845	Computational Methods	3	-	-	3
3.	19ME3001	Computer Integrated Manufacturing	3	-	-	3
Programme Elective -I						
4.	19ME3011	Geometric Modeling	3	-	-	3
	19ME3012	CNC Technology & Programming				
	19ME3023	Additive Manufacturing and Tooling				
Programme Elective -II						
5.	19ME3013	Quality Engineering and Manufacturing	3	-	-	3
	19ME3014	Computer Aided Process Planning				
	19ME3024	Mechanical Behaviour Of Materials				
6.	19ME3002	Computer Aided Design Lab	-	-	4	2
7.	19ME3003	Computer Modeling Lab	-	-	4	2
Audit Course-1						
8.	19HS0818	English for Research Paper Writing	2	-	-	-
		Contact periods/week	**16**	**-**	**8**	**18**
			Total/Week 24			

I YEAR II SEMESTER

S .No	COURSECODE	SUBJECT	L	T	P	C
1.	19ME3004	Finite Element Methods	3	-	-	3
2.	19ME3005	Rapid Prototyping	3	-	-	3
PROGRAMME ELECTIVE -III						
3.	19ME3015	Advances in Manufacturing Technology	3	-	-	3
	19ME3016	Advanced Optimization Techniques				
	19ME3025	Product Life Cycle Management				
PROGRAMME ELECTIVE-IV						
4.	19ME3017	Computer Graphics	3	-	-	3
	19ME3018	Robotics				
	19ME3026	Non Destructive Testing				
5.	19ME3006	Manufacturing Engineering Lab (Virtual Lab)	-	-	4	2
6.	19ME3007	Computer Aided Analysis Lab	-	-	4	2
AUDIT COURSE-II						
7.	19HS0829	Constitution of India				
8.	19ME3008	Mini-Project	-	-	4	2
		Contact periods/week	**14**	**-**	**12**	**18**
			Total/Week 26			

II YEAR I SEMESTER

S. No	COURSECODE	SUBJECT	L	T	P	C
PROGRAMME ELECTIVE-V						
1.	19ME3019	Mechatronics	3	-	-	3
	19ME3020	Mechanics of Composites				
	19ME3027	Industrial Robotics and Expert Systems				
OPEN ELECTIVE						
2.	19HS0824	Business Analytics	3	-	-	3
	19CE1028	Cost Management of Engineering Projects				
	19EE2128	Waste to Energy				
	19ME3121	Industrial Safety				
	19ME3021	Advances in Operations Research				
	19ME3022	Composite Materials				
3.	19ME3009	Dissertation Phase – I	-	-	20	10
		Contact periods/week	**6**	**-**	**20**	**16**
			Total/Week 26			

II YEAR II SEMESTER

S No.	COURSECODE	SUBJECT	L	T	P	C
1.	19ME3010	Dissertation Phase – II	-	-	32	16
		Contact periods/week	**-**	**-**	**32**	**16**
			Total/Week 32			

Total Number of Credits= 18 +18+16+16 = 68

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I M.Tech – I Sem

L	T	P	C
2	-	-	2

(19HS0823) RESEARCH METHODOLOGY AND IPR

COURSE OBJECTIVES

At the end of this course, students will be able to:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Enrich knowledge to their research field
4. Process for filing Patent

COURSE OUTCOMES

1. Recognize appropriate research problem, errors in selecting a research problem, Scope and objectives of research
2. Critically assess research methods pertinent to technology innovation research
3. *Identify, explain, compare, and prepare the key elements of a research proposal/report*
4. Skill to understand the need of intellectual property rights, IPR protection to inventors
5.Develop procedural knowledge to Legal System and solving the problem relating to intellectual property rights for further research work and investment in R & D

UNIT – I

Research: 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 – II

Literature survey in Research: Effective literature studies approaches - analysis - Plagiarism - Research ethics

UNIT – III

Project Report: 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 – IV

Intellectual Property Rights: Nature of Intellectual Property – Patents, Designs, Trade and Copyrights - 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 – V

Patent Rights: Scope of Patent Rights - Licensing and transfer of technology –Patent information and databases - Geographical Indications - New Developments in IPR - Administration of Patent System - New developments in IPR - IPR of Biological Systems, Computer Software - Traditional knowledge, Case Studies - IPR and IITs

TEXT BOOKS

1. CR Kothari, "*Research Methodology: Methods and Techniques*" 3rd Edition, New Age International(P) Limited, Publishers, 2013
2. Neeraj Pandey & Khushdeep Dharani, "*Intellectual Property Rights*" Eastern Economy Edition, PHI Learning Private Limited,

REFERENCES

1. John W. Creswell, "Research Design – Qualitative, Quantitative and Mixed Methods Approaches" 4th Edition, SAGE Publications, New Delhi 2014
2. Ranjit Kumar, 4th Edition, "*Research Methodology: A Step by Step Guide for beginners*" SAGE Publications, New Delhi, 2014.
3. Ramakrishna B & Anil Kumar H.S "*Fundamentals of Intellectual Property Rights- for students, Industrialist and Patent Lawyers*", First Published, Notion Press, Chennai, 2017.
4. Ahuja VK, "*Intellectual Property Rights in India*", Second Edition, Mittal Books India, 2015.
5. KC Kankanala, AK Narasani & V Radhakrishnan, "*Indian Patent Law and Practice*", Oxford India Paperbacks, Edition, 2012.

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I M.Tech–I Sem

L	T	P	C
3	-	-	3

(19HS0845) COMPUTATIONAL METHODS

COURSE OBJECTIVES

1. *To train the students thoroughly in Mathematical concepts of Curve fitting, Numerical differentiation and integration and their applications*
2. *To prepare students for lifelong learning and successful careers using mathematical Concepts of Curve fitting, Numerical solution of ordinary differential equations and their applications*
3. *To develop the skill pertinent to the practice of the mathematical concepts including the students abilities to formulate and modeling the problems, to think creatively and to synthesize information*

COURSE OUTCOMES

1. *Have acquired ability to participate effectively in group discussions*
2. *Have developed ability in writing in various contexts*
3. *Have acquired a proper level of competence for employability*
4. *Have acquired computational skills to solve real world problems in engineering*
5. *To develop the essential tool of numerical integration and numerical solutions of partial differential equations*

UNIT – I

Solutions of System of Equations: Matrix notation – Determinants and inversion –Gauss elimination method

Iterative methods: Jacobi's iteration method, Gauss Seidal iteration method – Relaxation method

System of Non-Linear Equations: Newton Raphson method.

UNIT – II

Numerical Integration: Newton-Cotes integration formulas – Simpson's 1/3 rule - Simpson's 3/8 rule - Gaussian quadrature.

Optimization: One dimensional unconstrained optimization, Multidimensional unconstrained optimization – Direct methods and gradient search methods - Constrained optimization.

UNIT – III

Boundary Value Problems and Characteristic Value Problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – IV

Numerical Solutions of Partial Differential Equations: Laplace's equations – Representations as a difference equation – Iterative methods (Gauss Seidel Iteration) for Laplace's equations – Poisson equation

Parabolic Partial Differential Equations: Explicit method – Crank- Nickelson method

UNIT – V

Curve Fitting and Approximation of Functions: Least square approximation fitting of non-linear curves by least squares – Regression analysis - multiple linear regression, non-linear regression.

TEXTBOOKS

1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers,42nd Edition, 2017
2. Peter V.O'Neil, *Advanced Engineering Mathematics*, CENGAGE publisher, seventh Edition, 2011.

REFERENCES

1. T.K.V. Iyengar, *Engineering Mathematics volume-III*, S.Cand, Eleventh Revised Edition, 2016
2. Atkinson K.E., J. Wiley and Sons, *An Introduction to Numerical Analysis*, 1989.
3. Sastry S. S, *Introductory Methods of Numerical Analysis*, Prentice Hall of India, 1998.

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I M.Tech – I Sem

L	T	P	C
3	-	-	3

(19ME3001) COMPUTER INTEGRATED MANUFACTURING

COURSE OBJECTIVES

1. *To understand the* Manufacturing Systems, automation, CAD /CAM and need of CIM
2. *To understand the* Numerical Control system applications and NC part programming
3. *To understand the* CNC /DNC Technology and Group technology
4. *To understand the* Flexible Manufacturing Systems Components, Work Stations integrated with computer control systems
5. *To understand the* Approach to CAPP, MRP and CIM hierarchical structure

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Define manufacturing Systems, automation and need of interdisciplinary fields of CAD/CAM*
2. *Describe the NC part programming and develop the manual part programming*
3. *Have a broad knowledge on different types of CNC /DNC and Group Technology*
4. *Solve the problems in FMS and integrate the systems with CIM*
5. *Interrelate the different systems like CAPP, MRP with CIM*

UNIT – I

Introduction: Production Systems-Automation in production Systems-Manual Labor in production system- Automation Strategies, Economic analysis in production.

Product Design and CAD/CAM: Product Design and CAD-CAD System Hardware- CAM, CAD/CAM and CIM-Automated flow lines, Transfer mechanisms, methods of Line balancing.

UNIT – II

Numerical Control Machines: Introduction- basic components of an NC system- NC coordinate system, NC motion control system- application, advantages and disadvantages of numerical control.

NC Part Programming: Manual part programming-computer assisted part programming-NC part programming using CAD/CAM-manual data input.

UNIT – III

Computer Numerical Control: Features of CNC – The machine control Unit for CNC-Direct Numerical control (DNC).

Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

UNIT – IV

Flexible Manufacturing Systems: Components of FMS, FMS Work stations, Material Handling and Storage Systems, FMS layout configurations - Computer Control system –FMS application and benefits -Agile manufacturing systems.

UNIT – V

Computer Aided Process Planning Systems: Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning (MRP), and mechanism of MRP, benefits, and Capacity Planning.

Computer Integrated Manufacturing: Adaptive control machining systems-Adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.

TEXT BOOKS

1. Mikel P.Groover, *Automation, Production systems and Computer Integrated Manufacturing Systems*, PHI Publishers, 3rd Edition, 2014
2. P.N. Rao, *CAD/CAM principles and applications, TATA McGraw Hill, 3rd Edition,2010*

REFERENCES

1. Mikell P.Groover and Emory W.Zimmers.Jr, *CAD/CAM*, PHI Publishers, 2000.
2. K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, *Computer Aided Design and Manufacturing*, PHI Publishers,2008
3. Radhakrishnan and Subramanian, *CAD/CAM/CIM*, New Age Publisher, 2001

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3	-	-	3

(19ME3011) GEOMETRIC MODELING

COURSE OBJECTIVES

1. *Learn the modeling of curves using Bezier and B-spline approximations*
2. *Extend these definitions to surfaces*
3. *Understand both rational polynomial curves and NURBs*
4. *Work with unstructured, polygonal representations of geometry*
5. *Wide knowledge application in diverse areas such as Science, Engineering and Medicine.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Understand the need for and the different applications of geometric Modelling techniques*
2. *Understand some of the technical solutions*
3. *Be able to reason about the range of solutions to problems involving 3D objects*
4. *Understanding reinforces the knowledge being learned and shortens the overall learning curve which is necessary to solve CAE problems that arise in engineering*
5. *Familiarized with the computer graphics application in Design*

UNIT – I

Introduction: Definition, Explicit and Implicit equations, parametric equations
Cubic Splines-1: Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, Reparametrization, truncating and subdividing of curves.

UNIT – II

Cubic Splines-2: Graphic construction and interpretation, Composite pc curves.
Bezier Curves: Bernstein basis, equations of Bezier curves, Properties, Derivatives.

UNIT – III

B-Spline Curves: B-Spline basis, Equations, Knot vectors, Properties, and Derivatives.

UNIT – IV

Surfaces: Bi cubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, Surfaces of revolutions, Sweep surfaces, Ruled surfaces, Tabulated cylinder, Bilinear surfaces, Gaussian curvature

UNIT – V

Solids: Tricubic solid, Algebraic and Geometric form.
Solid Modeling Concepts: Wire frames, Boundary representation, Half space Modelling, Spatial cell, Cell decomposition, classification problem.

TEXT BOOKS

1. Ibrahim Zeid *CAD/CAM Theory & Practice*, Tata McGraw Hill, 2nd edition 2009.
2. Roger & Adams *Elements of Computer Graphics*, Tata McGraw Hill, 2nd edition 2001.

REFERENCES

1. Michael E. Mortenson, John Wiley & Sons *Geometric Modeling*, ACM digital library,
   2nd edition, 2006.
2. K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, *Computer Aided Design and Manufacturing*, PHI Publishers, 1st edition, 2008.
3. Donald Hearn and M. Pauline Baker, *Computer Graphics*, Prentice Hall, Inc.
   1st edition 1992.

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I M.Tech – I Sem

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(19ME3012) CNC TECHNOLOGY & PROGRAMMING

COURSE OBJECTIVES

1. *To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design.*
2. *To broaden and deepen their capabilities in analytical and experimental research methods.*
3. *To provide an overview of how computers are being used in design.*
4. *To understand the need for integration of CAD and CAM.*
5. *Use engineering mathematics related to geometry to understand CAD/CAM concepts.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. Understand fundamentals of NC/CNC.
2. Distinguish the product specification methods.
3. Learn Tooling for NC/CNC.
4. Learn Maintenance and Trouble Shooting of CNC Machine Tools.
5. Recall the need of design and manufacturing integration.

UNIT–I

Introduction to CNC Machine Tools: Evolution of Computerized control in manufacturing-Components, Working principle of CNC, DNC - Machining centers.

Constructional Features of CNC Machine Tools: Introduction - Spindle drives - Transmission belting - axes feed drives - Slide ways - Ball screws.

UNIT–II

Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).

Feedback Devices: Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.

UNIT–III

Electro-Magnetic Analogue Position Transducers: Principle, advantages, characteristics, Synchros, Synchro-Resolvers, Inductors, Laser interferometer.

Control Systems and Interface: Open and closed loop systems, Microprocessor based CNC systems, block diagram of typical CNC system, description of hard ware and soft interpolation systems, Standard and optional features of CNC control systems.

UNIT–IV

APT Programming: APT language structure, APT geometry, Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motion commands, continuous path motion commands, post processor commands, control commands, Macro subroutines, Part programming preparation for typical examples.

UNIT–V

Economics And Maintenance Of CNC Machine Tools: Introduction, factors influencing selection of CNC machines, Cost of operation of CNC machines, Maintenance features of CNC machines, Preventive maintenance, Documentation, Spare parts, Training in Maintenance.

TEXT BOOKS

1. Dr.Radha Krishnanan, *Computer Numerical Control Machines*, New Central Book Agency, 1989.
2. Machines Hans B.Keif and T. Frederick Waters Macmillan, *Computer Numerical Control*, McGraw Hill, 2012.

REFERENCES

1. B.S. Aditahn and Pabla, *CNC Machines*, new age international publishers, 2005.
2. Graham T. Smith, *CNC Machining technology*, Springer – Verlag, 1993.
3. G.E. Thyer, NEWNES , *Computer Numerical Machine tools*, second Edition,1991.

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I M.Tech - I Sem

L	T	P	C
3	-	-	3

(19ME3023) ADDITIVE MANUFACTURING AND TOOLING

COURSE OBJECTIVES

1. To understand the classification of am processes
2. To understand the different types reverse engineering
3. To understand the various types of liquid based and solid based additive manufacturing systems.
4. To understand the powder based additive manufacturing systems
5. To understand the soft tooling

COURSE OUTCOMES

On successful Completion of this course the student will be able to
1. Understand history, concepts and terminology of additive manufacturing.
2. Apply the reverse engineering concepts for design development.
3. Understand the variety of additive manufacturing techniques.
4. Design and develop newer tooling models.
5. Analyse the cases relevant to mass customization and some of the important research challenges associated with AM and its data processing tools.

UNIT – I

Introduction: Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits- Applications.

UNIT – II

Reverse Engineering and CAD Modeling: Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT – III

Liquid Based and Solid Based Additive Manufacturing Systems: Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT – IV

Powder Based Additive Manufacturing Systems: Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies

UNIT – V

Tooling: Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries

TEXT BOOKS

1. Chua, C.K., Leong K.F. and Lim C.S., *"Rapid prototyping: Principles and applications",* second edition, World Scientific Publishers, 2010.
2. Gebhardt, A.*, "Rapid prototyping",* Hanser Gardener Publications, 2003

REFERENCES

1. Gibson, I., Rosen, D.W. and Stucker, B., "*Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing"*, Springer, 2010
2. Hilton, P.D. and Jacobs, P.F., *Rapid Tooling: Technologies and Industrial Applications*, CRC press, 2005.
3. Kamrani, A.K. and Nasr, E.A., "*Rapid Prototyping: Theory and practice*", Springer, 2006

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I M. Tech – I Sem

L	T	P	C
3	-	-	3

(19ME3013) QUALITY ENGINEERING AND MANUFACTURING

COURSE OBJECTIVES

1. S*tudents learn about quality in design and production with economic aspects.*
2. S*tudents learn design tolerance, its need and types.*
3. S*tudents learn parameter design and methods of tolerance design.*
4. *Students get awareness on design of experiments, methods of analysis of variance and test strategies.*
5. S*tudents are taught about analysis methods of experimental results.*

COURSE OUTCOMES

1. *Students know about quality engineering, its value and its economic impact on enforcement.*
2. *Students understands importance of tolerance and its allocation in design of a component.*
3. *Students are aware of strategies adopted while parameter and tolerance designing.*
4. Students knows steps involved in DOE and analysis of occurrence of variance.
5. *Students easily interpolate experimental results, analyze and get the conclusions.*

UNIT – I

Quality Value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.

Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT – II

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components.

UNIT – III

Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT – IV

Design of Experiments: Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description.

Analysis of Variance (Anova): No-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

UNIT – V

Interpolation of Experimental Results: Interpretation methods, percent contribution, estimating the mean ISO-9000 Quality system, BDRE, 6-sigma, bench marking, quality circles - brain storming - fishbone diagram - problem analysis.

TEXT BOOKS:

1. Philip J. Ross, *Taguchi Techniques for Quality Engineering*, McGraw Hill Publisher. 2nd Edition, 2017.
2. G.Taguchi, A.Elasayed, *Quality Engineering in Production systems,* McGraw Hill Publishers, New Ed edition, 1989

REFERENCES:

1. Joseph A. De Feo, *Juran's Quality Handbook*, Atlantic *Publishers, 7nth* Edition, 2016
2. Papan P. Bagchi , *Taguchi Methods Explained: Practical Steps To Robust Design*, Prentice Hall India Publisher, 1st Edition, 1993
3. David L. Goetsch, Stanley Davis, *Quality Management for Organizational Excellence*, 7nth Edition, Pearson publishers, 2015

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I M.Tech – I Sem

L	T	P	C
3	-	-	3

(19ME3014) COMPUTER AIDED PROCESS PLANNING

COURSE OBJECTIVES

1. *To provide the student with an understanding of the importance of process planning role in manufacturing .*
2. *To understand the process planning in production environment.*
3. *To understand the CAPP and GT concepts and applications.*
4. *To appreciate the need and demand of computer aided process planning and its constituents.*
5. *To understand the various concept of dimensioning and tolerances in part and assembly design.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation.*
2. *Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence.*
3. *Explain the generation of tool path and solve optimization models of machining processes.*
4. *Create awareness about the implementation techniques for CAPP*
5. *To appreciate the various concept of decision and process planning.*

UNIT–I

Introduction to CAPP: Information requirement for process planning system - Role of process planning - advantages of conventional process planning over CAPP - Structure of Automated process planning system - feature recognition, methods.

UNIT–II

Generative CAPP System: Importance - principle of Generative CAPP system - automation of logical decisions - Knowledge based systems - Inference Engine, implementation, benefits.
Retrieval CAPP System: Significance - group technology, structure, relative advantages - implementation, and applications.

UNIT–III

Selection of Manufacturing Sequence: Significance - alternative manufacturing processes - reduction of total set-up cost for a particular sequence - quantitative methods for optimal selection, examples.
Determination Of Machining Parameters: Reasons for optimal selection of machining parameters - effect of parameters on production rate - cost and surface quality - different approaches - advantages of mathematical approach over conventional approach - solving optimization models of machining processes.

UNIT–IV

Determination of Manufacturing Tolerances: Design tolerances - manufacturing tolerances - methods of tolerance allocation - sequential approach - integration of design and manufacturing tolerances - advantages of integrated approach over sequential approach.

Generation of Tool Path: Simulation of machining processes - NC tool path generation - graphical implementation - determination of optimal index positions for executing fixed sequence - quantitative methods.

UNIT–V

Implementation Techniques for CAPP: MIPLAN system - Computer programming languages for CAPP - criteria for selecting a CAPP system and benefits of CAPP - Computer integrated planning systems - Capacity planning system.

TEXT BOOKS

1. Mikell P.Groover, *Automation Production systems and Computer Integrated Manufacturing System*, Tata McGraw Hill, 2001.
2. Dr.Sadhu Singh, *Computer Aided Design and Manufacturing*, Khanna Publishers, 2009.

REFERENCES

1. David Bedworth, *Computer Aided Engineering*, Tata McGraw Hill , 2001.
2. Rarid M.L Amirouche, *Computer Aided Design & Manufacturing*, Prentice Hall, 1992.
3. U.Rembold and R Dillmann, *Computer Aided Design & Manufacturing, Methods & Tools*, Springer, 2000.

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L	T	P	C
3	-	-	3

(19ME3024) MECHANICAL BEHAVIOR OF MATERIALS

COURSE OBJECTIVES

1. *To understand the* Basic concept of material behavior and fracture mechanism maps
2. *To understand the* Behavior under Dynamic Loads and design approaches with Failure analysis
3. *To understand the* Selection of materials based on different variables
4. *To understand the* Modern metallic materials
5. *To understand the* Nonmetallic materials like Polymers, Advanced structural ceramics etc.

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Define and discuss the mechanical behavior of materials and analysis of fracture mechanism maps*
2. *Describe the Material behavior under dynamic loads and design approaches*
3. *Have a broad knowledge on different types of Material properties and its selection*
4. *Use of modern metallic materials for engineering structure*
5. *Manufacturing of nonmetallic materials like polymers and other materials for industrial and other applications*

UNIT – I

Basic Concepts of Material Behavior: Elasticity in metals and polymers– Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior – Super plasticity–.Griffith's theory,– Ductile, brittle transition in steel–High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps.

UNIT – II

Behavior under Dynamic Loads and Design Approaches: Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law.- Safe life, Stress life, strain-life and fail - safe design approaches - Effect of surface and metallurgical parameters on fatigue – Fracture of nonmetallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT – III

Selection of Materials: Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT – IV

Modern Metallic Materials: Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT – V

Non Metallic Materials: Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.

TEXT BOOKS

1. Ashby M.F., *Materials selection in Mechanical Design*, *4th* Edition, Butter worth 2011.
2. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., *Selection and use of engineering materials*, (3rd edition), Butterworth-Heiremann, 1997.

REFERENCES

1. Flinn, R.A., and Trojan, P.K., *Engineering Materials and their Applications*, (4th Edition) Jaico, 1999.
2. George E.Dieter, *Mechanical Metallurgy*, McGraw Hill, 1988
3. Metals Hand book, Vol.10, *Failure Analysis and Prevention*, (10th Edition), Jaico, 1999.

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(19ME3002) COMPUTER AIDED DESIGN LAB

COURSE OBJECTIVES:

1. *The objective of this lab is to teach the student basic drawing fundamentals in various mechanical engineering applications, specially in automobile parts drawing.*
2. *To Understand the function of editing commands and will demonstrate the ability to use edit commands to produce accurate drawings.*
3. *To understand the proper technique of scaling and plotting to proper size and will be able to demonstrate that ability by plotting industry-quality drawings.*
4. *To understand the 3-D modeling components in machine element.*
5. *To understand the geometrical modeling of using of CATIA.*

COURSE OUTCOMES

1. *Introduction to computer aided drafting*
2. *Software for CAD – Introduction to different software*
3. *Drawing of plans of automobile parts using software*
4. *Developing sections and elevations for machine elements*
5. *Developing the assembly of flange coupling.*

List of Experiments

I Introduction to CAD software
II. 2D drafting using Auto CAD (Two exercises)
III. 3D modeling using Auto CAD (Any four exercises)
Introduction to 3D modeling using AutoCAD software

1. Modeling of Component in 3D – Drawing of steps
2. Modeling of Component in 3D – Machine Elements
3. Modeling of Component in 3D – Machine Link 1
4. Modeling of Component in 3D – Machine Link 2
5. Modeling of Component in 3D – Bracket
6. Modeling of Component in 3D – Dovetail stop
7. Geometric Modeling Using Pro-E or CATIA or solid works or iron CAD (Any four exercises)

i) CAMERA Body
ii) Automobile Spring
iii) Assembly of Screw Jack
iv) Assembly of Flange Coupling

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(19ME3003) COMPUTER MODELING LAB

COURSE OBJECTIVES

1. To understand the solid works software.
2. To understand the Modeling of Component in 3D -Riveted joint for Plates.
3. To understand the Modeling of Component in 3D -Bolt & Nut and Piston.
4. To understand the Modeling of Component in 3D - Screw Jack and Connecting rod.
5. To understand the Modeling of Component in 3D - Flange Coupling and Propeller Shaft.

COURSE OUTCOMES

On successful Completion of this Lab the student will be able to
1. Demonstrate the different tools used in solid works software.
2. Have a broad knowledge on different types of -Riveted joint for Plates.
3. Differentiate between different types of Bolt & Nut and Piston.
4. Identify the applications of different types of Screw Jack and Connecting rod.
5. Have a broad knowledge on different types of Flange Coupling and Propeller Shaft.

List of Experiments:

1. Introduction to SOLIDWORKS software
2. Modeling of Component in 3D -Riveted joint for Plates
3. Modeling of Component in 3D -Bolt & Nut
4. Modeling of Component in 3D -Piston
5. Modeling of Component in 3D -Screw Jack
6. Modeling of Component in 3D -Connecting rod
6. Modeling of Component in 3D -Flange Coupling
7. Modeling of Component in 3D -Propeller Shaft

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(19HS0818) ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVES

1. *To understand that how to improve writing skills and level of readability.*
2. *To learn about what to write in each section.*
3. *To understand the skills needed when writing a Title.*
4. *To ensure the good quality of paper at very first-time submission.*
5. *To know the strategies and techniques for preparing academic projects.*

COURSE OUTCOMES

1. *To recognize and demonstrate the style and conventions of research writing.*
2. *To improve the clarity and coherence of their written proposal.*
3. *Able to use a variety of sentence patterns.*
4. *To enhance their revision and proofreading skills.*
5. *To use effective strategies and techniques to construct their academic projects.*

UNIT-I

Planning and Preparation- Word Order- Breaking up long sentences- Structuring Paragraphs and Sentences- Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-II

Clarifying Who Did What- Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism- Sections of a Paper, Abstracts and Introduction.

UNIT-III

Review of the Literature,-Methods, Results, Discussion, Conclusions and The Final Check.

UNIT-IV

Key skills needed when writing Title- Key skills needed when writing abstract- Key skills needed when writing an Introduction- Skills when writing a Review of the Literature.

UNIT-V

Skills needed when writing the Methods- Skills needed when writing the Results- Skills needed when writing the Discussion- Skills needed when writing the Conclusions.

TEXT BOOKS

1. Adrian Wallwork ,*English for Writing Research Papers*, Springer New York Dordrecht.Heidelberg London, 2011.
2. Adrian Wallwork, *English for Academic Correspondence and Socializing***,** Kindle Edition, 2011

REFERENCES

1. Day R *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006.
2. Highman N *Handbook of Writing for the Mathematical Sciences*, SIAM, Highman's Books, 1998.
3. Goldbort R *Writing for Science*, Yale University Press, 2006.

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(19ME3004) FINITE ELEMENT METHODS

COURSE OBJECTIVES

1. *To learn basic principles of finite element analysis procedure*.
2. To *learn the theory and characteristics of finite elements that represent engineering structures.*
3. *To learn and apply finite element solutions to structural, thermal, dynamic problems.*
4. *To develop the knowledge and skills needed to effectively evaluate finite element analyses*.
5. *To understand boundary condition applications.*

COURSE OUTCOMES

1. *Understand the concepts behind formulation methods in FEM*
2. *Identify the application and characteristics of FEA elements such as bars, beams, plane and iso- parametric elements.*
3. *Develop element characteristic equation and generation of global equation.*
4. *Able to apply suitable boundary conditions to a global equation for bars, trusses, beams .etc.*
5. *Understand the concepts of Nodes and elements*

UNIT – I

Formulation Techniques: Methodology - Engineering problems and governing differential equations-finite elements- Variational methods-potential energy method - Rayleigh Ritz method - Galerkin's and Weighted residual method.

UNIT – II

One-Dimensional Finite Element Methods: Bar elements - temperature effects - Element matrices- assembling of global stiffness matrix - Application of boundary conditions - Elimination and penalty approaches - solution for displacements, reaction, stresses.
Heat transfer problems: One - dimensional - conduction and convection problems on fins.

UNIT – III

Trusses: Element matrices- assembling of global stiffness matrix- solution for displacements, reaction, stresses, temperature effects.
Beams and Frames: Element matrices- assembling of global stiffness matrix - solution for displacements, reaction, stresses.

UNIT – IV

Two Dimensional Problems: CST- LST, four nodded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles - serendipity interpolation functions.
Heat Transfer Problems: Conduction and convection- two-dimensional fin.
Isoparametric Formulation: Concepts - sub parametric - super parametric elements - numerical integration.

UNIT – V

Finite Elements in Structural Dynamics: Dynamic equations- Eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement - complete and incomplete interpolation functions - Pascal's triangle.

TEXT BOOKS

1. Tiruapathi R Chandruputla and Ashok D. Belegundu, *Introduction to Finite element in Engineers*, Pearson Publishers, 2012
2. J N Reddy, *Finite element method in Heat transfer and fluid dynamics*, CRCpress, 2nd edtion, 1994

REFERENCES

1. Zienckiwicz O.C. & R. L. Taylor, *Finite Element Method*, McGraw-Hill,1983.
2. J. N. Oden, *Finite Element of Nonlinear continuation*, McGraw-Hill, New York, 1971.
3. K. J. Bathe, *Finite element procedures*, Prentice-Hall, 1996

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(19ME3005) RAPID PROTOTYPING

COURSE OBJECTIVES

1. *To provide the students with an understanding of the basic fundamentals of rapid prototyping.*
2. *To learn different algorithms associated with STL file errors in Rapid Prototyping*
3. *To understand the various types layering techniques*
4. *To understand the design manipulations for the generation of support structure.*
5. *To understand the different types of materials in Rapid Prototyping*

COURSE OUTCOMES

1. *The student will be able to apply solid modeling concepts and techniques in RP*
2. *Analyze and implement the different algorithms associated with STL file errors.*
3. *Able to calculate the layer thickness in different layering techniques.*
4. *Can carry out design manipulations for the generation of support structure*
5. *Able to identify, characterize and select the ideal materials for a given Rapid Prototyping system.*

UNIT-I

Introduction: Need for the compression in product development - History of RP system- Survey of applications - Growth of RP industry and classification of RP system.

Stereo Lithography System: Principle- Process parameter- Process details- Data preparation- Data files and machine details- Applications.

UNIT-II

Fusion Decomposition Modeling: Principle-process parameter - Path generation- Applications.

Solid ground curing: Principle of operation- Machine details-Applications.

Laminated Object Manufacturing: Principle of Operation - LOM materials - Process details - Applications.

UNIT –III

Concepts Modelers: Principle - Thermal jet printer - Sander's model market- 3-D printer- Genisys Xs printer HP system 5 - Object Quadra system.

UNIT–IV

Laser Engineering Net Shaping (Lens)

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling- Cast kriksite - 3Q keltool, etc, Direct Rapid Tooling Direct - AIM - Quick cast process-Copper polyamide - Rapid Tool- DMILS- Prometal- Sand casting tooling - Laminate tooling soft - Tooling vs. Hard tooling.

Software For RP: STL files - Overview of Solid view - magics- imics- magic communication - Internet based software - Collaboration tools.

UNIT-V

Rapid Manufacturing Process Optimization: Factors influencing accuracy - Data preparation error - Part building error - Error in finishing- Influence of build orientation.

Allied Process: Vacuum casting - surface digitizing - Surface generation from point cloud- Surface modification- Data transfer to solid models.

TEXT BOOKS

1. N.Hopkinson , RJM Hauge ,*Rapid manufacturing*, Wiley publishers, 1st edition,2006
2. Paul F.Jacobs SME ,*Stereo lithography and other RP & M Technologies*, NY, 1996

REFERENCES

1.Frank w. Liou, *Rapid prototyping & Engineering applications*- CRC Press Taylor & Francis Group, 2007
2. Flham D.T & Dinjoy S.S ,*Rapid Manufacturing*, Verlog London , 2004
3. Lament wood ,*Rapid automated*, Indus Press New York.

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(19ME3015) ADVANCES IN MANUFACTURING TECHNOLOGY

COURSE OBJECTIVES

1. *In-depth understanding of specialist bodies of knowledge within the engineering discipline.*
2. *Application of systematic engineering synthesis and design processes.*
3. *To provide the students with an understanding of the basic fundamentals of welding and surface processing operations*
4. *Fluent application of engineering techniques, tools and resources.*
5. *The students are expected to understand special machining processes, unconventional machining processes, rapid prototyping processes and nano technology*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Define and describe the fundamentals and principals of advanced manufacturing Technology*
2. *Apply relevant theories to solve manufacturing problems*
3. *Explain manufacturing processes via experimental and theoretical analyses*
4. *Relate manufacturing theory to practice through laboratory experiments*
5. *Improve a manufacturing process either working in a team or individually*

UNIT – I

Welding Processes: Fusion and Solid state welding process, Automation in Welding-Design aspects of welds-Weldability of aluminum alloys, titanium alloys and High strength low alloy steels-Non destructive testing of welds- Residual stresses and distortion in weldments.

Surface Processing Operations: Plating and Related Processes, Physical Vapor Deposition, Chemical Vapor Deposition- Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT – II

Abrasive Jet Machining: Elements of the process, mechanics of metal removal process parameters-economic considerations- applications and limitations- recent developments.

Ultrasonic Machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters-economic considerations- applications and limitations.

UNIT – III

Electro-Chemical Processes: Fundamentals of electro chemical machining(ECM)-metal removal rate in ECM,-Tool design- Surface finish and accuracy economics aspects of ECM.

Wire EDM Process: General Principle and applications of Wire EDM- Mechanics of metal removal-Process parameters-selection of tool electrode and dielectric fluids- methods of surface finishing and machining accuracy.

UNIT – IV

Electron Beam Machining: Generation and control of electron beam for machining- theory of electron beam machining-principle, advantages, and limitations- comparison of thermal and non-thermal processes.

Plasma Arc Machining: Principle- machining parameters, effect of machining parameters on surface finish and metal removal rate-applications, limitations

Laser Beam Machining: Principle- effect of machining parameters on surface finish-applications and limitations.

UNIT – V

Rapid Prototyping: Working principle methods-Steriolithography, Laser sintering, Fused deposition method-applications and limitations

Nano Technology: Nano milling processes, wet milling, dry milling, nano materials, fabrication of nano tubes- advantages of nano tubes- mechanical properties.

TEXT BOOKS

1. P. N. Rao,*Manufacturing Technology*, TMH Publishers,vol 2, 2009
2. Mikell P. Groover, ,*Fundamentals of Modern Manufacturing*, John Wiley & Sons Publishers,4th Edition, 2002.
3. Pandey P.S. and Shah.N,*Modern Manufacturing Processes,*Tata McGraw Hill, 1980

REFERENCES

1. G.S.Sawhney, *Manufacturing Science* ,IK International Publishers House Pvt. Ltd, 2015
2. Dr.R.S. Parmer, *Welding Processes and Tecnology*,Khanna Publishers,3rd Edition, 2003
3. Poole and Owens, *Introduction to Nanotechnology*,Wiley, 2003.

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(19ME3016) ADVANCED OPTIMIZATION TECHNIQUES

COURSE OBJECTIVES:

1. *To enable the student to Enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems*
2. *To Learn classical optimization techniques and numerical methods of optimization.*
3. *To Know the basics of different evolutionary algorithms.*
4. *To understand Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.*
5. *To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems.*
2. *Use classical optimization techniques and numerical methods of optimization.*
3. *Describe the basics of different evolutionary algorithms.*
4. *Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.*
5. *Investigate, study, develop, organize and promote innovative solutions for various applications.*

UNIT – I

Linear Programming: Two-phase simplex method - Big-M method, duality, interpretation, applications.

Assignment Problem: Hungarian's algorithm, Degeneracy, applications, unbalanced problems - traveling salesman problem.

UNIT – II

Classical Optimization Techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical Methods For Optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT – III

Genetic Algorithm (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, utation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA.

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT – IV

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.

UNIT – V

Applications Of Optimization In Design And Manufacturing Systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

TEXT BOOKS

1. Jasbir sing Arora, *Optimal design*, Mc Graw Hill, Publishers, Fourth Edition, 2012
2. Kalyanmoy Deb, *Optimization for Engineering Design*, , PHI Publishers , 2nd Edition, 2012

REFERENCES

1. R. Lowen and A.Verschoren *Foundation of generic Optimization*, , Spinger publishers,2nd2008,
2. John R . Koza. Forrest H BENNett ,*Genetic Programming*, , MK Publishers,1999.
3. Kalyanmoy Deb ,*Multi objective Optimization*, , PHI Publishers
4. S.S.Rao, *Engineering Optimization* –New Age Publishers, Forth Edition , 2009

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(19ME3025) PRODUCT LIFE CYCLE MANAGEMENT

COURSE OBJECTIVES

1. *To understand history, concepts and terminology of PLM.*
2. *To understand functions and features of PLM/PDM.*
3. *To understand different modules offered in commercial PLM/PDM tools*
4. *To understand PLM/PDM implementation approaches.*
5. *To understand integration of PLM/PDM with other applications*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. Understand history, concepts and terminology of PLM.
2 .Apply the functions and features of PLM/PDM.
3. Analyse the case studies.
4. Understand PLM/PDM implementation approaches.
5. Integrate PLM/PDM with other applications.

UNIT–I

History, Concepts and Terminology of PLM : Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM).

PLM/PDM Infrastructure: Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT–II

PLM/PDM Functions And Features : User Functions –Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT-III

Details Of Modules in a PDM /PLM Software : Case studies based on top few commercial PLM/PDM tools.

UNIT–IV

Role of PLM in Industries : Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation,

users, product or service, process performance.

UNIT-V

Basics on Customisation/Integration of PDM/PLM Software : PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP.

TEXT BOOKS

1. Antti Saaksvuori and Anselmi Immonen, *"Product Lifecycle Management",* Springer Publisher, 3rd Edition, 2008.
2. *International Journal of Product Lifecycle Management,* Inderscience Publishers.

REFERENCES

1. John Stark, *Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question,* Springer Publisher, 2007.
2. Michael Grieves, *Product Life Cycle Management,* Tata McGraw Hill, 2006.
3. John Stark, *Product Lifecycle Management: 21st Century Paradigm for Product Realisation,* Springer Publisher, 2nd Edition, 2011

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(19ME3017) COMPUTER GRAPHICS

COURSE OBJECTIVES

1. *To understand the* working computer input & output devices.
2. *To understand the* different types of filling algorithms & line clipping.
3. *To understand the* various types of polygon clipping algorithms & transformations.
4. *To understand the* Rendering process.
5. *To understand the* Shading Algorithms.

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. Demonstrate the different computer hardware.
2. Describe the various properties of different algorithms.
3. Have a broad knowledge on different types of clipping algorithms & transformations.
4. Differentiate between different types of Rendering used in Industrial Application.
5. Identify the applications of different types of Shading Algorithms.

UNIT – I

Introduction To Computer Graphics: Color CRT raster scan monitors- plasma display & liquid crystal display monitors - computer input devices - hard copy devices.
Raster Scan Graphics: Line drawing algorithms – DDA & Bresenham algorithms - circle generation - general function rasterization - displaying lines, characters and polygons.

UNIT – II

Filling Algorithms: Polygon filling - edge fill algorithm - seed fill algorithm - fundamentals of Antialiasing and half toning.
Line Clipping: Simple visibility algorithm - Cohen-Sutherland subdivision line clipping algorithm - Midpoint sub division algorithm.

UNIT – III

Polygon Clipping: polygon clipping - reentrant polygon clipping – Sutherland – Hodgeman algorithm -character clipping - 3D- clipping.
Transformations: Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming - viewing transformation – reflection - rotation about an axis - concatenation.

UNIT – IV

Rendering: Hidden line removal algorithms - surface removal algorithms – painters-Warnock - Z-buffer algorithm.

UNIT – V

Shading Algorithms: Constant intensity algorithm - Phong's shading algorithm - gourand shading algorithm - Comparison of shading algorithms.

TEXT BOOKS

1. D.F.Rogers, *Procedural elements for computer graphics,* Tata McGraw-Hil, 1985.
2. Donald Hearn & M.P. Bakers, *Computer Graphics,* Person Education Publishers, 2nd Edition, 2008.
3. A.Rajeswari, *Computer Graphics,* Professional Publication, 1st Edition, 2009.

REFERENCES

1. S.*Harrington*, *Computer Graphics A Programming Approach*, Tata McGraw-Hil, 7th Edition, 1987.
2. Enderle G., Kansy K., Andpfaff G., *Computer Graphics* Programming, Springer, 2ndEdition.
3. Zigang Xiang ., Roy Plasock, *Computer Graphics*, Tata McGraw-Hil, 2nd Edition, 2007.

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(19ME3018) ROBOTICS

COURSE OBJECTIVES

1. *To develop the student's knowledge in various robot structures and their workspace.*
2. *To develop student's skills in performing spatial transformations associated with rigid body motions.*
3. *To develop student's skills in perform kinematics analysis of robot systems.*
4. *To provide the student with knowledge of the singularity issues associated with the Operation of robotic systems.*
5. *To provide the student with some knowledge and analysis skills associated with trajectory planning.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.
2. Apply spatial transformation to obtain forward kinematics equation of robot manipulators.
3. Solve inverse kinematics of simple robot manipulators.
4. Obtain the Jacobian matrix and use it to identify singularities.
5. Generate joint trajectory for motion planning.

UNIT – I

Introduction: Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors.

Robot Kinematics: Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT – II

Matrix Transformations: Introduction, robots as a mechanisms– matrix representation-representation of a point in a space, representation of a vector in space, representation of a frame at the origin of a reference frame, representation of a frame in a reference frame, representation of a rigid body.

Homogeneous Transformation Matrices: Representation of a pure translation – pure rotation about an axis representation of combined transformations, transformations relative to the rotating, inverse of transformation matrices.

UNIT – III

Differential Motions and Velocities: Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

UNIT – IV

Dynamic Analysis And Forces: Introduction, Lagrangian mechanics, Effective moments of inertia, dynamic equations for multi-degree of freedom robots-kinetic energy, potential energy, the Lagrangian, robot's equations of motion, static force analysis of robots.

Trajectory Planning: Introduction, path Vs trajectory, basics of trajectory planning, joint space trajectory planning-third order polynomial trajectory planning, fifth order polynomial trajectory planning, Cartesian-space trajectories.

UNIT – V

Robot Sensors: Introduction, sensor characteristics, Position sensors-potentiometers, encoders, LVDT, Resolvers, time of travel displacement sensor, Velocity sensors-Encoders, Tachometers, differentiation of position signal, Accelerating sensors, force and pressure sensors-piezoelectric, force sensing resistor, strain gauges, Torque sensors, light and infrared sensors, touch and tactile sensors, proximity sensors-magnetic proximity sensors, optical proximity sensors, Ultrasonic proximity sensors, inductive proximity sensors, capacitive proximity sensors, eddy current proximity sensors, sniff sensors.

TEXT BOOKS

1. Mikell P. Groover & Mitchell Weiss, Roger N. Nagel,Nicholas G.Odrey., *Industrial Robotics,* Mc Graw Hill, 1986.
2. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, *Robotics Control, Sensing, Vision and Intelligence.* Mc Graw Hill, 1987.

REFERENCES

1. Rachid Manseur, *Robot Modeling and Kinematics* , Laxmi Publicationss Pvt. Ltd, 2008.
2. H. Asada and J.J.E. Slotine, *Robot Analysis and Control,* John Willey & Sons,1986.
3. Analysis and control, Robert J. Schilling, *Fundamentals of Robotics,* Prentice Hall, 1990.

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(19ME3026) NON DESTRUCTIVE TESTING

COURSE OBJECTIVES

1. *Impart the knowledge of quality assurance and inspection techniques.*
2. *To introduce the various aspects of destructive testing and Non destructive testing.*
3. *To introduce the fundamentals of radiography.*
4. *To study and understand the various types of waves of ultrasonic testing*
5. *To introduce students with fundamental concepts recent techniques.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *To provide better understanding of the principles of various Non destructive testing methods.*
2. *Able to select appropriate NDT method for testing of defects.*
3. *Understand the concept of liquid penetrant and magnetic particle testing*
4. *Acquire knowledge of ultrasonic inspection techniques*
5. *Acquire knowledge of recent techniques of NDT*

UNIT – I

Liquid Penetrant and Magnetic Particle Inspection: Liquid penetrant system – Processing cycles –Inspection of surface defects Generation of Magnetic fields-Magnetic particle inspection equipment – Demagnetization- Applications and limitations.

UNIT – II

Radiography : Production of X-rays – Characteristics rays and white rays- Tube current and voltage – Source of γ ray - Half-life period- Penetrating power – Absorption of x and γ ray – Radiation contrast and film contrast- Exposure charts - penetrometers and sensitivity –Safety.

UNIT – III

Eddy Current Inspection: Eddy current production – Impedance concepts –Inspection of magnetic materials-Inspection of Non magnetic materials –Influences of various parameters - Advantages and limitations.

UNIT – IV

Ultrasonic Testing: Production of ultrasonic waves – Different types of waves-Normal beam inspection –Angle beam inspection-Thickness measurements –Applications.

UNIT – V

Recent Techniques: Principle of acoustic emission- Instrumentation for Non destructive testing Principles of holography-Applications of holographic techniques Non destructive inspection-Advantages and limitations- Other techniques.

TEXT BOOKS

1. Barry Hull and Vernon John, *" Non Destructive Testing "*, MacMillan, 1988
2. American Society for Metals, *" Metals Hand Book "*, Vol.II, 1976.

REFERENCES

1. Holler, P., "*New Procedures in Non Destructive Testing*", Springer Verlag, 1983.
2. Progress in Acoustic Emission, *" Proceedings of 10th International Acoustic Emission Symposium "*, Japanese Society for NDI, 1990.
3. Ravi Prakash, "*Non-Destructive Testing Techniques*", 1st revised edition, New Age International Publishers, 2010
4. Baldev Raj, T.Jayakumar, M.Thavasimuthu "*Practical Non-Destructive Testing*", Narosa Publishing House, 2009

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(19ME3006) VIRTUAL LAB IN MANUFACTURING ENGINEERING

COURSE OBJECTIVES

1. *To learn about different computer-controlled tools for machining operations.*
2. *To learn about fabrication of circuit boards.*
3. *To learn about digital fabrication process.*
4. *To learn the different methods of micro machining*
5. *To study about the different tools of the micro machining.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Understand the concept of digital fabrication.*
2. *Understand the concept of design and fabrication of different types of circuit boards.*
3. *Understand about 3D scanning and 3D machining process.*
4. *Understand the different methods and tools used in micro machining process.*
5. *Understand the concept of mechanism from Lazarenko's model.*

FAB LAB

1. Computer Controlled Cutting of wooden object
2. 3D Machining
3. PCB design & fabrication
4. Interface & Application Programming
5. Digital Fabrication of Flexible Circuit board
6. 3D scanning
7. Molding and Casting of Polyurethane parts.
8. Digital Fabrication and Project Development .

MICRO MACHINING LAB

1. To study pulsed-heating of materials
2. To study erosion mechanism from Lazarenko's model
3. To study various thermal models for EDM
4. To study influence of process parameters on the Wire EDM
5. Laser hardening using NdYAG laser system
6. Laser spot welding using NdYAG laser system
7. Study of Electrochemical machining process
8. Study the effect of process parameters in electrochemical grinding

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(19ME3007) COMPUTER AIDED ANALYSIS LAB

COURSE OBJECTIVES

1. *To learn about Structural Analysis of solid*
2. *To learn about thermal analysis of 2D dimension component.*
3. *To learn about MATLAB software.*
4. *To acquire basic understanding of analysis software.*
5. *To prepare the students to use this softwares for real time applications and in their project works.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Understand the Analysis of a truss member under loading*
2. *Understand the concepts of Analysis of Tapered plate under transverse load*
3. *Understand the concepts of the flow of incompressible gas through an S-bend for laminar flow.*
4. *Understand the analysis of conductive heat transfer of different geometry 2D components.*
5. *Understand the usage of MATLAB software*

List of Experiments

Introduction to ANSYS

Structural Analysis

1) Truss Member
2) Simply Supported Beam
3) Plate with hole
4) Taper Cross Section

Thermal Analysis

1) Conductive Heat Transfer Analysis in Rectangular 2D Component.
2) Conductive Heat Transfer Analysis in Different Geometry 2D Components

Mat Lab

1) Construct Perceptron, train and test the performance
2) Construct Back Propagation Network, train and test the performance
3) Construct Radial Basis Function Network, train and test the performance
4) Build fuzzy logic membership functions through MATLAB tool box.

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(19HS0829) CONSTITUTION OF INDIA

COURSE OBJECTIVES

1. To know the premises informing the twin themes of liberty and freedomfrom a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals 'constitutional role
3. To address entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
4. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the India Constitution
5. To acquire knowledge for various competitive examinations

COURSE OUTCOMES

1. Explain the key concepts of political economy Analyse the significant developments in the political ideologies
3. Describe the salient features of the constitution of India interpret, integrate and critically
4. Analyse the political economy of Indian international relations and gain knowledge in Judiciary system
5. Apply their knowledge and skills acquired to write various competitive examinations

UNIT-I

Introduction to the Constitution

UNIT-II

Historical Perspective of the Constitution of India- Salient features and characteristics of the Constitution of India

UNIT-III

Scheme of the fundamental rights-The scheme of the Fundamental Duties and its legal status-The Directive Principles of State Policy – Its importance and implementation

UNIT-IV

Parliamentary Form of Government in India – Powers and Functions-The President of India - Status and Powers -The historical perspectives of the constitutional amendments in India-Judiciary system - Powers and Functions

UNIT-V

Local Self Government – Constitutional Scheme in India - Election Commission: Role and Functions

TEXT BOOKS

1. Government of India Ministry of Law and Justice (Legislative Department) ,*The Constitution of India, 1950 (Bare Act)* Government Publication, 2015
2. Dr. S. N. Busi *Dr. B. R. Ambedkar framing of Indian Constitution*, 1st Edition, Government Publication 2015

REFERENCES

1. M. P.Jain *Indian Constitution Law* Lexis Nexis 7th Edn., 2014.
2. D.D. Basu *Introduction to the Constitution of India* Lexis Nexis, 2015
3. P.M.Bakshi *Constitution of India* Universal Law Publishing.15th Edition,2018

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II M.Tech - I Sem

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(19ME3019) MECHATRONICS

COURSE OBJECTIVES

The objective of the course is to

1. *Understand the Working of Mechatronics system, Artificial intelligence needed for Mechatronics system.*
2. *Classify various types of sensors and transducers.*
3. *Explain the Architecture of 8085 microcontroller and 8051 microprocessor.*
4. *Describe the Basic structure of programmable logic controller and PLC components.*
5. *Educate the concepts of data base management system, data edition & manipulation.*

COURSE OUTCOMES

On successful completion of the course the students will be able to

1. *Illustrate the usage of Mechatronics systems and Artificial intelligence for manufacturing sectors.*
2. *Explain the working principles and classification of sensors and transducers.*
3. *Describe the basic structure and operation of Microcontroller and Microprocessor.*
4. *Interpret the basic structure and categorize the components used in Programmable logic controller.*
5. *Explain the Concept of Data Base Management System and its usage in CAD/CAM.*
6. *Elucidate about Transducers and its applications in real life.*

UNIT–I

Introduction to Mechatronics - Mechatronics systems- concepts of Mechatronics approach-need for Mechatronics- Mechatronics in manufacturing, Products, and design. Artificial intelligence for Mechatronics system.

UNIT–II

Sensors: Analog and digital sensors for motion measurement, Displacement sensors, Position sensors, Proximity sensors and temperature sensors, selection of sensors

Transducers: analog and digital transducers, photoelectric transducer, Human-Machine and Machine-Machine interfacing devices.

UNIT–III

8085 Microprocessor and 8051 Microcontroller: Introduction-architecture of 8085-pin configuration-Addressing Modes-instruction set-Timing diagram of 8085-application of Microprocessor control-Structure of 8051 Microcontroller-impact of Microcontrollers of society

UNIT–IV

Programmable Logic Controller: Introduction-Basic structure –components of PLC-Input and output processing-Ladder diagram-Latching and internal relays-timers-counters-shift registers

UNIT–V

Manufacturing of Data Bases: Data Base management system, CAD/CAM data bases, graphic data base, introduction to object oriented concepts, objects oriented model language interface, procedures and methods in creation, edition and manipulation of data

TEXT BOOKS

1. K.P.Ramachandran,G.K.Vijayaraghavan, *Mechatronics*,Wiley India Pvt.ltd,New Delhi,2008
2. W. Bolton, Mechatronics, *Electronic Control Systems in Mechanical and Electrical Engineering*, Pearson Education, 2011.

REFERENCES

1. DavudG.Alciatore, R.Miches,B.Histand, *Introduction to Mechatronics and Measurement systems,* Tata McGraw Hill,2008.
2. R.V. Rajput, *Mechatronics*, S. Chand Publishers, 2nd Edition, 2007.
3. Rohner, P., Macmillan, *Automation with Programmable Logic Controllers,* McGraw Hill, 1996.

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II - M.Tech I Sem

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(19ME3020) MECHANICS OF COMPOSITES

COURSE OBJECTIVES

The objective of the course is to

1. *Understand the mechanical behaviour of composite materials.*
2. *Get an overview of the micromechanical behaviour of composite materials.*
3. *Get the knowledge of coordinate transformation of composite materials.*
4. *Evaluate the elastic behaviour of unidirectional composite and its design.*
5. *Analyze the laminate composite material and its behavior.*

COURSE OUTCOMES

On completion of this course, the students will be able to

1. *Elucidate the mechanical characteristics of composite materials.*
2. *Evaluate and estimate the micromechanical behavior of the materials.*
3. *Define the coordinate transformation of composite materials*
4. *Design the elastic behaviour on unidirectional composite materials.*
5. *Formulate of laminate composite materials and its behaviors.*
6. *Develop new methods of manufacturing composites.*

UNIT–I

Basic Concepts and Characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetting plastics, Metal matrix and ceramic composites.

UNIT–II

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

UNIT–III

Coordinate Transformations: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

UNIT–IV

Elastic Behavior Of Unidirectional Composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

Strength Of Unidirectional Lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design.

UNIT–V

Analysis Of Laminated Composite Plates : Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

Manufacturing Methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

TEXT BOOKS

1. R. M. Jones, *Mechanics of Composite Materials*, CRC Press; 2nd Edition, 2015.
2. B. D. Agarwal and L. J. Broutman, *Analysis and performance of fibre Composites*, John Wiley & Sons; 3rd Revised Edition, 2006.

REFERENCES

1. L. R. Calcote, *Analysis of Laminated Composite Structures*, VanNostrandRainfold, New York, 1999.
2. Isaac and M.Daniel, *Engineering Mechanics of Composite Materials*, Oxford University Press, 1994.

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II M.Tech – I Sem

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(19ME3027) INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS

COURSE OBJECTIVES

The Objective of this course to:

1. *Teach students the Basics of Robotics and Robot Kinematics.*
2. *Develop the student's knowledge in various robot drives and control valves.*
3. *Provide the students with knowledge of the construction features, sensor and* Image *Representation.*
4. *Impart the knowledge of robot cell design and applications.*
5. *Study and understand the robot programming and application of artificial intelligence and expert systems in robotics.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Understand fundamentals of Robotics.*
2. *Provide better understanding of the principles of controlling the Robot motion.*
3. *Design robots and robotic work cells.*
4. *Acquire knowledge of write program for controlling the robots.*
5. *Apply artificial intelligence and expert systems in robotics.*
6. *Understand about Robot Kinematics.*

UNIT I

Introduction: Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors.

Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects

UNIT II

Robot Drives: Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators

Control Valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT III

Robot Sensors: Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing – Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT IV

Robot Cell Design and Application: Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT V

Robot Programming: Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation.

Artificial Intelligence and Expert Systems – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

TEXTBOOKS

1. Deb, S.R.*Robotics Technology and Flexible Automation*, Tata McGraw-Hill, 1994.
2. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, *Robotics Control, Sensing, Vision and Intelligence*, McGraw Hill, 1987.

REFERENCES

1. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,*Industrial Robotics Technology, Programming and Applications*, McGraw-Hill, Int. 1986.
2. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, *Robotics Engineering – An Integrated Approach*, Prentice-Hall of India Pvt. Ltd., 1984.
3. YoramKoren, *Robotics for Engineers*, McGraw-Hill, 1987
4. Kozyrey, Yu. *Industrial Robots*, MIR Publishers Moscow, 1985.

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II M.Tech-I Semester

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(19HS0824) BUSINESS ANALYTICS

COURSE OBJECTIVES

Students undergoing this course are able to

1. *Understand the concepts and methods of business analytics.*
2. *To Gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.*
3. *Identify the management related issues and processes to resolve*
4. *Understand the significance of forecasting models helpful in decision making*
5. *To become familiar with processes needed to develop, report and analyze business data*

COURSE OUTCOMES

On successful completion of course student will be able to

1. *Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.*
2. *Design alternatives to solve business problems utilizing quantitative analysis, critical thinking and sound ethical decision making.*
3. *Summarize process and transform data for obtaining meaningful conclusions.*
4. *Interpret data using latest data analytics tools to address organizational problems.*
5. *Organize and critically apply the concepts and methods of business analytics.*
6. *Assess decision problems and build models for creating solutions using business analytical tools.*

UNIT-I

Business analytics: Overview of Business analytics - Scope of Business analytics - Business Analytics Process - Relationship of Business Analytics Process and organization - competitive advantages of Business Analytics - Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data - simple Linear Regression - Important Resources - Business Analytics Personnel - Data and models for Business analytics - problem solving - Visualizing and Exploring Data, Business Analytics Technology

UNIT III

Organization Structures of Business analytics: Team management - Management Issues - Designing Information Policy – Outsourcing - Ensuring Data Quality - Measuring contribution of Business analytics - Managing Changes - Descriptive Analytics - predictive analytics - predicative Modelling - Predictive analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive analytics and its step in the business analytics Process - Prescriptive Modelling - nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting - Statistical Forecasting Models - Forecasting Models for Stationary Time Series - Forecasting Models for Time Series with a Linear Trend - Forecasting Time Series with Seasonality - Regression Forecasting with Casual Variables - Selecting Appropriate Forecasting Models - Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform - New-Product Development Model - Newsvendor Model - Overbooking Model - Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems - Decision Strategies with the Outcome Probabilities - Decision Trees - The Value of Information - Utility and Decision Making - Recent Trends in Embedded and collaborative business intelligence - Visual data recovery - Data Storytelling and Data journalism.

TEXT BOOKS

1. S. Christian Albright & Wayne Winston, *Business Analytics: Data analysis & Decision making*, Cengage Learning, 6th Edition, 2019.
2. James Evans, *Business Analytics*, Pearson Education, 2nd Edition, 2013.

REFERENCES

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, *Business analytics Principles, Concepts, and Applications*, 1st Edition, Pearson FT Press,2014.
2. SeemaAcharya& RN Prasad, *Fundamentals of Business Analytics*,WILEY,2nd Edition.
3. GalitShmueli, Peter C. Bruce, Nitin R. Patel, *Data mining for business analytics: Concepts, Techniques and Applications in Microsoft Office Excel with XLMiner*, WILEY, 2008.

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II M.Tech - I Sem

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(19CE1028) COST MANAGEMENT OF ENGINEERING PROJECTS

COURSE OBJECTIVES

The objective of the course is to

1. *Establish systems to help streamline the transactions between corporate support departments and the operating units.*
2. *Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.*
3. *Use pseudo profit centers to create profit maximizing behaviour in what were formerly cost centers.*

COURSE OUTCOMES

On successful completion of the course, the student should be able to

1. *Summarize the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.*
2. *Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.*
3. *Summarize the meaning and different types of project management and project execution, detailed engineering activities.*
4. *Understand the project contracts.*
5. *Describe the cost behavior and profit planning types and contents, Bar charts and Network diagram.*
6. *Analyze by using quantitative techniques for cost management like PERT/CPM.*

UNIT-I

Introduction and Overview of the Strategic Cost Management Process

UNIT- II

Cost Concepts: Cost concepts in decision-making - Relevant cost - Differential cost - Incremental cost and Opportunity cost - Objectives of a Costing System - Inventory valuation - Creation of a Database for operational control - Provision of data for Decision Making.

UNIT-III

Project Management: Project: meaning - Different types - why to manage - cost overruns centers - various stages of project execution: conception to commissioning - Project execution as conglomeration of technical and nontechnical activities - Detailed Engineering activities - Pre project execution main clearances and documents - Project team: Role of each member - Importance Project site: Data required with significance - Project contracts - Types and contents - Project execution Project cost control - Bar charts and Network diagram - Project commissioning: mechanical and process.

UNIT- IV

Cost Behavior and Profit Planning: Cost Behavior and Profit Planning Marginal Costing - Distinction between Marginal Costing and Absorption Costing - Break-even Analysis - Cost-Volume-Profit Analysis - Various decision-making problems - Standard Costing and Variance Analysis - Pricing strategies: Pareto Analysis - Target costing - Life Cycle Costing - Costing of service sector - Just-in-time approach - Material Requirement – Planning - Enterprise Resource Planning -Total Quality Management and Theory of constraints - Activity-Based Cost Management - Bench Marking - Balanced Score Card and Value-Chain Analysis - Budgetary Control - Flexible Budgets - Performance budgets - Zero-based budgets- Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V

Quantitative Techniques: Quantitative techniques for cost management - Linear Programming, PERT/CPM - Transportation Problems - Assignment problems – Simulation - Learning Curve Theory.

TEXT BOOKS

1. Robert S Kaplan Anthony A. Alkinson, *Management & Cost Accounting*, Pearson Education (US), 1994.
2. N.D. Vohra, *Quantitative Techniques in Management*, McGraw Hill Education, 4th Edition, 2009.

REFERENCES

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster,Advanced Management Accounting.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler Publisher.

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II M.Tech - I Sem

(19EE2128) WASTE TO ENERGY

L	T	P	C
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COURSE OBJECTIVES

The objectives of this course is to

1. *Learn different types of waste materials available for energy conversion.*
2. *Understand Pyrolytic oil and gases.*
3. *Introduce gasification methods for biomass.*
4. *Learn the concepts of biomass resources, combustion types and biogas plant technology.*

COURSE OUTCOMES

On successful completion of this course, the student will be able to

1. *Analyse agro based, forest residue and industrial waste conversion processes.*
2. *Describe the Manufacture of Pyrolytic oils and gases*
3. *Discuss about the methods of Manufacture of charcoal and its applications*
4. *Understand various types of gasifiers operation*
5. *Understand inclined and fluidized bed combustors operation*
6. *Understand types of biogas plants and biomass energy programme in India*

UNIT-I

Introduction to Energy From Waste: Classification of waste as fuel – Agro based- Forest residue- Industrial waste- MSW- conversion devices- Incinerators- Gasifiers-Digestors.

UNIT-II

Bio-Mass Pyrolysis: Pyrolysis- Types- Slow-Fast- Manufacture of Charcoal- methods- yields and application. Manufacture of Pyrolytic oils and gases – yields and applications.

UNIT-III

Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and Updraft gasifiers- Fluidized bed gasifiers- construction and operation- Gasifier burner arrangement for thermal heating.

UNIT-IV

Biomass Combustion: Biomass stoves- Types- Inclined combustors- Fluidized bed combustors- construction and operation of above biomass combustors.

UNIT-V

Properties of Biogas: Biogas plant Technology and status – Biomass resources and their classification- Biomass conversion processes- thermo chemical conversion – Direct Combustion- Biomass gasification- Pyrolysis and liquefaction – bio-chemical conversion- anaerobic digestion- Types of biogas plants- applications-Biomass Energy Programme in India.

TEXT BOOKS

1. Desai, Ashok V ,*Non-Conventional Energy*, Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi ,*Biogas Technology - A Practical Hand Book* -, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

REFERENCES

1. Challal D.S , *Food, Feed and Fuel from Biomass* , IBH Publishing Co Pvt Ltd.,1991.
2. GD Roy, *Non-conventional Energy Sources*- Khanna Publishers, 6th Edition
3. Khahid Rehman Hekeem, Mohammad Jawald., Umar Rashid, *Biomass & Bioenergy*, Springer International Publishing Ltd.

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(19ME3121)INDUSTRIAL SAFETY

COURSE OBJECTIVES

The objective of this course is to

1. *Learn about Mechanical and electrical hazards.*
2. *Understand the Fundamentals of Maintenance Engineering.*
3. *Identify the importance of Wear, Corrosion and their prevention.*
4. *Explain the Fault Tracing concept of various instruments used.*
5. *Know the terms Periodic and preventive maintenance.*

COURSE OUTCOMES

On successful completion of this course the student will be able to

1. *Explain the Points of factories act 1948 for health and safety.*
2. *Define the term Cost & its relation with replacement economy.*
3. Recognize the Concept of Wear, Corrosion and its Prevention methods
4. Understand the Concept of sequence of fault finding activities and the importance of decision tree
5. *Elaborate the importance of scheduled preventive maintenance of mechanical and electrical equipment.*
6. *Distinguish between Periodic and Preventive maintenance of equipments*

UNIT-I

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II

Fundamentals Of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III

Wear and Corrosion and Their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic And Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Higgins & Morrow, *Maintenance Engineering Handbook*, Da Information Services.
2. H. P. Garg, *Maintenance Engineering*, S. Chand and Company.

REFERENCES

1. Audels, *Pump-hydraulic Compressors*, Mcgrew Hill Publication.
2. Winterkorn, *Foundation Engineering Handbook*, Chapman& Hall London.

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II M.Tech - I Sem

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(19ME3021) ADVANCES IN OPERATIONS RESEARCH

COURSE OBJECTIVES

The objective of this course is to

1. *Enumerate the fundamentals of Linear Programming.*
2. *Learn classical optimization techniques.*
3. *Develop the best strategy of Game and identifying the Queuing theory.*
4. *Understand about sequence and optimum Duration of the Project.*
5. *Develop the importance of Replacement models and Inventory control.*
6. *Identify the critical path of the project for optimum project duration.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Create mathematical models of the real time situations.*
2. *Implement Transportation and Assignment problems to solve in real time industry*
3. *Choose the best strategy of Game and capable of identifying the suitable queuing Theory*
4. *Enumerate fundamental techniques and apply it to solve various optimization areas*
5. *Investigate, study, Apply knowledge in Replacement models and Inventory Control Models*
6. *Understand the Inventory control Models*

UNIT-I

Introduction to OR and Linear Programming: OR definition–Types of Operations Research models; Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Degeneracy – Problems.

UNIT-II

Transportation Problem: Formulation; Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel's Approximation Method Modified Distribution (MODI) Method, Unbalanced Transportation-Problem.

Assignment Problem: Formulation, Optimal Solution -Traveling Salesman problem.

UNIT-III

Game Theory: Introduction – Minimax (Maximin) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy and Mixed Strategies – 2 X 2 Games – Dominance Principle.

Queuing Theory: Introduction to queuing system–Service Channel, Arrival Pattern, Size of Population, Service Pattern, Queue Discipline, Customer Behavior, Probability Distribution-Birth & Death Process, Simple Problems on Single Service channel only.

UNIT-IV

Sequencing: Terminology - Johnson's Algorithm for n-jobs x 2 Machines and n-jobs x 3 machines models - Problems

PERT & CPM: Introduction, Difference between PERT and CPM, Terminology- Activities, Events, Predecessor, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float; CPM- Deterministic Model; PERT- Probabilistic Model, Critical Path, Optimal Project Duration, Least Possible Project Duration- Problems.

UNIT-V

Replacement: Failure Mechanism of Items**,** Types of Replacements- Individual Replacement policy, Group Replacement policy, Replacement of items fail suddenly – problems

Inventory: Necessity for maintaining inventory, inventory costs, classification of fixed order quantity inventory models, selective inventory management techniques.

TEXT BOOKS

1.S D. SHARMA *Operations Research,* KNRN Publications, 17th Edition, 2015.

2.Hamdy A Taha, *Operations Research,* Pearson Publications, 9th Edition, 2015.

REFERENCES

1. Manohar Mahajan, *Operations Research,* Dhanpat Rai&Co, 2016.
2. Er. Premkumar Guptha & Dr.D.S.Hira, *Operations Research*, Schand publications, 2012.
3. R Panneerselvam, *Operations Research*, PHI, 2nd Edition, 2012.

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II M.Tech - I Sem

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(19ME3022) COMPOSITE MATERIALS

COURSE OBJECTIVES

The objective of the course is to

1. *Understand the mechanical behavior of composite materials.*
2. *Get an overview of the methods of manufacturing composite materials.*
3. *Know the fundamentals of composite materials.*
4. *Understand the fabrication and process of composites.*
5. *Recognize the applications of composite materials.*
6. *Understand the mechanics of composites in the manufacturing process.*

COURSE OUTCOMES

On successful Completion of this course the student will be able to

1. *Explain the Fundamental concept of composite materials.*
2. *Classify different types of composite materials.*
3. *Describe the Fabrication and processing of composite materials.*
4. *Illustrate the Methods of preparation of Metal matrix Composites and polymer matrix composites*
5. *Discuss about the Mechanical behavior of composite materials.*
6. *Explain the application of composite materials.*

UNIT-I

Introduction To Composites: Fundamentals of composites – need– enhancement of properties – classifications –Introduction to Reinforcement composites–types, Applications-Fiber production techniques for glass, carbon and ceramic fibers –Resin materials-Types.

UNIT-II

Polymer Matrix Composites: Fabrication of PMC's ,Fabrication of Fibers, Plastic Fiber Forms, Pre-pregs, Molding Compounds-Processes, Lay-Ups, Filament Winding, Pultrusion, and Recycling- Matrix – Reinforcement Interface, Wettability.

UNIT-III

MMC&CMC: Fabrication of MMC'S, Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding &In Situ Technique- Fabrication of CMC's, Hot-Pressing, Infiltration, In Situ Chemical reaction Techniques. CVD & CVI, Sol-gel, Carbon Carbon composites.

UNIT-IV

Mechanics of Composites: Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, Von - Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

UNIT-V

Applications Of Composites: Applications of advanced composite materials-Environmental effects in Composites, Green composites, Synthesis and Properties of Nano composites. Surface Composites & Surface metal matrix composites: Need, Synthesis, Properties and applications.

TEXT BOOKS

1. Mathews F. L. and Rawlings R. D., *Composite Materials: Engineering and Science*, Chapman and Hall, London, England, 1st Edition, 1994.
2. Chawla K. K., *Composite materials*, Springer – Verlag, 2nd Edition, 1998.

REFERENCES

1. Clyne, T. W. and Withers, P. J., *Introduction to Metal Matrix Composites*, Cambridge University Press, 1993.
2. Strong, A.B., *Fundamentals of Composite Manufacturing*, SME, 2nd Edition, 1989.
3. Sharma, S.C., *Composite materials*, Narosa Publications, 4th Edition, 2000.

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(19ME3009) DISSERTATION PHASE-I

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(19ME3010) DISSERTATION PHASE-II