122EDT02	CONCEPTS OF ENGINEERING DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce basic concepts in design process.
2. To provide knowledge on tools in engineering design.
3. To learn material selection and materials in designing to machine members.
4. To impart basic knowledge in material processing for designing machine members.
5. To identify legal, ethical environmental and safety issue in design and quality Engineering.

UNIT I THE DESIGN PROCESS **08**

The Design Process - Need identification – Design requirements – Product Life Cycle – Morphology of Design steps of Product Design – Conceptual Design, Embodiment Design, Detailed Design – Concurrent Engineering – CAD & CAM, Human factors in Design.

UNIT II TOOLS IN ENGINEERING DESIGN **09**

Creativity and Problem solving, Decision Theory, Modeling – Role of models in Engineering Design, Mathematical Modeling, Geometric modeling, Finite Element Modeling, Rapid Prototyping – Simulation Finite Difference method, Monte Carlo method – Optimization – Search Methods, Geometric programming, Structural and Shape optimization.

UNIT III MATERIAL SELECTION AND MATERIALS IN DESIGN **09**

Classification and Properties of Engineering materials, Material Standards and specifications – Methods of material selection – Ashby Chart and method of weight factors, Derivation of material indices, Use of material selection Chart, Pugh selection method, Selection with computed aided databases – Design for brittle fracture, Design for fatigue failure, Design for corrosion resistance, Designing with plastics.

UNIT IV MATERIAL PROCESSING AND DESIGN **09**

Classification of manufacturing processes and their role in design, Factors determining the process selection, Use of process selection chart and computerized database – Design for manufacturing, Design for forging and sheet metal forming, Design for casting, Design for machining, welding and assembly, Design for residual stresses and heat treatment

UNIT V LEGAL, ETHICAL ENVIRONMENTAL AND SAFETY ISSUES IN DESIGN AND QUALITY ENGINEERING **10**

Origin of laws, Contracts, Liability, Tort Law, Product Liability, Design aspects of product liability, Codes of ethics, Solving ethical conflicts, Design for environment – Life Cycle assessment, Material recycling and remanufacture, Design for safety – Potential Dangers and Guidelines for design for safety, Design for reliability failure mode effect analysis, Robust Design.

TOTAL : 45 Hours

COURSE OUTCOMES:

Student will be able to

- Perform design process for developing new machine members.
- Notice tools in engineering design
- Find the solution in materials selection and materials in designing a new machine member.
- Conduct designing machine members using materials processing.
- Apply knowledge to select material basing on legal, ethical environmental and safety issues in design and quality engineering.

TEXT BOOKS:

1. Dieter George E, "Engineering Design – A Materials and Processing Approach", McGraw Hill, International Edition, Singapore 2012.
2. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw Hill, International Edition, 6th Edition, 2016.

REFERENCE BOOKS:

1. Gerhard Pahl and Beitz W, "Engineering Design: A Systematic Approach", Springer, Verlag, London, 3rd Edition, 2014.
2. Suh. N. P., "The Principles of Design", Oxford University Press, New York, 1990.
3. Ray M.S., "Elements of Engineering Design: An Integrated Approach", Prentice Hall Inc. 1985.

122EDT03	COMPUTER APPLICATIONS IN DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand fundamental concepts of computer graphics and its tools in a generic framework.
2. To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
3. To impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.
4. To provide clear understanding of CAD systems for 3D modeling and viewing.
5. To create strong skills of assembly modeling and prepare the student to be an effective user of a standards in CAD system.

PREREQUISITE: Fundamentals of Computer and Programming, Design of Machine Elements, Design of Transmission Systems.

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Overview of Graphics systems: Video Display Devices, Raster-Scan System, Random-Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard-Copy Devices, Graphics Software.

Output primitives: Line Drawing Algorithm - DDA, Bresenham's and Parallel Line Algorithm. Circle generating algorithm – Midpoint Circle Algorithm.

Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations -Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT – II CURVES AND SURFACES MODELLING 9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.

Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermitebicubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT III NURBS AND SOLID MODELING 9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry- comparison of representations - user interface for solid modeling.

UNIT IV VISUAL REALISM 9

Hidden Line removal, Hidden Surface removal, – Hidden Solid Removal algorithms - Shading – Coloring.

Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT V ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT 9

Assembly modeling – Design for manufacture – Design for assembly – computer aided DFMA - inferences of positions and orientation - tolerances analysis –Center of Gravity and mass property calculations - mechanism simulation. Graphics and computing standards – Data Exchange standards. Product development and management – new product development – models utilized in various phases of new product development – managing product life cycle.

TOTAL : 45 Hours

COURSE OUTCOMES:

Students will be able to

- Solve 2D and 3D transformations for the basic entities like line and circle.
- Formulate the basic mathematics fundamental to CAD system.
- Use the different geometric modeling techniques like feature based modeling, surface modeling and solid modeling.
- Create geometric models through animation and transform them into real world systems
- Simulate assembly of parts using Computer-Aided Design software.

TEXT BOOKS:

1. Ibrahim Zeid, "Mastering CAD/CAM", McGraw Hill, 2nd Edition, 2006.
2. William M Newman and Robert F.Sproull “Principles of Interactive Computer Graphics”, McGraw Hill Book Co. 1st Edition, 2001.

REFERENCE BOOKS:

1. Boothroyd, G, “Assembly Automation and Product Design”, Marcel Dekker, New York, 1997.
2. Chitale A.K and Gupta R.C, “Product design and manufacturing”, PHI learning private limited, 6th Edition, 2015.
3. David Rogers, James Alan Adams, “Mathematical Elements for Computer Graphics” 2nd Edition, Tata McGraw-Hill edition, 2003.
4. Donald D Hearn and M. Pauline Baker “Computer Graphics C Version”, Prentice Hall, Inc., 2nd Edition, 1996.

122EDT04	ADVANCED FINITE ELEMENT ANALYSIS	L	T	P	C
		3	1	0	4

OBJECTIVES:

1. To formulate and analysis of 1D analysis arising in engineering design.
2. To formulate and analysis of 2D, 3D analysis arising in engineering design.
3. To know about the isoparametric formulation of triangular and rectangular elements.
4. To provide further advanced FEA knowledge and techniques for solving Dynamic analysis
5. To analyze the thermal and fluid flow problems by FEA.

PREREQUISITE - Knowledge of Numerical Methods and Strength of Materials are required.

UNIT I ONE DIMENSIONAL ANALYSIS **12**

Relevance of finite element analysis in design, Modeling and discretization, Interpolation, elements, nodes and Degrees of Freedom, Applications of FEA, Variational methods, Potential energy method – Weighted residual methods, Galerkin method, One Dimensional Elements and Computational Procedures: Bar element, Beam element, Truss element, Shape functions, Element matrices and vectors - Assembly of elements – Boundary conditions - Solution of equations, Mechanical loads and stresses, Example problems.

UNIT II TWO AND THREE DIMENSIONAL ANALYSIS **12**

Basic Boundary Value Problems in two-dimensions – Triangular, quadrilateral, higher order elements, Poisson's and Laplace's Equation, Weak Formulation, Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation, Principle of virtual work – Element matrices and vectors, Three dimensional stress and strain – Tetrahedral Element – Hexahedral Element, Finite Element formulation, Example problems.

UNIT III ISOPARAMETRIC FORMULATION **12**

Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Isoparametric Elements, Bilinear Isoparametric quadrilateral elements – shape function, Jacobian matrix, strain displacement matrix, stress-strain relationship matrix, force vector, Isoparametric Formulation - triangular element – rectangular elements – Serendipity elements, Numerical Integration - Gauss quadrature – Stress calculations, Examples problems.

UNIT IV DYNAMIC ANALYSIS **12**

Introduction, Equations of motion, Axial vibration of rod, Transverse Vibration of beam, Formulation of element stiffness, Mass and force matrices, Lumped and consistent mass matrices, Natural frequencies, Eigen Values and Eigen Vectors, Mode shapes, Vector iteration methods, Transient vibration, Example problems.

UNIT V THERMAL AND FLUID FLOW ANALYSIS **12**

Steady state heat transfer, Heat transfer with convection, One Dimensional Finite Element Formulation, Two Dimensional Finite Element Formulation, Basic differential equations of fluid flow, One Dimensional Finite Element Formulation, Two Dimensional Finite Element Formulation, Example problems.

TOTAL : 60 Hours

COURSE OUTCOMES:

- Students will capable of formulate and analysis of 1D Problems.
- Students will capable of formulate and analysis of 2D and 3D Problems.
- Students will have the ability to solve isoparametric problems using FEA.
- Students will able to solve dynamic analysis problem using FEA
- Students will have the ability to apply finite element to formulate and solve thermal and fluid flow problems.

TEXT BOOKS:

1. Daryl L Logan, "A First course in the finite element method", Cengage learning, 6th Edition, 2017.
2. Seshu P, "A Text book on Finite Element Analysis", Prentice Hall of India, New Jersey, 2003.

REFERENCE BOOKS:

1. S.S.Rao, "The Finite Element Method in Engineering", Butterworth-Heinemann, 5th Edition, 2010.
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 4th Edition, 2008.
3. J. N.Reddy, "An Introduction to the Finite Element Method", McGraw Hill International, 2005.
4. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Int. Ed., New Delhi, 2004.
5. Chandrupatla T R and Belegundu A D, "Introduction to Finite Elements in Engineering", Third Edition, Prentice Hall, 2002.
6. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1996.

122EDT05	OPTIMIZATION TECHNIQUES IN DESIGN	L	T	P	C
		3	1	0	4

OBJECTIVES:

1. To understand the basic concepts of unconstrained optimization techniques.
2. To understand the basic concepts of constrained optimization techniques.
3. To provide the mathematical foundation of artificial neural networks and swarm intelligence for design problems.
4. To implement optimization approaches and to select appropriates solution for design application.
5. To demonstrate selected optimization algorithms commonly used in static and dynamic applications.

PREREQUISITE: Knowledge of Design of Machine Elements is required.

UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES 12

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications-Single variable and multi variable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES 12

Optimization with equality and inequality constraints-Direct methods–Indirect methods using penalty functions, Lagrange multipliers-Geometric programming.

UNIT III ARTIFICIAL NEURAL NETWORKS AND SWARM INTELLIGENCE 12

Introduction–Activation functions, types of activation functions, neural network architectures, Single layer feed forward network, multi layer feed forward network, Neural network applications. Swarm intelligence-Various animal behaviors, Ant Colony optimization, Particle Swarm optimization.

UNIT IV ADVANCED OPTIMIZATION TECHNIQUES 12

Multistage optimization–dynamic programming, stochastic programming Multiobjective optimization Genetic algorithms and Simulated Annealing technique.

UNIT V STATIC AND DYNAMIC APPLICATIONS 12

Structural applications – Design of simple truss members – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members –Design of springs. Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms–Optimum design of simple linkage mechanisms.

TOTAL : 60 Hours

COURSE OUTCOME:

The students will be able to

- Formulate unconstrained optimization techniques in engineering design application.
- Formulate constrained optimization techniques for various applications.
- Implement neural network technique to real world design problems.
- Apply genetic algorithms to combinatorial optimization problems.
- Evaluate solutions by various optimization approaches for a design problem.

TEXT BOOKS:

1. Rao Singiresu S., "Engineering Optimization – Theory and Practice", New Age International Limited, New Delhi, 3rd Edition, 2013.
2. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples", PHI Learning Private Limited, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Jang, J.S.R, Sun, C.T and Mizutani E., "Neuro-Fuzzy and Soft Computing", Pearson Education, 2015.
2. Rajasekaran S and Vijayalakshmi Pai G.A, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2011.
3. Goldberg, David.E, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson, 2009.
4. Johnson Ray,C., "Optimum Design of Mechanical Elements", Wiley, 2nd Edition,1980.

122EDT06	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To know how to identify and to solve the research problem.
2. To develop the skills of research related activities.
3. To learn about the procedure for applying patents.
4. To analyse the structure of patents.
5. To know about the advances and practical applications of patents by taking case studies.

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY 9

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 RESEARCH SKILLS 9

Effective literature studies approach, analysis Plagiarism, Research ethics, 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 III NATURE OF INTELLECTUAL PROPERTY RIGHTS 9

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV PATENT RIGHTS 9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V NEW DEVELOPMENTS IN IPR 9

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

TOTAL : 45 Hours

COURSE OUTCOMES:

The student will be able to

- Determine research problem formulation.
- Equip research related skills like writing a research paper, report preparation and format of research proposal.
- Analyse the process of patenting and its procedure.
- Know about the scope of patent rights and applications of technology transfer.
- Gather information about recent developments about IPR.

TEXT BOOKS:

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", SAGE Publication, 3rd Edition, 2011.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.
3. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Law & Business, 3rd Edition, 2016.
2. Debora J Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta Academic, 1996.
4. William Henry Mayall, "Industrial Design for Engineers", McGraw Hill, 1992.
5. Benjamin W Niebel, "Product Design and Process Engineering", McGraw Hill, 1st Edition, 1974.

6. Asimov, “Introduction to Design”, Prentice Hall, 1962.

122EDP08	CAD LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

1. To know about design concepts, to use the Finite Element Method software correctly and efficiently.
2. To know about the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem.
3. To acquire the basic skills in using professional level finite element software, applied to structural, heat transfer and fluid flow components at various loading conditions.
4. To analyze a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.
5. To simulate simple mechanisms using simulation software.

Simulation of mechanisms using simulation software like MATLAB/ADAMS etc. 15

Simulation of mechanism: Simple pendulum, Four bar mechanism, Slider crank mechanism, Cam and Follower mechanism, Spur gear drive, Piston and Cylinder.

Analysis of mechanical machine components using analysis software like ANSYS/ NASTRAN etc. 30

Static Structural analysis: Truss, Bar, Beam, Axisymmetric analysis.

Dynamic analysis: Modal, Harmonic, Transient analysis, Buckling analysis, Non linear analysis

Thermal analysis: Conduction heat transfer, Heat transfer with Conduction and Convection, Transient heat conduction analysis.

Coupled field analysis, Contact analysis, Fluid flow analysis and Design optimization.

COURSE OUTCOMES:

Student will be able to

- Select the method, meshing, analysis and optimize the given problem for structural and thermal applications.
- Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis
- Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer
- Simulate simple kinematic mechanisms using simulation software.
- Recognize sources of errors in FEA.

TOTAL : 45 Hours

122EDP09	VIBRATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

1. To evaluate the stiffness and natural frequency of spring-mass systems.
2. To determine the natural frequencies of damped and undamped torsional vibrations of single rotor systems and obtain the radius of gyration of a body through torsional oscillations.
3. To acquire the critical speed of shaft supported at its ends.
4. To assess the natural frequency, damping coefficient, mode shapes of specimens under free vibrations.
5. To determine the natural frequency of specimens under forced vibrations.

LIST OF EXPERIMENTS: 30

1) Determination of stiffness and natural frequency of undamped spring-mass systems arranged in series, parallel and series-parallel fashions
2) Determination of effective radius of gyration of an irregular body through torsional oscillation of tri filar suspension
3) Determination of natural frequency a single rotor un damped shaft system
4) Determination of natural frequency a single rotor damped shaft system
5) Determination of critical speed of shaft
6) Determination of natural frequency and mode shapes of specimens supported at its ends through modal analysis
7) Determination of damping coefficient of specimens supported at its ends
8) Forced vibration of specimens supported under simply supported and cantilever boundary conditions – Determination of natural frequency

COURSE OUTCOMES:

Student will be able to

- Evaluate the stiffness and natural frequency of spring-mass systems.
- Determine the natural frequencies of damped and undamped torsional vibrations of single rotor systems
- Acquire the critical speed of shaft supported at its ends.
- Assess the natural frequency, damping coefficient, mode shapes of specimens under free vibrations.
- Determine the natural frequency of specimens under forced vibrations.

TOTAL : 45 Hours

X22EDA07	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

OBJECTIVES:

1. To teach how to improve writing skills and level of readability.
2. To tell about what to write in each section.
3. To summarize the skills needed when writing a Title.
4. To Infer the skills needed when writing the Conclusion.
5. To ensure the quality of paper at very first-time submission.

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING **6**

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

UNIT II PRESENTATION SKILLS **6**

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

UNIT III TITLE WRITING SKILLS **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL : 30 Hours

COURSE OUTCOMES:

Student will be able to

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title
- Understand the skills needed when writing the Conclusion
- Ensure the good quality of paper at very first-time submission

REFERENCE BOOKS:

1. Adrian Wallwork, “English for Writing Research Papers”, Springer New York, Dordrecht Heidelberg London, 2011.
2. Day R, “How to Write and Publish a Scientific Paper”, Cambridge University Press, 2006.
3. Goldbort R, “Writing for Science”, Yale University Press (available on Google Books), 2006.
4. Highman N, “Handbook of Writing for the Mathematical Sciences”, SIAM. Highman’s book, 1998.

X22EDA08	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

OBJECTIVES:

1. To summarize basics of disaster
2. To explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3. To Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4. To describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. To develop the strengths and weaknesses of disaster management approaches.

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 Hours

COURSE OUTCOMES:

Student will be able to

- Summarize basics of disaster.
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches.

REFERENCE BOOKS:

1. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company, 2007.
3. Sahni, Pardeep Et.Al., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.

X22EDA09	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

1. To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
3. To know the role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
4. To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION **5**

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION **5**

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES **5**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE **5**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION **5**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION **5**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL : 30 Hours

COURSE OUTCOMES:

Student will be able to

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the Conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

REFERENCE BOOKS:

1. The Constitution of India,1950 (Bare Act), Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar "Framing of Indian Constitution",1st Edition, 2015.
3. M.P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

X22EDA10	நற்றமிழ் இலக்கியம்	L	T	P	C
		2	0	0	0

UNIT I சங்க இலக்கியம் **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர் க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II அறநெறித் தமிழ் **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல் அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III இரட்டைக் காப்பியங்கள் **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV அருள்நெறித் தமிழ் **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச் சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V நவீன தமிழ் இலக்கியம்	**6**
1. உரைநடைத் தமிழ், - தமிழின் முதல் புதினம், - தமிழின் முதல் சிறுகதை, - கட்டுரை இலக்கியம், - பயண இலக்கியம், - நாடகம், 2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும், 3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும், 4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும், 5. அறிவியல் தமிழ், 6. இணையத்தில் தமிழ், 7. சுற்றுச் சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.	
	TOTAL : 30 Hours

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித்துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

222EDT01	TRIBOLOGY IN DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the principles for selecting compatible materials for minimizing friction and wear in machinery.
2. To understand the principles of hydrodynamic and hydrostatic lubrication and their design and applications.
3. To understand the principles of bearing selection and bearing arrangement in machines.
4. To understand the factors influencing the design and selection of Porous bearings.
5. To learn about space and automotive tribology.

UNIT I INTRODUCTION TO TRIBOLOGY **9**

Introduction, Friction, Wear, Wear Characterization, Regimes of lubrication Classification of contacts, lubrication theories, Effect of pressure and temperature on viscosity. Newton's Law of viscous forces, Flow through stationary parallel plates. Hagen's Poiseuille's theory, viscometers. Numerical problems, Concept of lightly loaded bearings, Petroff's equation, Numerical problems.

UNIT II HYDRODYNAMIC LUBRICATION **9**

Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynold's equation in two dimensions with assumptions. Introduction to idealized slide bearing with fixed shoe and Pivoted shoes. Expression for load carrying capacity. Location of center of pressure, effect of end leakage on performance, Numerical problems

Journal Bearings: Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings, Sommerfeld number and its significance, short and partial bearings, Comparison between lightly loaded and heavily loaded bearings, effects of end leakage on performance, Numerical problems.

UNIT III HYDROSTATIC BEARINGS **9**

Hydrostatic thrust bearings, hydrostatic circular pad, annular pad, rectangular pad bearings, types of flow restrictors, expression for discharge, load carrying capacity and condition for minimum power loss, numerical problems, and hydrostatic journal bearings. **EHL Contacts:** Introduction to Elasto - hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution.

UNIT IV ANTIFRICTION BEARINGS **9**

Advantages, selection, nominal life, static and dynamic load bearing capacity, probability of survival, equivalent load, cubic mean load, bearing Mountings.

Porous Bearings: Introduction to porous and gas lubricated bearings. Governing differential equation for gas lubricated bearings, Equations for porous bearings and working principal, Fretting phenomenon and its stages.

UNIT V SPACE AND AUTOMOTIVE TRIBOLOGY **9**

Introduction - Mechanism, components, liquid and solid lubricants, accelerated testing and life testing of space mechanism. Principles of Aerospace eccentric bearing test mechanism. Engine Tribology -importance, engine bearings, wheel bearings, tire. Mechanics of load transfer - contact area and normal pressure distribution, brakes, effects of service on engine oil properties. Tribology in manufacturing - macro and micro tribology of MEMS materials. Technologies for machinery diagnosis and prognosis.

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will be able to

- Select compatible materials for minimizing friction and wear in machinery.
- Design or choose efficient tribological systems such as rolling element bearings, hydrodynamic bearings, and dry sliding bearings, for the needs of a specific application.
- Design bearings under Hydrostatic condition.
- Explain the concepts advanced bearings like porous bearings and gas lubricated bearings.
- Performs space and automotive tribology related study.

TEXT BOOKS:

1. Majumdar.B.C, “Introduction to Tribology of Bearing”, Wheeler Publishing, New Delhi, 2001.
2. Radzimovsky, “Lubrication of Bearings – Theoretical Principles and Design”, Oxford Press Company, 2000.

REFERENCE BOOKS:

1. Dudley D.Fulier, "Theory and Practice of Lubrication for Engineers", New York Company, 1998
2. Moore "Principles and Applications of Tribology", Pergamon Press, 1975.
3. Oscar Pinkus, BenoSternlicht, “Theory of Hydrodynamic Lubrication”, McGraw-Hill, 1961.
4. G W Stachowiak, A W Batchelor, “Engineering Tribology”, Elsevier Publication 1993.
5. F. M. Stansfield, “Hydrostatic Bearings for Machine Tools and Similar Applications”, Machinery Publishing, 1970.

222EDT02	VIBRATION ANALYSIS AND CONTROL	L	T	P	C
		3	1	0	4

OBJECTIVES:

1. To fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operates in vibratory conditions.
2. To obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF).
3. To write the differential equation of motion of vibratory systems.
4. To make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.
5. To understand working principles of vibration measurement devices.

UNIT I FUNDAMENTALS OF VIBRATION **12**

Introduction -Sources Of Vibration-Mathematical Models- Displacement, velocity and Acceleration-Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers - Response To Arbitrary and non- harmonic Excitations – Transient Vibration –Impulse loads- Critical Speed Of Shaft-Rotor systems.

UNIT II TWO DEGREE FREEDOM SYSTEM **12**

Introduction-Free Vibration Of Undamped And Damped - Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM **12**

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients-Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method -Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams

UNIT IV VIBRATION CONTROL **12**

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS **12**

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes

TOTAL : 60 HOURS

COURSE OUTCOMES:

The student will have an ability to

- Analyze the mathematical model of a linear vibratory system to determine its response.
- Obtain linear mathematical models of real life engineering systems.
- Use Lagrange's equations for linear and nonlinear vibratory systems.
- Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.
- Conduct test by using different vibration measuring device.

TEXT BOOKS:

1. Rao, S.S.," Mechanical Vibrations," Prentice Hall, 2011.
2. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.

REFERENCE BOOKS:

1. V. P. Singh, "Mechanical Vibrations Mechanical Engineering; a Modern Approach", Dhanpat Rai Publication, 2009.
2. S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw – Hill Publishing Com. Ltd New Delhi, 2007.
3. S Graham Kelly, "Schaum's Outline of Mechanical Vibrations", McGraw Hill Education, 1996.
4. Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.

222EDT03	ADVANCED MECHANISMS IN DESIGN	L	T	P	C
		3	1	0	4

OBJECTIVES:

1. To learn the concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms
2. To study complex mechanisms to determine velocity and acceleration of output links.
3. To learn to locate inflection points and to draw the inflection circle.
4. To study the synthesis of planar mechanisms.
5. To learn to design of six bar coupler driven mechanisms and cam mechanisms.

UNIT I INTRODUCTION **12**

Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms - Equivalent mechanisms.

UNIT II KINEMATIC ANALYSIS **12**

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters – Forward and inverse kinematics of robot manipulators.

UNIT III PATH CURVATURE THEORY, COUPLER CURVE **12**

Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp -crunode - coupler driven six-bar mechanisms-straight line mechanisms

UNIT-IV SYNTHESIS OF FOUR BAR MECHANISMS **12**

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein's Equation-Bloch's Synthesis.

UNIT-V SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS **12**

Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms- determination of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation software packages. Students should design and fabricate a mechanism model as term project.

TOTAL : 60 HOURS

COURSE OUTCOMES:

The student will have an ability to

- Apply concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms.
- Determine velocity and acceleration of complex mechanisms.
- Evaluate inflection points and draw the inflection circle.
- Synthesise planar mechanisms.
- Design of six bar coupler driven mechanisms and cam mechanisms.

TEXT BOOKS:

1. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Robert L.Norton., "Design of Machinery", Tata McGraw Hill, 2012

REFERENCE BOOKS:

1. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 2016.
2. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi,1999.
3. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.

222EDP08	CAE LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

1. To understand and practice the drawings of machine components and simple assemblies using modeling packages.
2. To provide the fundamental concepts of the theory of the finite element method through software.
3. To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.
4. To understand the concepts of Structural and thermal stress analysis on components.
5. To gain knowledge about the Failure analysis of various joints.

Modeling and Assembling of mechanical machine components using modeling software **15**

Modeling and Assembling of Machine Vice, Tailstock, Connecting rod, Shaper tool head assembly etc.

Analysis of mechanical machine components using analysis software **30**

Stress analysis in Curved beam.
Single edge notched beam in four point bending.
Torsion of Prismatic bar with rectangular cross section.
Contact Stress Analysis of Circular Disc under diametrical compression.
Vibration Characteristics of a Spring Mass Damper System.
Buckling, Bending and Modal analysis of stiffened Panels.
Design Optimization problems (shape and weight optimization).
Thermal Stress Analysis a thick walled cylinder filled with a fluid at high temperature.
FE Modeling and Failure Analysis of welded joints, bolted joints and adhesive bonded joints.

Total: 45 HOURS

COURSE OUTCOMES:

The students will have ability to

- Model and assemble the drawings of any mechanical products using modeling software.
- Select the method, meshing, analysis and optimize the real time problems using finite element analysis software.
- Evaluate and interpret FEA analysis results for design and evaluation purposes
- Develop a basic understanding of the limitations of the FE method and understand the possible error sources in its use.
- Use analysis software for the application and use of the FE method for heat transfer and structural problems.

222EDE01	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To have knowledge on how to use and application of hydraulics and pneumatics as fluid power in Industry.
2. To learn the various control valves and actuation systems.
3. To comprehend the design concepts of hydraulic system for automation.
4. To analyse the pneumatic circuit for energy efficiency.
5. To study installation, maintenance and special circuits.

PREREQUISITE: Knowledge of Applied Hydraulics and Pneumatics is required.

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS **9**

Hydraulic Power Generators, Selection and specification of pumps, Pump characteristics, Linear and Rotary Actuators – selection, specification and characteristics.

UNIT II CONTROL AND REGULATION ELEMENTS **9**

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT III HYDRAULIC CIRCUITS **9**

Reciprocation, quick return, sequencing, synchronizing circuits, accumulator circuits, industrial circuits, press circuits, hydraulic milling machine, grinding, planning, copying, forklift, earth mover circuits, design and selection of components, safety and emergency mandrels.

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS **10**

Pneumatic fundamentals, control elements, position and pressure sensing, logic circuits, switching circuits, fringe conditions modules and these integration - sequential circuits - cascade methods, mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS **8**

Pneumatic equipments, selection of components, design calculations, application -fault finding - hydro pneumatic circuits, use of microprocessors for sequencing, PLC, Low cost automation - Robotic circuits.

TOTAL : 45 Hours

COURSE OUTCOMES:

- The students will have fundamental knowledge on fluid power control.
- The students will be able to select various control valves and use them in hydraulic and pneumatic circuit development.
- The students will be able to design hydraulic circuits for automation.
- The students will be able to analyse the pneumatic circuit for energy efficiency.
- The students know installation, maintenance of power systems.

TEXT BOOKS:

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 7th Edition, 2016.
2. Dudley A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.

REFERENCE BOOKS:

1. Jagadeesha T and Thammaiah Gowda, “Fluid Power: Generation, Transmission and Control”, Wiley, 2016.
2. Shanmuga Sundaram K, “Hydraulic and Pneumatic controls: Understanding made easy”, S.Chand & Co. Book Publishers, New Delhi, 2009.
3. Andrew Parr, “Hydraulics and Pneumatics” (HB), Jaico Publishing House, 2005.
4. Majumdar S R, “Oil Hydraulic Systems: Principles and Maintenance”, McGraw Hill Education, 28th Edition, 2017.
5. Bolton. W., “Pneumatic and Hydraulic Systems”, Butterworth –Heinemann, 1998.
6. Majumdar S R, “Pneumatic Systems: Principles and Maintenance”, McGraw Hill Education, 1996.

222EDE02	QUALITY CONCEPTS IN DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To impart knowledge on various concepts in engineering design, material selection and manufacturing methods.
2. To learn the principles of implementing quality in a product or services using different tools.
3. To enhance the quality of product by use of failure mode effect analysis and implement methods to uphold the status of six sigma.
4. To develop a robust product or service using various strategies of design of experiments.
5. To maintain the quality of the product by use of statistical tools and enforce methods to improve the reliability of a product.

PREREQUISITE: Knowledge of Manufacturing Technology - I is required.

UNIT I DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION 9

Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding.

UNIT II DESIGN FOR QUALITY 9

Quality Function Deployment -House of Quality-Objectives and functions-Targets- Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design – testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points – reflecting and repeating.

UNIT III FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA9

Basic methods: Refining geometry and layout, general process of product embodiment - Embodiment checklist-Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling – Basis of SIX SIGMA – Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services.

UNIT IV DESIGN OF EXPERIMENTS 9

Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments – Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi's approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT V STATISTICAL CONSIDERATION AND RELIABILITY 9

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams- Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control– Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution.

TOTAL : 45 Hours

COURSE OUTCOMES:

The students will be able to

- Apply fundamentals of design process and material selection for developing a quality product.
- Apply the quality concepts to develop a robust product.
- Perform Failure Mode Effect Analysis on a product and use six sigma principles to enhance its quality.
- Apply different experimental design methods in product development.
- Implement various statistical tools to improve its quality and reliability.

TEXT BOOKS:

1. Karl T. Ulrich, Steven D. Eppinger, "Product Design and Development", Tata McGraw-Hill Education, 2015.
2. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw Hill Education Pvt. Ltd., 2013.

REFERENCE BOOKS:

1. Montgomery,D.C, "Design and Analysis of Experiments", John Wiley and Sons, 2017.
2. Amitava Mitra, "Fundamentals of Quality Control and Improvement", John Wiley & Sons, 2016.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw Hill, 2005.
4. Kevin N. Otto and Kristin L. Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", Prentice Hall, 2001.

222EDE03	DESIGN FOR SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To select the relevant process; applying the general design principles for manufacturability; GD &T.
2. To apply the design considerations while designing the cast and welded components.
3. To apply the design considerations while designing the formed and machined components.
4. To apply design considerations for assembled systems.
5. To apply design considerations for environmental issues.

UNIT I INTRODUCTION **9**

Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T)– Form tolerancing: straightness, flatness, circularity, cylindricity – Profile tolerancing: profile of a line, and surface – Orientation tolerancing: angularity, perpendicularity, parallelism – Location tolerancing: position, concentricity, symmetry – run out tolerancing: circular and total–Supplementary symbols.

UNIT II CAST & WELDED COMPONENTS DESIGN **9**

Design considerations for: Sand cast – Die cast – Permanent mold parts. Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment. Resistance welding–Design considerations for: Spot–Seam–Projection–Flash & Upset weldment

UNIT III FORMED & MACHINED COMPONENTS DESIGN **9**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts. Design considerations for: Turned parts– Drilled parts – Milled, planned, shaped and slotted parts– Ground parts.

UNIT IV DESIGN FOR ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly– Computer Application for DFMA.

UNIT V DESIGN FOR ENVIRONMENT **9**

Introduction– Environmental objectives–Global issues–Regional and local issues–Basic DFE methods–Design guide lines–Example application–Life cycle assessment–Basic method–AT&T's environmentally responsible product assessment-Weighted sum assessment method–Life cycle assessment method–Techniques to reduce environmental impact–Design to minimize material usage–Design for disassembly–Design for recyclability–Design for manufacture–Design for energy efficiency –Design to regulations and standards.

TOTAL : 45 Hours

COURSE OUTCOMES:

Student will be able to

- Select relevant process; apply the general design principles for manufacturability; GD&T.
- Apply design considerations while designing the cast and welded components.
- Apply design considerations while designing the formed and machined components.
- Apply design considerations for assembled systems.
- Apply design considerations for environmental issues.

TEXT BOOKS:

1. Boothroyd, G, "Design for Assembly Automation and Product Design", New York, Marcel Dekker, 2nd Edition 2002.
2. Graedel T. Allen By B, "Design for the Environment", Angle Wood Cliff, Prentice Hall. Reason Pub.,1996.

REFERENCE BOOKS:

1. Kevin Otto and Kristin Wood, "Product Design", Pearson Publication, (Fourth Impression) 2009.
2. Fixel, J. "Design for the Environment" McGraw Hill., 2nd Edition, 2009.
3. Bralla, "Design for Manufacture handbook", McGraw Hill, 1999.
4. Dickson, John.R, and Corroda Poly, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA,1995.
5. Boothroyd, G,Heartz and Nike, "Product Design for Manufacture", Marcel Dekker,1994.
6. Harry Peck, "Designing for Manufacture", Pitman-1973.

222EDE04	COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To study different composite materials and finding its mechanical strength.
2. To fabricate FRP and other composites by different manufacturing methods.
3. To know about stress analysis of fiber reinforced laminates for different combinations of plies with different orientations of the fiber.
4. To calculate stresses in the lamina of the laminate using different failure theories
5. To calculate residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

PREREQUISITE: Knowledge of Composite Materials is required.

UNIT I INTRODUCTION TO COMPOSITE MATERIALS **9**

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments-ceramic fibers-fiber fabrication-natural composite wood, Jute-Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites

UNIT II MANUFACTURING OF COMPOSITES **9**

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs)–hot press ingreaction bonding process-infiltration technique, direct oxidation-interfaces

UNIT III LAMINA CONSTITUTIVE EQUATIONS **9**

Lamina Constitutive Equations: Lamina Assumptions–Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, CrossPly Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES **9**

Introduction- Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials, Generalized Hill's Criterion for Anisotropic materials, Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion, Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations, Static Bending Analysis. Buckling Analysis. Free Vibrations– Natural Frequencies

UNIT V THERMO-STRUCURAL ANALYSIS **9**

Fabrication stresses / Residual stresses in FRP laminated composites-Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law, Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's -Stress and Moment Resultants due cooling of the laminates during fabrication-Calculations for thermo-mechanical stresses in FRP laminates.

Case studies: Implementation of CLT for evaluating residual stresses in the components made with different isotropic layers such as electronic packages etc.

TOTAL : 45 HOURS

COURSE OUTCOMES:

The student will be able to

- Calculate for mechanical strength of the composite material
- Fabricate the FRP and other composites by different manufacturing methods
- Analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
- Evaluate the stresses in the lamina of the laminate using different failure theories
- Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

TEXT BOOKS:

1. Gibson RF, "Principles of Composite Material Mechanics", CRC press, 4th Edition, 2015.
2. Agarwal BD and Broutman LJ, "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.

REFERENCE BOOKS:

1. Hyer MW and Scott R White, "Stress Analysis of Fiber – Reinforced Composite Materials", DEStech Publication Incorporated, 2009.
2. Issac M Daniel and OriIshai, "Engineering Mechanics of Composite Materials", Oxford University Press, First Indian Edition, 2007.
3. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, Reprinted, 2008.
4. Mallick PK, "Fiber – Reinforced Composites: Materials, Manufacturing and Design", CRC Press, 3rd Edition, 2007.

222EDE05	ADVANCED MECHANICS OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To learn the concepts of theory of elasticity in three-dimensional stress system.
2. To study the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
3. To learn the stresses in flat plates and curved members.
4. To study torsional stress of non-circular sections.
5. To learn the stresses in rotating members, contact stresses in point and line contact applications.

PREREQUISITE: Knowledge of Strength of Materials is required.

UNIT I ELASTICITY **9**

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium – compatibility - boundary conditions - representation of three - dimensional stress of a tension generalized Hook's law - St. Venant's principle - plane stress - Airy's stress function. Energy methods.

UNIT II SHEAR CENTRE AND UNSYMMETRICAL BENDING **9**

Location of shear centre for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section.

UNIT III STRESSES IN FLAT PLATES AND CURVED MEMBERS **9**

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions

UNIT IV TORSION OF NON-CIRCULAR SECTIONS **9**

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

UNIT V STRESSES IN ROTATING MEMBERS AND CONTACT STRESSES **9**

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds, Methods of computing contact stress-deflection of bodies in point and line contact applications.

TOTAL : 45 Hours

COURSE OUTCOMES:

The students will be able to

- Apply the concepts of theory of elasticity in three-dimensional stress system.
- Determine the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
- Evaluate the stresses in flat plates and curved members.
- Calculate torsional stress of non-circular sections.
- Determine the stresses in rotating members, contact stresses in point and line contact applications.

TEXT BOOKS:

1. Arthur P Boresi, Richard J.Schmidt, “Advanced Mechanics of Materials”, Wiley India Pvt. Ltd., 2009.
2. Timoshenko and Goodier, "Theory of Elasticity", Tata McGraw Hill, 2010.

REFERENCE BOOKS:

1. Hibbeler. R.C., “Mechanics of Materials”, Prentice-Hall, 2018.
2. Srinath. L.S., “Advanced Mechanics of Solids”, Tata McGraw Hill, 2009.
3. Robert D.Cook, Warren C.Young, "Advanced Mechanics of Materials", Prentice Hall, 1999.

222EDE06	DESIGN OF AUTOMOTIVE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To study about the design and loading conditions on automobile components.
2. To gain knowledge about the design of clutch with different parameters.
3. To enable the student to comprehend the purpose and usage of transmission system in automobiles.
4. To design the suspension and steering system.
5. To study the design principles of brakes at various pressure & torques.

PREREQUISITE: Knowledge of Design of Transmission system is required.

UNIT I INTRODUCTION **9**

General Layout of Automobile, Types of Chassis, Material, Performance of Automobiles. Design Conditions, Loading Conditions, Forced Vibrations of Spring Mass with Random Disturbance, Fatigue Resistance Analysis Procedure.

UNIT II CLUTCHES **9**

Design of Clutches, Calculation of Critical Parameters of Clutches, Design Calculation of Standard Elements of Friction Clutches, Torsional Vibration Dampers, Clutch Control Drives.

UNIT III TRANSMISSION **9**

Transmission Systems, Parameters, Differential, Axle Shafts, Gear Box. Transfer Case, Auxiliary Gear Box, Gear Shift Mechanisms, Planetary Gears. Kinematics of Universal Joints, Design of Universal Joint and Propeller Shaft.

UNIT IV SUSPENSION AND STEERING SYSTEM **9**

Oscillation and Smoothness of Ride, Elastic Characteristics of Ride, Elastic Elements of Suspension, Shock Absorbers. Fundamentals of Designing and Calculating Steering Control Linkage, Steering Gears, Hydraulic Booster.

UNIT V BRAKES **9**

Pressure Distribution in Brakes, Braking Torque, Internally Expanding Brakes, Design of Drum and Disk Brakes, Fundamentals of Designing Brake Force Regulators, Antilocking System.

TOTAL : 45 HOURS

COURSE OUTCOMES:

The student will have an ability to

- Design the various automobile components.
- Design of clutch with different parameters.
- Design the various transmission components
- Design the suspension and steering system.
- Design the brakes at various pressure & torques.

TEXT BOOKS:

1. Heinz Heisier, "Vehicle and Engine technology", SAE, New York, Second Edition, 1999.
2. Lukin P Gasparyants G and Rodionov V, "Automobile Chassis Design and Calculations", Second Edition, Mir Publishers, 1989.

REFERENCE BOOKS:

1. Jack Erjavec, “Automotive Technology – A System Approach”, Thomson Delmar Learning, 6th Edition, 2014.
2. Horst Bauer, “Diesel-Engine Management – Systems and Components”, Robert Bosch, 4th Edition, 2006.
3. John Fenton, “Handbook of automotive body and systems design”, Professional Engineering Publishing, 2001.
4. Schwaller AE, "Motor Automotive Technology", 3rd Editions, Delman Publishers, New York, 1999.
5. Gillespie T D, "Fundamentals of Vehicle Dynamics", SAE Inc., New York, 2nd Edition, 2021.

222EDE07	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To explain the role of supply chain management in an organization.
2. To identify the various aspects of supply chain management and the factors affecting them.
3. To explain the relationship among various factors involved in planning, organising and controlling supply chain operations.
4. To summarize the sourcing and inventory decisions involved in supply chain operations.
5. To explain the use of information technology in supply chain management.

UNIT I INTRODUCTION SUPPLY CHAIN MANAGEMENT 9

Introduction, Types of supply chains with and examples, Evolution of SCM concepts, Supply chain performance, Strategic Fit, Drivers of Supply Chain Performance – key decision areas – External Drivers of Change. Supply contracts – centralized vs. decentralized system

UNIT II SUPPLY CHAIN NETWORK DESIGN 9

Need for distribution network design- Factors affecting, Design options for distribution network. Network design decisions - Framework, factors influencing, Models of facility location and capacity allocation. Role of Transportation in supply chain, modes of transportation Modal Selection, Classification of carriers, Carrier Selection, Transportation Execution and Control. Food Mile Concept., design options.

UNIT III DEMAND AND SUPPLY IN SUPPLY CHAIN 9

Forecasting in supply chain- Methods, Approach, Errors. Aggregate planning in supply chain- Problem, Strategies and Implementation. Predictable variability in supply chain, Managing supply and demand. Distribution strategies-direct shipment, traditional warehousing, cross docking, inventory pooling, transhipment, Choosing appropriate strategy, Milk Run Model.

UNIT IV SOURCING AND INVENTORY DECISIONS IN SUPPLY CHAIN 9

Purchasing Vs Procurement Vs Strategic Sourcing, Item procurement importance matrix, Strategic Sourcing Methodology, Managing sourcing and procurement process, Supplier selection and evaluation, Bullwhip effect and its management, Economies of scale in supply chain- Cycle inventory, Estimation, Quantity discounts, Multiechelon cycle inventory. Uncertainty in supply chain- Safety inventory, Determination of appropriate level, Impact on uncertainity.

UNIT V SUPPLYCHAIN AND INFORMATION SYSTEMS 9

Information in supply chain, Role of Information technology, IT framework in supply chain, Supplier and Customer relationship management. Role of e-business in supply chain, e-sourcing and eprocurement. Technology drivers in supply chain - Risk management.

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will able to

- To introduce the concepts and elements of supply chain management.
- To understand supply chain network design aspects for various manufacturing and service.
- sectors.
- To understand the principle of demand and supply in supply chain.
- To gain knowledge on the sourcing and inventory decisions in supply chain.
- To understand the concepts of supply chain information systems.

TEXT BOOKS:

1. Sahay B.S. “Supply Chain Management: For Global Competitiveness”, 2nd Edition, Macmillan, India Ltd, 2011.
2. Chopra S. and Meihdl P., “Supply Chain Management- Strategy, Planning and Operations”, Pearson Education Asia, 2007.

REFERENCE BOOKS:

1. Dougart L., Stock J. and Ellram L., “Logistic Management”, Irwin McGraw Hill International Edition, 1998.
2. Kaminsky S., “Design and Managing the Supply chain”, McGraw Hill International Edition, 2000.
3. Raghuram G, and N.Rangaraj, “Logistics and Supply Chain Management -cases and concepts”, McMilan India Pvt Ltd, New Delhi, 2000.

222EDE08	INTEGRATED PRODUCT AND PROCESS DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To know the generic development process and concept development.
2. To study about the product planning and its phases.
3. To know about the product specifications.
4. To apply the knowledge on concept selection for a product.
5. To gain knowledge on product architecture to apply on real time situations.

PREREQUISITE: Knowledge of CAD/CAM/CIM is required.

UNIT I INTRODUCTION **9**

Characteristics of Successful Product Development, Who Designs and Develops Products, Duration and Costs of Product Development, Challenges of Product Development, Development Processes and Organizations, A Generic Development Process, Concept Development: The Front-End Process, Adapting the Genetic Product Development Process- Product Development Process Flows- The AMF Development Process-Product Development Organizations.

UNIT II PRODUCT PLANNING **9**

Product Planning Process- Identifying Opportunities- Evaluating and Prioritizing Projects- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process- Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs-Organizing the Needs into a Hierarchy-Establishing the Relative Importance of the Needs-Reflecting on the Results and the Process

UNIT III PRODUCT SPECIFICATIONS **9**

What Are Specifications -When Are Specifications Established-Establishing Target Specifications-Setting the Final Specifications-Concept Generation-The Activity of Concept Generation-Clarify the Problem- Search Externally-Search Internally-Explore Systematically- Reflect on the Results and the Process.

UNIT IV CONCEPT SELECTION **9**

Concept Selection- Overview of Methodology-Concept Screening-Concept Testing-Define the Purpose of the Concept Test- Choose a Survey Population- Choose a Survey Format- Communicate the Concept- Measure Customer Response-Interpret the Results- Reflect on the Results and the Process

UNIT V PRODUCT ARCHITECTURE **9**

Product Architecture-Implications of the Architecture-Establishing the Architecture-Delayed Differentiation-Platform Planning-Related System, Level Design Issues

TOTAL : 45 HOURS

COURSE OUTCOMES:

- The students will have the knowledge about the product development process and challenges in product development.
- The student will be able to implement the projects and execute them.
- The students will have an ability to gain knowledge on writing about the product specifications.
- The students will be able to know about concept selection process and concept testing.
- The students will have an ability to gain knowledge on product level design issues.

TEXT BOOKS:

1. Karl T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw –Hill International Edns., Fifth Edition, 2017.
2. Kevin Otto, Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", 1st Edition, Pearson, 2nd Indian Reprint 2004.

REFERENCE BOOKS:

1. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4
2. Stuart Pugh, "Tool Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, NY, 1991, ISBN 0-202-41639-5
3. Kemnneth Crow, "Concurrent Engg. /Integrated Product Development", DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.

222EDE09	INTEGRATED MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the important features of production systems.
2. To gain knowledge on group technology, computer aided process planning and integrated manufacturing systems in modern manufacturing.
3. To gain the knowledge on Computer Aided Planning and Control.
4. To gain the knowledge of computer monitoring systems in production.
5. To know the concepts of integrated manufacturing system.

PREREQUISITE: Knowledge of CAD/CAM/CIM is required.

UNIT I INTRODUCTION **8**

Objectives of a manufacturing system-identifying business opportunities and problems-classification of production systems-linking manufacturing strategy and systems analysis of manufacturing operations.

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING **9**

Introduction-part families-parts classification and coding - group technology machine cells-benefits of group technology. Process planning function CAPP – Computer generated time standards.

UNIT III COMPUTER AIDED PLANNING AND CONTROL **9**

Production planning and control-cost planning and control-inventory management- Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology- automated data collection system.

UNIT IV COMPUTER MONITORING **9**

Types of production monitoring systems-structure model of manufacturing process, process control & strategies- direct digital control-supervisory computer control computer in QC - contact inspection methods non-contact inspection method – computer aided testing - integration of CAQC with CAD/CAM.

UNIT V INTEGRATED MANUFACTURING SYSTEM **10**

Definition - application - features - types of manufacturing systems- machine tools materials handling system- computer control system - DNC systems manufacturing cell. Flexible Manufacturing Systems (FMS) - the FMS concept transfer systems - head changing FMS - variable mission manufacturing system - CAD/CAM system - human labor in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

TOTAL : 45 HOURS

COURSE OUTCOMES:

Students will be able to

- Get good exposure on manufacturing systems.
- Get good exposure on CAPP systems for rotational and prismatic parts and GT.
- Understand the effect of manufacturing automation strategies and derive production metrics with computer monitoring and control of manufacturing.
- Understand the production monitoring system.
- Understand the applications of FMS and Rapid prototyping concepts.

TEXT BOOKS:

1. Mikell P Groover, "Automation, Production System and Computer Integrated Manufacturing", Pearson/Prentice-Hall of India, 2012.
2. James A Rehg and Henry W Kroebber, “Computer Integrated Manufacturing”, Pearson/Prentice-Hall of India, 2005.

REFERENCE BOOKS:

1. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 2010.
2. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1st Edition, 1986.
4. R.W. Yeomans, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1986.

222EDE10	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To aquire knowledge on process capability and tolerances, form design.
2. To know about the factors influencing form design.
3. To gain the knowledge on component design for machining consideration, casting consideration in component design and design for the environment.
4. To gain the knowledge on group technology concepts.
5. To know about the environmental objectives and global issues.

PREREQUISITE: Knowledge of Machine drawing is required.

UNIT I PROCESS CAPABILITY AND TOLERANCES **8**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, Evaluation method, Process capability - Feature tolerances, Geometric tolerances. Worst case method - Assembly limits, Datum features, Tolerance stacks**.**

UNIT II FACTORS INFLUENCING FORM DESIGN **9**

Influence of materials on form design - form design of grey iron, malleable iron, steel and aluminium castings - form design of welded members, forgings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION **10**

Design features to facilitate machining – drills, milling cutters, keyways, Doweling procedures, Counter sunk screws - Reduction of machined area, simplification by separation, simplification by amalgamation. Design for machinability - Design for economy, Design for clampability, Design for accessibility, Design for assembly.

UNIT IV COMPONENT DESIGN - CASTING CONSIDERATION **9**

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - Group technology, Computer Applications for DFMA.

UNIT V DESIGN FOR THE ENVIRONMENT **9**

Introduction – Environmental objectives, Global issues, Regional and local issues. Basic DFE methods – Design guide lines, Example application. Lifecycle assessment – Basic method, AT&T's environmentally responsible product assessment. Weighted sum assessment method – Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage. Design for disassembly, Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will be able to

- Understand the complex interrelationships between design and manufacturing.
- Explore and understand basic manufacturing processes and the design for manufacturing (DFM) implications of design choices for specific manufacturing processes.
- Understand the role of components design with machining consideration.
- Understand approaches and practices related to CAD model building and model checking for specific manufacturing processes such as models for sheet metal and models for casts and molds.
- Know about the environmental issues with case study.

TEXT BOOKS:

1. Peck, Harry, "Designing for Manufacture", Pitman Publications, 2010.
2. James Bralla, "Design for Manufacturability Handbook", Second Edition, McGraw-Hill, New York, 1999.

REFERENCE BOOKS:

1. George E Dieter, "Engineering Design- Material and processing approach", McGraw Hill Intl., 2nd Edition, 2013.
2. Matousek, "Engineering Design- A Systematic Approach", Blackie & Son Ltd, London, 2013.
3. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, New Delhi, 2011.
4. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Second Edition, Marcel Dekker Inc., London, 2010.

222EDE11	ENGINEERING FRACTURE MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the basic concepts of solid mechanics.
2. To get knowledge on stationary crack, crack growth and fatigue crack growth.
3. To analyze dynamic energy balance.
4. To understand the concepts of fatigue crack growth curve.
5. To analyze crack Growth for cyclic loading and crack initiation under large scale.

PREREQUISITE: Knowledge of Engineering Materials and Metallurgy is required.

UNIT I ELEMENTS OF SOLID MECHANICS **9**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - Limit analysis.

UNIT II STATIONARY CRACK UNDER STATIC LOADING **9**

Two dimensional elastic fields - Analytical solutions yielding near a crack front - Irwin's approximation - Plastic zone size - Dugdale model - J integral and its relation to crack opening displacement.

UNIT III ENERGY BALANCE AND CRACK GROWTH **9**

Griffith analysis - Linear Fracture Mechanics-Crack opening displacement - Dynamic energy balance –R Curves - Crack arrest.

UNIT IV FATIGUE CRACK GROWTH CURVE **9**

Empirical relation describing crack growth by fatigue - Life calculations for a given load amplitude - Effects of changing the load spectrum - Effects of Environment.

UNIT V APPLICATION OF FRACTURE MECHANICS **9**

Crack Initiation under large scale yielding – Thickness as a design parameter – Mixed mode fractures - Crack instability in thermal and residual stress fields - Numerical methods

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will be able to

- Calculate the stress-strain and load-displacement fields around a crack tip.
- It helps the engineers to get familiarized with the design of components that contain crack under static load condition.
- It helps the engineers to get familiarized with the design of components that contain crack and its growth under fatigue load condition.
- Design materials and structures using fracture mechanics approaches.
- Know different application of fracture mechanics.

TEXT BOOKS:

1. David Broek, "Elementary Engineering Fracture Mechanics ", 4th Edition, Kluwer Academic Publishers, 2005.
2. George E.Dieter,"Mechanical Metallurgy", 3rd Edition, Tata McGraw Hill, 1986.
3. Preshant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, 2009.

REFERENCE BOOKS:

1. Anderson T L, "Fracture Mechanics: Fundamentals and Applications", CRC Press, 4th Edition, 2017.
2. Janssen M, Zuidema J, Wanhill R J H, "Fracture Mechanics", VSSD, 2nd Edition, 2006.

3. Sanfard R J, “Principles of Fracture Mechanics”, Pearson Education Inc., Upper Saddle River, 2003.
4. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 2000.

222EDE12	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To gain knowledge on artificial intelligence.
2. To understand the concepts of Machine Learning.
3. To appreciate supervised learning and their applications.
4. To appreciate the concepts and algorithms of unsupervised learning.
5. To understand the theoretical and practical aspects of Probabilistic Graphical Models.

UNIT I ARTIFICIAL INTELLIGENCE **9**

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

UNIT II INTRODUCTION TO MACHINE LEARNING **9**

Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.

UNIT III SUPERVISED LEARNING **9**

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naive Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feedforward Network, Error Back propagation - Support Vector Machines.

UNIT IV UNSUPERVISEDLEARNING **9**

Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

UNIT V PROBABILISTIC GRAPHICAL MODELS **9**

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields- Hidden Markov Models – Conditional Random Fields (CRFs).

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will able to

- Optimize the robots using Artificial Intelligence.
- Design a learning model appropriate to the application.
- Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
- Use a tool to implement typical Clustering algorithms for different types of applications.
- Identify applications suitable for different types of Machine Learning with suitable justification.

TEXT BOOKS:

1. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman and Hall, CRCPress, Second Edition, 2014.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.

REFERENCE BOOKS:

1. Kevin P.Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
3. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.

222EDE13	MECHATRONICS SYSTEM IN DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the functions of Mechatronics system.
2. To select appropriate sensors for an engineering application.
3. To study about application of microprocessors and microcontrollers programs.
4. To study programmable logic controllers and their applications.
5. To study about different possible design solutions for a Mechatronic system.

PREREQUISITE: Knowledge of Mechatronics is required.

UNIT I INTRODUCTION **9**

Introduction to Mechatronics – Systems, Key Elements, Mechatronics Design Process, Measurement Systems, Control Systems, Traditional design and Mechatronics Design.

UNIT II SENSORS AND TRANSDUCERS **9**

Sensors and Transducers - Types**,** Performance Terminology, Displacement, Position and Proximity, Velocity and Motion, Fluid pressure, Temperature sensors, Light sensors, Selection of sensors, Signal processing.

UNIT III MICROPROCESSORS AND MICRO CONTROLLERS **9**

Microprocessors and Micro Controllers – Architecture, Pin Configuration and Instruction Set, Programming of Microprocessors Using 8085 Instructions. Interfacing input and output devices - Interfacing D/A converters and A/D converters, Applications, Temperature Control, Stepper motor control, Traffic light controller.

UNIT IV PROGRAMMABLE LOGIC CONTR-OLLERS **9**

Basic structure - Input / Output processing, Programming, Mnemonics, Timers, Internal Relays and Counters.Data handling - Analog input / output, Selection of PLC.

UNIT V DESIGN OF MECHATRONICS SYSTEMS **9**

Design of Mechatronics System – Future Trends, Possible Design Solutions. Case studies of Mechatronics Systems - Automatic Washing Machine, Auto Focusing in Digital Cameras, Thermal Cycle Fatigue of Ceramic Plate with mechatronics approach, Time Delay Blower**.**

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will have the ability to

- Understand the functions of Mechatronics system.
- Select appropriate sensors for an engineering application.
- Write microcontroller programs.
- Learn Programmable Logic Controllers and their applications.
- Design solutions for a Mechatronic system.

TEXT BOOKS:

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 5th Edition, 2019.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, A J., "Mechatronics: Electronics in Products and Processes ", Chapman and Hall, 2018.

REFERENCE BOOKS:

1. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", 5th Edition, Prentice Hall, 2002.
2. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", IEEE Inc, New York, 1996.
3. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 2009.
4. Bolton .W, “Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering”, Pearson Education Press, 6th Editions, 2018.

222EDE14	ADVANCED MACHINE TOOL DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To selecting the different machine tool mechanisms.
2. To design the Multi speed Gear Box and feed drives.
3. To design the machine tool structures.
4. To design the guideways and power screws.
5. To design the spindles and bearings.

UNIT I INTRODUCTION TO MACHINE TOOL DESIGN **9**

Introduction to Machine Tool Drives and Mechanisms, Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

UNIT II REGULATION OF SPEEDS AND FEEDS **9**

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

UNIT III DESIGN OF MACHINE TOOL STRUCTURES **9**

Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriage.

UNIT IV DESIGN OF GUIDEWAYS AND POWER SCREWS **9**

Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slide ways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

UNIT V DESIGN OF SPINDLES AND SPINDLE SUPPORT **9**

Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness

TOTAL : 45 HOURS

COURSE OUTCOMES:

The students will able to

- Select the different machine tool mechanisms.
- Design the Multi speed Gear Box and feed drives.
- Design the machine tool structures.
- Design the guideways and power screws.
- Design the spindles and bearings.

TEXT BOOKS:

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