ANNA UNIVERSITY, CHENNAI

NON- AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY

M.E. CAD/CAM

REGULATIONS – 2021

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ED4153	Computer Applications in Design	PCC	3	0	0	3	3
2.	CD4152	Design for Sustainability	PCC	3	0	0	3	3
3.	CC4101	Advanced Manufacturing Processes	PCC	3	0	0	3	3
4.	CC4102	Computer Aided Tools for Manufacturing	PCC	3	0	0	3	3
5.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Professional Elective – I	PEC	3	0	0	3	3
7.		Audit Course I*	AC	2	0	0	2	0
PRACTICAL								
8.	CD4161	Computer Aided Design Laboratory	PCC	0	0	4	4	2
9.	CM4161	Computer Aided Manufacturing Laboratory	PCC	0	0	4	4	2
			TOTAL	19	0	8	27	21

* Audit Course is optional

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PD4351	Product Lifecycle Management	PCC	3	0	0	3	3
2.	ED4251	Finite Element Methods in Mechanical Design	PCC	3	1	0	4	4
3.	CM4152	Solid Freeform Manufacturing	PCC	3	0	0	3	3
4.	II4071	Industry 4.0	PCC	3	0	0	3	3
5.		Professional Elective-II	PEC	3	0	0	3	3
6.		Professional Elective-III	PEC	3	0	0	3	3
7.		Audit Course II*	AC	2	0	0	2	0
PRACTICAL								
8.	CC4211	Rapid Prototyping Laboratory	PCC	0	0	4	4	2
9.	ED4261	Simulation and Analysis Laboratory	PCC	0	0	4	4	2
			TOTAL	**20**	**1**	**8**	**29**	**23**

* Audit Course is optional

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective-IV	PEC	3	0	0	3	3
2.		Professional Elective-V	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICAL								
4.	CC4311	Technical Seminar	EEC	0	0	2	2	1
5.	CC4312	Project Work I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**14**	**23**	**16**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICAL								
1.	CC4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 72

PROFESSIONAL ELECTIVES

SEMESTER I, ELECTIVE I

Sl. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
1.	PD4152	Integrated Product Development	PEC	3	0	0	3	3
2.	ED4072	Composite Materials and Mechanics	PEC	3	0	0	3	3
3.	CC4001	Computer Control in Process Planning	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE II

Sl. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
1.	ED4071	Advanced Finite Element Analysis	PEC	3	0	0	3	3
2.	ED4078	Optimization Techniques in Design	PEC	3	0	0	3	3
3.	CC4071	Advanced Machine tool Design	PEC	3	0	0	3	3
4.	PD4153	Reverse Engineering	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE III

Sl. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
1.	CC4002	Industrial Safety Management	PEC	3	0	0	3	3
2.	ED4077	Mechanical Measurements and Analysis	PEC	3	0	0	3	3
3.	CC4003	Reliability in Engineering Systems	PEC	3	0	0	3	3

SEMESTER III, ELECTIVES – IV

SI. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1.	CC4004	Performance Modeling and Analysis of Manufacturing Systems	PEC	3	0	0	3	3
2.	PD4151	Creativity and Innovation	PEC	3	0	0	3	3
3.	CD4072	Industrial Robotics and Expert systems	PEC	3	0	0	3	3
4.	CC4005	Design for Cellular Manufacturing Systems	PEC	3	0	0	3	3
5.	CC4006	Electronics manufacturing	PEC	3	0	0	3	3

SEMESTER III, ELECTIVES –V

SI. No.	Course Code	Course Title	Category	Periods Per week			Total Contact periods	Credits
				L	T	P		
1.	ED4079	Quality Concepts in Design	PEC	3	0	0	3	3
2.	CC4007	Non Destructive Testing	PEC	3	0	0	3	3
3.	ED4073	Design of Hybrid and Electric Vehicles	PEC	3	0	0	3	3
4	ED4076	Material Handling Systems and Design	PEC	3	0	0	3	3
5	PD4251	Designing with Advanced Materials	PEC	3	0	0	3	3

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

SI. No.	Course Code	Course title	Periods Per week			Credits
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

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ED4153 **COMPUTER APPLICATIONS IN DESIGN**   L   T   P   C
                                                   3   0   0   3

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

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   9
                 MANAGEMENT**
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 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

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

REFERENCES:

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

CD4152	DESIGN FOR SUSTAINABILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. Selecting the relevant process; applying the general design principles for manufacturability; GD &T.
2. Applying the design considerations while designing the cast and welded components.
3. Applying the design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. 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) - Formtolerancing: straightness, flatness, circularity, cylindricity - Profile tolerancing: profile of a line, and surface - Orientation tolerancing: angularity, perpendicularity, parallelism - Location tolerancing: position, concentricity, symmetry - runouttolerancing: 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 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Select relevant process; apply the general design principles for manufacturability; GD&T.
2. Apply design considerations while designing the cast and welded components.
3. Apply design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.

REFERENCES:
1. Boothroyd, G, 2nd Edition 2002, Design for Assembly Automation and Product Design. New York,   Marcel Dekker.
2. Bralla, Design for Manufacture handbook, McGrawhill,1999
3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture,MarcelDekker,1994
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher,USA,1995
5. Fixel, J. Design for the Environment McGraw Hill., 2nd Edition 2009
6. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub.,1996
7. Kevin Otto and Kristin Wood, Product Design. Pearson Publication,(Fourth Impression) 2009
8. Harry Peck, Designing for manufacture, Pitman-1973

CC4101	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
1. To analyze and determine material fabrication processes.
2. To use laboratory instrument doing routine metrological measurements
3. To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.
4. To recognize engine machine tool requirements and be selective in the choice of tools.
5. To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.
6. To identify with numerical control machining and computer programming.

UNIT– I   SURFACE TREATMENT   9
Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT– II   NON-TRADITIONAL MACHINING   9
Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM.

UNIT–III   LASER BEAM MACHINING   9
Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT– IV   PROCESSING OF CERAMICS   9
Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application , finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT– V   FABRICATION OF MICROELECTRONIC DEVICES   9
Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining

                                                                                TOTAL: 45 PERIODS

COURSE OUTCOMES:
- At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser hybrid welding processes.
- Able to understand different types of composite material characteristics, types of micro & macro machining processes.
- Understand the e-manufacturing & nano materials
- To make the students get acquainted with the design for manufacturing, assembly and environment.

REFERENCES:
1. Boothroyd,G,1997 Design for Assembly Automation and Product Design. NewYork, Marcel Dekker.
2. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, MarcelDekker, 2nd Edition 2002.
3. Bralla, Design for Manufacture handbook, McGrawhill,1999.
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
5. Fixel, J. Design for the Environment McGrawHill.1996.
6. Graede IT. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. ReasonPub.,1996.
7. Harry Peck, Designing for manufacture,Pitman–1973
8. Kevin Otto and Kristin Wood, Product Design. Pearson Publication, (Fourth Impression) 2009.

CC4102	COMPUTER AIDED TOOLS FOR MANUFACTURING	L	T	P	C
		3	0	0	3

UNIT– I COMPUTER AIDED MANUFACTURING 9

Manufacturing Processes – Removing, Forming, Deforming and joining – Integration equipments. Integrating CAD, NC and CAM – Machine tools – Point to point and continuous path machining, NC, CNC and DNC – NC Programming – Basics, Languages, G Code, M Code, APT – Tool path generation and verification – CAD/CAM NC Programming – Production Control – Cellular Manufacturing

UNIT– II COMPUTER AIDED PROCESS PLANNING 9

Role of process planning in CAD/CAM Integration – Computer Aided Process Planning – Development, Benefits, Model and Architecture – CAPP Approaches – Variant, Generative and Hybrid – Process and Planning systems – CAM-I, D-CLASS and CMPP – Criteria in selecting a CAPP System.

UNIT–III COMPUTER AIDED INSPECTION 9

Engineering Tolerances – Need for Tolerances – Conventional Tolerances – FITS and LIMITS – Tolerance Accumulation and Surface quality – Geometric Tolerances – Tolerances Practices in design, Drafting and manufacturing – Tolerance Analysis – Tolerance synthesis – Computer Aided Quality control – Contact Inspection Methods – Non Contact Inspection Methods - Non optical.

UNIT– IV REVERSE ENGINEERING 9

Scope and tasks of Reverse Engineering – Domain Analysis – Process Duplicating – Tools for RE – Developing Technical data – Digitizing techniques – Construction of surface model – Solid part model – Characteristic evaluation – Software's and its application – CMM and its feature capturing – surface and solid modeling.

UNIT– V DATA MANAGEMENT 9

Strategies for Reverse Engineering Data management – Software application – Finding renewable software components – Recycling real time embedded software – Design experiments to evaluate a RE tools – Rule based detection for RE user interface – RE of assembly programs

TOTAL:45 PERIODS

REFERENCES:
1. Catherine A. Ingle, "Reverse Engineering", Tata Mc Graw Hill Publication, 1994
2. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, "Computer Integrated Design and manufacturing", Mc Graw Hill International series, 1991
3. Donald R. Honra, "Co-ordinate measurement and reverse Engineering, American Gear Manufacturers Association.
4. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", Revised First special Indian Edition, Tata Mc Graw Hill Publication, 2007
5. Ibrahim Zeid, "Mastering CAD/CAM", special Indian Edition, Tata Mc Graw Hill Publication, 2007
6. Linda Wills, "Reverse Engineering" Kluwer Academic Press, 1996

RM4151   **RESEARCH METHODOLOGY AND IPR**   **L T P C**
                                                                              2 0 0 2

UNIT I   RESEARCH DESIGN   6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II   DATA COLLECTION AND SOURCES   6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III   DATA ANALYSIS AND REPORTING   6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV   INTELLECTUAL PROPERTY RIGHTS   6
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V   PATENTS   6
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL : 30 PERIODS

REFERENCES
1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

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Anna University, Polytechnic & Schools

CD4161	**COMPUTER AIDED DESIGN LABORATORY**	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's

- **CAD Introduction.**
- **Sketcher**
- **Solid modeling** – Extrude, Revolve, Sweep and variational sweep, Loft
- **Surface modeling** – Extrude, Sweep, Trim and Mesh of curves, Freeform.
- **Feature manipulation** – Copy, Edit, Pattern, Suppress, History operations etc.
- **Assembly** - Constraints, Exploded Views, Interference check
- **Drafting** - Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in modeling and drafting of mechanical components-assembly using parametric and feature-based packages like PRO-E/SOLIDWORKS /CATIA/NX

TOTAL= 60 PERIODS

OUTCOMES:

On completion of the course the student will be able to

- Use the modern engineering tools necessary for engineering practice
- Draw 2D part drawings, sectional views, and assembly drawings as per standards.
- Create 3D Model on any CAD software.
- Convert 3D solid models into 2D drawings and prepare different views, sections, and dimensioning of part models.
- Examine interference to ensure that parts will not interfere.

CM4161	**COMPUTER AIDED MANUFACTURING LABORATORY**	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To familiarize students with manual CNC part programming for milling and turning machines.
- To generate part programs using CAM packages for milling and turning machines.
- To train students with dimensional and geometric measurements for machined features using video measuring system and coordinate measuring machine.
- To get hands on knowledge on programming logic controller - ladder programming and robot programming.
- To introduce the concept of printing parts using additive manufacturing and to introduce Relational database management system in Material requirements planning.

LIST OF EXPERIMENTS

1. Programming and simulation for various operations using canned cycle for CNC turning Centre.
2. Programming and simulation for machining of internal surfaces in CNC turning Centre
3. Programming and simulation for profile milling operations
4. Programming and simulation for circular and rectangular pocket milling
5. Programming and simulation using canned cycle for CNC Milling such as peck drilling and tapping cycle

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6. CNC code generation using CAM software packages – Milling
7. CNC code generation using CAM software packages – Turning
8. Dimensional and geometric measurement of machined features using VMS and CMM
9. PLC ladder logic programming.
10. Robot programming for Material handling applications.
11. Study on RDBMS and its application in problems like inventory control MRP.
12. Design and fabrication of a component using extrusion based additive manufacturing.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:
CO1: Explain the manual CNC part programming for milling and turning machines.
CO2: Create part programs using CAM packages for milling and turning Machines.
CO3: Appraise dimensional and geometric measurements of machined features using video measuring system and coordinate measuring machine.
CO4: Construct PLC ladder programming and robot programming.
CO5: Relate the concept of printing parts using additive manufacturing and appreciate the application RDBMS in MRP.

LIST OF EQUIPMENTS REQUIRED:
1. Computers 30
2. CAM Software for 3 axis machining or more
3. CNC Production type turning or Machining center
4. Video Measuring System
5. Coordinate Measuring Machine
6. Surface Roughness tester
7. 5 -axis Robot
8. Programmable Logic Controller with ladder logic programming software
9. RDMBS Package with relevant modules like Inventory Control and MRP
10. 3D Printer

PD4152	INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
1. To Understand the principles of generic development process; product planning; customer need analysis for new product design and development.
2. To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
3. To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
4. To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.
5. Applying the concepts of economics principles; project management practices in development of new product.

UNIT– I   **INTRODUCTION TO PRODUCT DESIGN**   **9**

Characteristics of Successful Product development –Duration and Cost of Product Development – Challenges of Product Development - Product Development Processes and Organizations – Product Planning Process - Process of Identifying Customer Needs

UNIT– II   **PRODUCT SPECIFICATIONS, CONCEPT GENERATION,**   **9**
                       SELECTION AND TESTING

Establish Target and Final product specifications – Activities of Concept Generation - Concept Screening and Scoring - Concept Testing Methodologies.

UNIT–III   **PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN**   **9**

Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning – Related system level design issues - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design

UNIT– IV   **DESIGN FOR MANFACTURE, PROTOTYPING AND**   **9**
                       ROBUST DESIGN

DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors - Prototype basics - Principles of prototyping – Prototyping technologies - Planning for prototypes - Robust design –Robust Design Process

UNIT– V   **PRODUCT DEVELOPMENT ECONOMICS AND**   **9**
                       MANAGING PROJECTS

Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks- Baseline Project Planning - Accelerating the project - Project execution – Postmortem project evaluation.

                                              TOTAL:45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.

REFERENCES:
1. Karl T.Ulrich, Steven D.Eppinger, Anita Goyal, "Product Design and Development", McGraw – Hill Education (India) Pvt. Ltd, 4th Edition, 2012.
2. Kenneth Crow, "Concurrent Engineering/Integrated Product Development". DRM Associates, 6/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
3. Kevin N Otto, Kristin L Wood, "Product Design – Techniques in Reverse Engineering and New Product Development", Pearson Education, Inc, 2016
4. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin Homewood, 1992
5. Stuart Pugh, "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, Neyourk, NY, 1991**.**

COURSE OBJECTIVES:
1. Study of different composite materials and finding its mechanical strength
2. Fabrication of FRP and other composites by different manufacturing methods
3. Stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Calculation of stresses in the lamina of the laminate using different failure theories
5. Calculation of residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

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 pressing-reaction bonding process-infiltration technique, directoxidation-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 PlyLaminates, 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   9
                   FLAT PLATES

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(L:45)=45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
1. Calculate for mechanical strength of the composite material
2. Fabricate the FRP and other composites by different manufacturing methods
3. Analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Evaluate the stresses in the lamina of the laminate using different failure theories
5. Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

REFERENCES:
1. Agarwal BD and Broutman LJ,"Analysis and Performance of Fiber Composites", John Wiley and Sons, New York,1990.
2. Gibson RF, Principles of Composite Material Mechanics, CRC press, 4th Edition, 2015.
3. Hyer MW andScott R White, "Stress Analysis of Fiber – Reinforced Composite Materials",McGraw-Hill,1998
4. Issac M Daniel and OriIshai, "Engineering Mechanics of Composite Materials", OxfordUniversityPress-2006,FirstIndian Edition-2007
5. MadhujitMukhopadhyay,"Mechanics of Composite Materials and Structures", University Press(India)Pvt.Ltd.,Hyderabad,2004(Reprinted 2008)
6. Mallick PK, Fiber – Reinforced Composites: Materials, Manufacturing and Design, CRC Press, 3rd Edition,2007.

CC4001	**COMPUTER CONTROL IN PROCESS PLANNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:
- To provide the student with an understanding of the importance of process planning role in manufacturing and the application of Computer Aided Process Planning tool in the present manufacturing scenario

UNIT I   INTRODUCTION   9
The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology

UNIT II   PART DESIGN REPRESENTATION   9
Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input /output devices - topology- Geometric transformation- Perspective transformation –Data structure - Geometric modelling for process planning- GT coding - The optiz system - The MICLASS system.

UNIT III   PROCESS   ENGINEERING   AND   PROCESS   9
**   PLANNING**
Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

UNIT IV   COMPUTER AIDED PROCESS PLANNING SYSTEMS   9

Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT V   AN INTERGRADED PROCESS PLANNING SYSTEMS   9

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation –Report Generation, Expert process planning.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- To understand the need of process planning in manufacturing
- To know handle the computer aided process planning tool
- To apply the knowledge of Expert systems, Group technology and part representation for various applications
- To interpret the use of computer aided process panning for CAD/CAM Systems
- To analyse the computer aided planning systems for various industrial applications

REFERENCES:
1. Chang, T.C., "An Expert Process Planning System ", Prentice Hall,1985.
2. Gideon Halevi and Roland D.Weill, "Principles of Process Planning", A logical approach,Chapman &Hall,1995.
3. Nanua Singh,"SystemsApproachtoComputerIntegratedDesignandManufacturing",John Wiley & Sons, 1996.
4. Rao, "Computer Aided Manufacturing", Tata Mc Graw Hill Publishing Co.,2000.
5. Tien-Chien Chang, Richard A. Wysk, "An Introduction to automated process planning systems",PrenticeHall,1985.

WEB REFERENCES:
1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
2. http://Estraj.ute.sk/journal/engl/027/027.htm

www.binils.com

Anna University, Polytechnic & Schools

AUDIT COURSES

AX4091	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- 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 PERIODS

COURSE OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

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.

AX4092	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSE OBJECTIVES

- 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

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 PERIODS

COURSE OUTCOMES

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

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

AX4093   **CONSTITUTION OF INDIA**   **L T P C**
                                                                          2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- 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**

History, Drafting Committee, (Composition & Working)

UNIT II   **PHILOSOPHY OF THE INDIAN CONSTITUTION**

Preamble, Salient Features

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

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**

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**

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**

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 PERIODS

OUTCOMES

Students 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.

SUGGESTED READING

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

AX4094   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 மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஒளவையார்

UNIT II   **அறநெறித் தமிழ்**   **6**
1. அறநெறி வகுத்த திருவள்ளுவர்
    - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு 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
   சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV   **அருள்நெறித் தமிழ்**   **6**
1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குத் போர்வை கொடுத்தது, அதியமான் ஒளவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை 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. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

                                                                    TOTAL: 30 PERIODS

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 ஆதின வெளியீடு
4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்