ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. / M.TECH CAD/CAM (R 2021)
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA & SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I.	To Impart knowledge to students in recent advances in the Computer Aided Manufacturing to educate them to prosper in Manufacturing engineering and research related professions.
II.	To enhance the scientific and engineering fundamentals the provide students with a solid foundation in required to solve analytical problems
III.	To coach students with good design and engineering skills so as to comprehend, analyze, design, and produce novel materials, products and solutions for the contemporary manufacturing issues.
IV.	To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Computer Integrated Manufacturing engineering issues to broader engineering and social context.

2. PROGRAMME OUTCOMES(POs):

PO#	Programme Outcomes
1	An ability to independently carry out research/investigation and development work to solve practical problems
2	An ability to write and present a substantial technical report/document
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4	Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze engineering problems.
5	Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks in the design and manufacturing applications
6	Responsibility of understanding ethically and professionally and develop confidence for self-education and ability for life-long learning

4. PEO/PO Mapping:

PEO	PO					
	1	**2**	**3**	**4**	**5**	**6**
I.	**2**	**2**	**1**	**3**	**2**	**1**
II.	**2**	**2**	**1**	**2**	**3**	**2**
III.	**1**	**2**	**1**	**2**	**3**	**2**
IV.	**1**	**3**	**2**	**2**	**1**	**2**

1,2,3,-, scale against the correlation PO's with PEO's

PROGRAM ARTICULATION MATRIX OF M.E./M.TECH. CAD/CAM

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR I	SEMESTER I	Computer Applications in Design	2	2	2	1		
		Design for Sustainability	2	2	2	1	2	
		Advanced Manufacturing Processes	2	2	2	2	2	
		Computer Aided Tools for Manufacturing	2	2	2	1	1	
		Professional Elective – I						
		Research Methodology and IPR	1	1	3	3		
		Audit Course I						
		Computer Aided Design Laboratory	2	2	2	1	1	
		Computer Aided Manufacturing Laboratory	2	3	2	1		
	SEMESTER II	Product Lifecycle Management	3	3	3	1		
		Finite Element Methods in Mechanical Design	3	3	2	1		
		Solid Freeform Manufacturing	3	3	2	2		
		Industry 4.0						
		Professional Elective-II						
		Professional Elective-III						
		Audit Course II*						
		Rapid Prototyping Laboratory	2	2	2	2	2	2
		Simulation and Analysis Laboratory	2	2	2	2	2	2
YEAR II	SEMESTER III	Professional Elective-IV						
		Professional Elective-V						
		Open Elective						
		Technical Seminar	1	1	1	1	1	1
		Project Work - I	2	2	2	2	2	2
	SEMESTER IV	Project Work - II	3	3	3	3	3	3

NNA 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 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

Sl. 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

Sl. 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.	MF4072	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

Sl. 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

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 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 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.

CO	PO					
	1	2	3	4	5	6
1	2	1	1	3	2	1
2	2	1	1	3	2	1
3	2	1	1	3	2	1
4	2	1	1	3	2	1
5	2	1	1	3	2	1
AVg.	2	1	1	3	2	1

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.

INTRODUCTION **9**

UNIT- I

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

CO	PO					
	1	2	3	4	5	6
1	1	1	1	2	2	1
2	1	1	1	2	2	1
3	1	1	1	2	2	1
4	1	1	1	2	2	1
AVg.	1	1	1	2	2	1
	1	1	1	2	2	1

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 lT. 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.

Mapping of CO with PO and PSO

	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	2	3		
CO2	2	2		2	2	2
CO3	2		2	2	2	3
CO4	3	2	2	2	2	3
AVG	3	3	3	3	2	3

1-low, 2-medium, 3-high, '-'- no correlation

CC4102 COMPUTER AIDED TOOLS FOR MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:
computer aided tools that can be implemented in various industrial applications

UNIT– I COMPUTER AIDED MANUFACTURING **9**

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

UNIT– II COMPUTER AIDED PROCESS PLANNING **9**

Role of process planning in CAD/CAM Integration – Computer Aided Process Planning – Developn Benefits, Model and Architecture – CAPP Approaches – Variant, Generative and Hybrid – Process 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 LIMI Tolerance Accumulation and Surface quality – Geometric Tolerances – Tolerances Practices in de Drafting and manufacturing – Tolerance Analysis – Tolerance synthesis – Computer Aided Qu 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 F Developing Technical data – Digitizing techniques – Construction of surface model – Solid part mo Characteristic evaluation – Software's and its application – CMM and its feature capturing – su and solid modeling.

UNIT– V DATA MANAGEMENT **9**

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

TOTAL:45 PERIOD

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 specia 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

Mapping of CO with PO and PSO

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2		1	3	2	
2	2		1	3	2	
3	2		1	3	2	
4	2		1	3	2	
AVG	2		1	3	2	

1-low, 2-medium, 3-high, '-'- no correlation

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.

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.

Mapping of CO with PO

CO	PO					
	1	2	3	4	5	6
1	1	3	3	2	2	
2	1	3	3	2	2	
3	1	3	3	2	2	
4	1	3	3	2	2	
AVg.	1	3	3	2	2	

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
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

	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		3	2		
CO2	1		3	2		
CO3	1		3	2		
CO4	1		3	2		
CO5	1		3	2		
Avg	(5/5)=1		(15/5)=3	(10/5)=2		

PD4351 PRODUCT LIFE CYCLE MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

1. To understand history, concepts and terminology of PLM
2. To understand functions and features of PLM/PDM
3. To understand different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To Use PLM/PDM with legacy data bases, CAx & ERP systems

UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM).PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT II PLM/PDM FUNCTIONS AND FEATURES 9

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

UNIT III DETAILS OF MODULES IN APDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools

UNIT IV ROLE OF PLM ININDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for-business, organization, users, product or service, process performance.

UNIT V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL:45PERIODS

OUTCOMES:

The students will be able to

1. Summarize the history, concepts and terminology of PLM
2. Use the functions and features of PLM/PDM
3. Use different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx& ERP systems.

CO	PO					
	1	2	3	4	5	6
1	1	2	2	1	-	-
2	2	2	2	1	-	-
3	2	1	2	1	-	-
4	1	1	3	1	-	-
5	1	1	1	1	-	-
Avg	1.4	1.4	2	1	-	-

01 Low 02 Medium 03- High

REFERENCES

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition).
2. International Journal of Product Lifecycle Management, Inderscience Publishers
3. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
4. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.
5. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
6. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

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ED4251	FINITE ELEMENT METHODS IN MECHANICAL DESIGN	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. To learn mathematical models for one dimensional problems and their numerical solutions
2. To learn two dimensional scalar and vector variable problems to determine field variables
3. To learn Iso parametric transformation and numerical integration for evaluation of elementmatrices
4. To study various solution techniques to solve Eigen value problems
5. To learn solution techniques to solve non-linear problems

UNIT-I FINITE ELEMENT ANALYSIS OF ONEDIMENSIONAL PROBLEMS 9+3

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of B.V.P. – Ritz Method – Finite Element Modelling – Element Equations – Linear and Higher order Shape functions – Bar, Beam Elements –Applications to Heat Transfer problems.

UNIT-II FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS 9+3

Basic Boundary Value Problems in two-dimensions – Linear and higher order Triangular, quadrilateral elements – Poisson's and Laplace's Equation – Weak Formulation – Element Matrices and Vectors – Application to scalar variable problems - Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation – Principle of virtual work – Element matrices using energy approach

UNIT-III ISO-PARAMETRIC FORMULATION 9+3

Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Iso parametric Elements –Formulation – Shape functions -one dimensional , two dimensional triangular and quadrilateral elements -Serendipity elements- Jacobian transformation - Numerical Integration – Gauss quadrature – one, two and three point integration

UNIT-IV EIGEN VALUE PROBLEMS 9+3

Dynamic Analysis – Equations of Motion – Consistent and lumped mass matrices – Free Vibration analysis – Natural frequencies of Longitudinal, Transverse and torsional vibration – Solution of Eigenvalue problems - Introduction to transient field problems

UNIT-V NON-LINEAR ANALYSIS 9+3

Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and viscoplasticity, stress stiffening, contact interfaces- problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate

TOTAL = 60 PERIODS

COURSE OUTCOMES:

On Completion of the course the student will be able to

- Develop mathematical models for one dimensional problems and their numericalsolutions
- Determine field variables for two dimensional scalar and vector variable problems
- Apply Isoparametric transformation and numerical integration for evaluation of element matrices
- Apply various solution techniques to solve Eigen value problems
- Formulate solution techniques to solve non-linear problems

REFERENCES:

1. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990
2. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill, 2005
3. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth-Heinemann,2018.
4. Reddy,J.N. "Introduction to the Finite Element Method", 4 thEdition, Tata McGrawHill,2018
5. Seshu.P, "Text Book of Finite Element Analysis", PHI Learning Pvt. Ltd., NewDelhi, 2012.
6. TirupathiR.Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.

CO	PO					
	1	2	3	4	5	6
1	3	2	2	2	3	-
2	3	2	2	2	3	-
3	3	2	2	2	3	-
4	3	2	2	2	3	-
5	3	2	2	2	3	-
AVg.	3	2	2	2	3	-

1-low, 2-medium, 3-high, '-"- no correlation

CM4152 SOLID FREEFORM MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

UNIT I INTRODUCTION 9

Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain – Classification – Applications. Case studies: Bio printing- Food Printing- Electronics printing – Rapid Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative aspect.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation - Support Structure Design and Support Structure Generation - Model Slicing - Tool Path Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass Production, For Series Production. Case Studies.

UNIT III VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES 9

Stereolithography Apparatus (SLA): Principles – Photo Polymerization of SL Resins - Pre Build Process – Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and Applications.

Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies.

UNIT IV MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES 9

Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM.

Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure – Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion.

Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes – Materials – Advantages - Limitations and Applications. Case Studies.

UNIT V JETTING AND DIRECT ENERGY DEPOSITION PROCESSES 9

Binder Jetting: Three dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of printing: Continuous mode – Drop on Demand mode - Process – Materials - Advantages - Limitations - Applications.

Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and Applications. Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Relate the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.

CO2: Analyze the design for AM and its importance in the quality of fabricated parts.

CO3: Build knowledge on principles and applications of polymerization and sheet lamination processes with case studies.

CO4: Explain the principles of material extrusion and powder bed fusion processes and design guidelines.

CO5: Elaborate jetting and direct energy deposition processes and their applications.

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hotter, “Additive Manufacturing:3D Printing for Prototyping and Manufacturing”, Hanser publications Munchen, Germany, 2016. ISBN:978-1-56990-582-1.
2. Ben Redwood, Brian Garret, FilemonSchöffer, and Tony Fadel, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs B.V., Netherland, 2017. ISBN-13: 978-9082748505.
3. Ian Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer - New York, USA, 2nd Edition, 2015. ISBN-13: 978-1493921126.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 1st Edition, 2007 FL, USA. ISBN- 9780849334092.
5. Milan Brandt., “Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications”, Woodhead Publishing, UK, 2016. ISBN- 9780081004333.

	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	3	1	3	3	2
CO2	3	2	3	3	3	2
CO3	3	3	2	3	2	1
CO4	3	3	2	3	2`	1
CO5	3	3	2	3	2	1
Avg	(14/5)=2.8	(14/5)=2.8	(10/5)=2	(15/5)=3	(10/4)=2.5	(7/5)=1.4

II4071 **INDUSTRY 4.0** **LT P C**

3 0 0 3

OBJECTIVES:

The students will be able to

- Understand Industry 4.0
- Apply iot and iiot for Industry 4.0
- Understand CPS for Industry 4.0

UNIT I **9**

Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT II **9**

Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT III **9**

System, Technologies for enabling Industry 4.0–Cyber Physical Systems - Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing - Cyber Security

UNIT IV **9**

Role of data, information, knowledge and collaboration in future organizations - Resource- based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics -Cloud Computing and Industry 4.0

UNIT V **9**

Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0

TOTAL : 45 PERIODS

OUTCOMES:

The students will be able to

- use Industry 4.0 for Industrial Applications
- use IoT and IIoT for Industry 4.0
- apply smart devices Industrial Applications

TEXT BOOKS

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things
2. Arsheep Bahga, Internet of Things: A Hands-On Approach

CC4211	RAPID PROTOTYPING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

At the end of the course, the student shall be able to:

1. Optimize the process parameters of FDM machine to improve the quality of the parts produced.
2. Build complex engineering assemblies in plastic material with less process planning.
3. Improve surface finish of fabricated plastic components for the engineering applications.
4. Design and fabricate working models for the conceptual testing applications.

DETAILED SYLLABUS:

1. Review of CAD Modeling Techniques and Introduction to RP
2. Forming Groups & Assigning Creative Idea
3. Generating STL files from the CAD Models & Working on STL files
4. Modeling Creative Designs in CAD Software
5. Assembling Creative Designs in CAD Software

6. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7. Sending the tool path data to FDM RP machine
8. Removing the supports & post processing (cleaning the surfaces)
9. Demonstrating Creative Working Models

Mapping of CO with PO

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	3	3	2	3	2
2	1	3	3	2	3	2
3	1	3	3	2	3	2
4	1	3	3	2	3	2
AVg.	1	3	3	2	3	2

1-low, 2-medium, 3-high, '-'- no correlation

ED4261 SIMULATION AND ANALYSIS LABORATOR L T P C
0 0 4 2

OBJECTIVES:

• To give exposure to software tools needed to analyze engineering problems.

LIST OF EXPERIMENTS

1. Force and Stress analysis using link elements inTrusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates.
4. Stress analysis of axi–symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Modal analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Analysis of machine elements under dynamic loads
11. Analysis of non-linear systems

TOTAL:60PERIODS

LISTOFEQUIPMENTS/SOFTWARE:

Finite Element Analysis packages

COURSEOUTCOMES:

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

CO1 Solve engineering problems numerically using Computer Aided Finite Element Analysis packages

CO2 Analyze the force, stress, deflection in mechanical components.

CO3 Analyze thermal stress and heat transfer in mechanical components.
CO4 Analyze the vibration of mechanical components.
CO5 Analyze the modal, harmonic, transient and spectrum concepts in mechanical components.

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	3	3	2	3	3
2	2	3	3	2	3	3
3	2	3	3	3	3	3
4	2	3	3	1	2	3
5	2	3	3	3	3	3
AVg.	2	3	3	2.2	2.8	3

1-low, 2-medium, 3-high, '-"- no correlation

CC4311 **TECHNICAL SEMINAR** **L T P C**

0 0 2 1

COURSE OBJECTIVES:

- To work on a specific technical topic in Engineering design related topics in order toacquire the skills of oral presentation
- To acquire technical writing abilities for seminars and conferences

The students will work for two hours per week guided by a group of staff members. They will be askedto talk on any topic of their choice related to Engineering design topics and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On Completion of the course the student will be able to:

CO1:Students comprehend concepts and methods adequate to understand inductive and deductive reasoning, and increase their general problem solving skills.

CO2:Students develop communicative skills(e.g. speaking, listening, reading, and/or writing).

Mapping of CO with PO

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	3	3	2	2	2
2	1	3	3	2	2	2
3	1	3	3	2	2	2
4	1	3	3	2	2	2
AVg.	1	3	3	2	2	2

1-low, 2-medium, 3-high, '-'- no correlation

CC4312 **PROJECT WORK I** **L T P C**
0 0 12 6

COURSE OBJECTIVES

1. To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2. To develop the methodology to solve the identified problem.
3. To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design and manufacturing applicationa. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

On Completion of the course the student will be able to

CO1 Demonstrate a sound technical knowledge of their selected project topic.

CO2 Undertake problem identification, formulation and solution.

CO3 Design and manufactuiring engineering solutions to complex problems utilising a systems approach

CO4 The students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	2	3	2	2	2
2	2	2	3	2	2	2
3	2	2	3	2	2	2
AVg.	2	2	3	2	2	2

CC4411 **PROJECT WORK II** **L T P C**
3 0 0 3

OBJECTIVES:

1. To solve the identified problem based on the formulated methodology.
2. To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner

TOTAL: 360 PERIODS

OUTCOME:

On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it.

COURSE OUTCOMES:

On Completion of the course the student will be able to

CO1 Demonstrate a sound technical knowledge of their selected project topic.

CO2 Undertake problem identification, formulation and solution.

CO3 Design engineering solutions to complex problems utilising a systems approach

CO4 Demonstrate the knowledge, skills and attitudes of a professional engineer to take up any challenging practical problem in the field of engineering design and manufacturing engineering and find better solutions to it.

CO	PO					
	1	2	3	4	5	6
1	2	3	3	2	3	2
2	2	3	3	2	3	2
3	2	3	3	2	3	2
4	2	3	3	2	3	2
AVg.	2	3	3	2	3	2

1-low, 2-medium, 3-high, '-"- no

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, SELECTION AND TESTING 9

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 ROBUST DESIGN **9**

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 MANAGING PROJECTS **9**

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**.**

CO	PO					
	1	2	3	4	5	6
1	3	3	3	3	3	-
2	3	3	3	3	3	-
3	3	3	3	3	3	-
4	3	3	3	3	3	-
5	3	3	3	3	3	-
AVg.	3	3	3	3	3	-

1-low, 2-medium, 3-high, '-"- no correlation

ED4072 COMPOSITE MATERIALS AND MECHANICS L T P C
3 0 0 3

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 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(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 Orilshai, "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.

CO	PO					
	1	2	3	4	5	6
1	1	1	3	2	2	2
2	1	1	3	2	2	2
3	1	1	3	2	2	2
4	1	1	3	2	2	2
AVg.	1	1	3	2	2	2

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 PLANNING **9**

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

Mapping of CO with PO

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	2	3	2	2	2
2	1	2	3	2	2	2
3	1	2	3	2	2	2
4	1	2	3	2	2	2
AVg.	1	2	3	2	2	2

1-low, 2-medium, 3-high, '-'- no correlation

ED4071 ADVANCED FINITE ELEMENT ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To study concept of Finite Element Analysis to solve problems involving plate and shell elements
2. To learn concept of Finite Element Analysis to solve problems involving geometric and material non linearity
3. To study solution techniques to solvedynamic problems
4. To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
5. To study error norms, convergence rates and refinement.

UNIT-I BENDINGOFPLATESANDSHELLS 9

Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation ofPlate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 ContinuityElements –Degeneratedshell elements-Application and Examples.

UNIT-II NON-LINEARPROBLEMS 9

Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation –Solution procedure-Application in Metal Forming Process and Contact Problems.

UNIT-III DYNAMICPROBLEM 9

Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Eigensolution-SubspaceIterativeTechnique–Responseanalysis-Houbolt,Wilson,Newmark–Methods–Explicit&ImplictMethods-Lanchzos,Reducedmethodforlargesizesystemequations.

UNIT-IV FLUIDMECHANICSANDHEATTRANSFER 9

Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming–Navier Stokes Equation–Steady and Transient Solution.

UNIT-V ERRORESTIMATESANDADAPTIVEREFINEMENT 9

Error norms and Convergence rates–h-refinement with adaptivity–Adaptive refinement.

TOTAL=45PERIODS

COURSE OUTCOMES:

On Completion oft the course the student will be able to

CO1 ApplyconceptofFiniteElementAnalysistosolveproblemsinvolvingplateandshellelements
CO2 Apply concept of Finite Element Analysis to solve problems involving geometric and
CO3 material non linearity
CO4 Formulate solution techniques to solve dynamic problems
CO4 Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
CO5 Investigate error norms, convergence rates and refinement.

REFERENCES:

1. BatheK.J.,"FiniteElement Procedures in Engineering Analysis",PrenticeHall,1990
2. Logan.D.L.,"AfirstcourseinFiniteElementMethod",CengageLearning,2012
3. Reddy,J.N."AnIntroductiontoNonlinearFiniteElementAnalysis",2nd Edition,Oxford,2015
4. Robert D.Cook, David S.Malkus, Michael E.Plesha, Robert J.Witt,"Concepts and Applications of Finite Element Analysis", 4thEdition,WileyStudentEdition,2004.
5. Tirupathi R.Chandrupatla and Ashok D.Belegundu,"Introduction to Finite Elements in Engineering",InternationalEdition,PearsonEducationLimited,2014.
6. Zienkiewicz,O.C.,Taylor,R.L.andZhu.J.Z.,"The Finite Element Method:Its Basis and Fundamentals",7th Edition, Butterworth-Heinemann,2013.

CO	PO					
	1	2	3	4	5	6
1	2	1	3	2	2	1
2	2	1	3	2	2	1
3	2	1	3	2	2	1
4	2	1	3	2	2	1
5	2	1	3	2	2	1
Avg	2	1	3	2	2	1

1-low, 2-medium, 3-high, '-"- no correlation

ED4078	OPTIMIZATION TECHNIQUES IN DESIGN	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

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.

UNIT– I UNCONSTRAINED OPTIMIZATION TECHNIQUES 9

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications- inglevariableandmultivariableoptimization,Techniquesofunconstrainedminimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT– II CONSTRAINED OPTIMIZATION TECHNIQUES 9

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 9

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

UNIT– IV ADVANCEDOPTIMIZATIONTECHNIQUES 9

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

UNIT– V STATICANDDYNAMICAPPLICATIONS 9

Structural applications – Design of simple truss members – Design of simple axial, transverseloaded members for minimum cost, weight – Design of shafts and torsionally loaded members –Designofsprings. Dynamic Applications – Optimum design of single, two degree of freedom systems, vibrationabsorbers.ApplicationinMechanisms– Optimumdesignofsimplelinkagemechanisms.

TOTAL:45PERIODS

COURSEOUTCOMES:

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

- **CO1** Formulate unconstrained optimization techniques in engineering design application.
- **CO2** Formulate constrained optimization techniques for various applications.
- **CO3** Implement neural network technique to real world design problems.
- **CO4** Apply genetic algorithms to combinatorial optimization problems.
- **CO5** Evaluate solutions by various optimization approaches for a design problem.

REFERENCES:

1. Goldberg, David.E, “Genetic Algorithms in Search,Optimization and MachineLearning”,Pearson,2009.
2. Jang, J.S.R,Sun, C.TandMizutaniE.,"Neuro-Fuzzy andSoft Computing",PearsonEducation.2015,
3. JohnsonRay,C.,“Optimumdesignofmechanicalelements”,Wiley,2ndEdition1980.
4. KalyanmoyDeb,“OptimizationforEngineeringDesign:AlgorithmsandExamples”,PHILearningPrivateLimited,2nd Edition,2012.
5. RaoSingiresu S.,“Engineering Optimization – Theory and Practice”, New Age InternationalLimited,NewDelhi,3rdEdition,2013.
6. Rajasekaran S and Vijayalakshmi Pai,G.A,"Neural Networks,FuzzyLogic andGeneticAlgorithms",PHI,2011

CO	PO					
	1	2	3	4	5	6
1	3	3	2	-	-	1
2	3	2	2	-	2	-
3	3	2	3	-	2	-
4	3	3	3	-	2	-
5	3	3	3	3	2	-
AVg.	3	2.6	2.6	3	2	1

1-low, 2-medium, 3-high, ‘-“- no correlation

CC4071 ADVANCED MACHINE TOOL DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Selecting the different machine tool mechanisms.
2. Designing the Multi speed Gear Box and feed drives.
3. Designing the machine tool structures.
4. Designing the guideways and power screws.
5. Designing 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 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

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

REFERENCES:

1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 3rd edition 2012
2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2015
3. K Pal, S. K. Basu, “Design of Machine Tools”, 6th Edition. Oxford IBH, 2014
4. N. S. Acherkhan, “Machine Tool Design”, Volume 2 University Press of the Pacific, 2000
5. F. Koenigsberger, Design Principles of Metal-Cutting Machine Tools, Pergamon Press, 1964
6. F. Koenigsberger, Machine Tool Structures, Pergamon Press,1970.

CO	PO					
	1	2	3	4	5	6
1	3	3	3	2	3	3
2	3	3	3	2	3	3
3	3	3	3	2	3	3
4	3	3	3	2	3	3
5	3	3	3	2	3	3
AVg.	3	3	3	2	3	3

PD4153	REVERSE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Applying the fundamental concepts and principles of reverse engineering in product design and development.
2. Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyzing the various legal aspect and applications of reverse engineering in product design and development.

UNIT I INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM 9

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION 9

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III MATERIAL IDENTIFICATION AND PROCESS de VERIFICATION 9

Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT IV DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY 9

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT V ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE 9

Legality of Reverse Engineering – Patent – Copyrights –Trade Secret – Third-Party Materials – Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the fundamental concepts and principles of reverse engineering in product design and development.
2. Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and

development.

5. Analyze the various legal aspect and applications of reverse engineering in product design and development

REFERENCES

1. Co-ordinate Measurement and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association
2. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
3. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
4. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
5. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
6. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994

CO	PO					
	1	2	3	4	5	6
1	3	3	3	2	3	3
2	3	3	3	2	3	3
3	3	3	3	2	3	3
4	3	3	3	2	3	3
5	3	3	3	2	3	3
AVg.	3	3	3	2	3	3

INDUSTRIAL SAFETY MANAGEMENT

CC4002

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To achieve an understanding of principles of safety management.
2. To enable the students to learn about various functions and activities of safety department.
3. To have knowledge about sources of information for safety promotion and training.
4. To familiarize students with evaluation of safety performance.

UNIT– I SAFETY MANAGEMENT 9

Evaluation of modern safety concepts- Safety management functions- safety organization, safety department-safety committee, safety audit-performance measurements and motivation-employee participation in safety-safety and productivity.

UNIT– II OPERATIONAL SAFETY 9

Hot metal Operation-Boiler, pressure vessels- heat treatment shop- gas furnace operation-electroplating-hot bending pipes - Safety in welding and cutting. Cold-metal Operation - Safety inMachineshop-Coldbendingandchamferingofpipes-metalcutting-shotblasting,grinding,painting-powerpress and other machines.

UNIT–III SAFETYMEASURES 9

Layoutdesignandmaterialhandling-Useofelectricity-Managementoftoxicgasesandchemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety ofsewage disposal and cleaning - Control of environmental pollution - Managing emergencies inIndustries-planning,securityandriskassessments,on-siteandoffsite.Controlofmajorindustrialhazards.

UNIT– IV ACCIDENTPREVENTION 9

Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees-First Aid-Fire fighting devices-Accident reporting, investigation.

UNIT– V SAFETY,HEALTH,WELFARE & LAWS 9

Safety and health standards - Industrial hygiene - occupational diseases prevention – Welfare facilities-History of legislations related to Safety-pressure vessel act-Indian boileract-The environmental protection act-Electricity act-Explosive act.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion.

REFERENCES:

1. Ray Asfahl. C “Industrial Safety and Health Management” Pearson Prentice Hall, 2003.
2. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973.
3. John V.Grimaldi and Rollin H. Simonds, “Safety Management”, Richard D Irwin, 1994.
4. Dan Petersen, “Techniques of Safety Management”, McGraw-Hill Company, Tokyo, 1981.
5. Philip Hagan, “Accident Prevention Manual for Business and Industry”, N.S.C.Chicago, 13th edition, 2009.
6. Lees, F.P & M. Sam Mannan, “Loss Prevention in Process Industries: Hazard Identification, Assessment and Control”, Butterworth-Heinemann publications, London, 4th edition, 2012.
7. John Ridley, “Safety at Work”, Butterworth and Co., London, 1983.
8. Subramanian.V., “The Factories Act 1948 with Tamilnadu factories rules 1950”, Madras Book Agency, 21st ed., Chennai, 2000.
9. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
10. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997

Mapping of CO with PO

CO	PO					
	1	2	3	4	5	6
1	1	3	3	2	3	3
2	1	3	3	2	3	3
3	1	3	3	2	3	3
4	1	3	3	2	3	3
5	1	3	3	2	3	3
AVg.	1	3	3	2	3	3

ED4077 MECHANICAL MEASUREMENTS AND ANALYSIS L T P C

3 0 0 3

COURSEOBJECTIVES:

1. The student will understand the principle of force and strain measurement.
2. The student will understand the vibration measurement and their applications.
3. To impart knowledge on the principle behind acoustics and wind flow measurements.
4. To familiarize with the distress measurements
5. To realize the non destructive testing principle and application

UNIT– I FORCESANDSTRAINMEASUREMENT 9

Strain gauge,principle,types,performance and uses.Photo elasticity–Principle and applications -Moire Fringe-Hydraulic jacks and pressuregauges–Electronicloadcells–ProvingRings– CalibrationofTestingMachines.

UNIT– II VIBRATIONMEASUREMENTS 9

Characteristics of Structural Vibrations–Linear Variable Differential Transformer(LVDT)– Transducers for velocity and acceleration measurements. Vibration meter– Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters–Digital data Acquisition systems.

UNIT–III ACOUSTICSANDWINDFLOWMEASUREMENTS 9

Principles of Pressure and flow measurements–pressure transducers–sound level meter–venturimeter and flow meters–windtunnel and its use in structural analysis–structural modeling –direct and indirect modelanalysis

UNIT– IV DISTRESSMEASUREMENTS 9

Diagnosis of distress instructures–crack observation and measurements–corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition.

UNIT– V NONDESTRUCTIVETESTINGMETHODS 9

Load testing on structures,buildings ,bridges and towers–Rebound Hammer –acoustice mission –ultrasonictestingprinciplesandapplication–Holography–useoflaserforstructuraltesting–Brittlecoating

TOTAL:45PERIODS

COURSEOUTCOMES:

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

CO1 Measure physical quantities such as forces and strains.
CO2 Apply different vibration measurements techniques.
CO3 Measure physical quantities such as pressure and flow.
CO4 Apply techniques involved in crack measurement.
CO5 Select the appropriate nondestructive testing methods for various engineering applications.

REFERENCES:

1. Bray DonE and Stanley, R.K.,"Non-destructive Evaluation", McGraw Hill Publishing Company, N.Y.1989
2. Garas,F.K.,Clarke,J.LandArmerGST, "Structural assessment", Butterworths,London,1987
3. James W. Dally and William Franklin Riley, "Experimental Stress Analysis", McGraw Hill , 3rdEdition,1991
4. SadhuSingh, ExperimentalStressAnalysis, KhannaPublishers,NewDelhi,2009.
5. SrinathLS, RaghavanMr, LingaiahK, GargeshaG, PantBand Ramachandra,K,"ExperimentalStress Analysis",TataMcGrawHillCompany,NewDelhi,1984
6. Sirohi,R.S.andRadhakrishna,H.C,"MechanicalMeasurements",NewAgeInternational (P) Ltd,3rdEdition1997

	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	2	3	2	2	3
2	1	2	3	2	2	3
3	1	2	3	2	2	3
4	1	2	3	2	2	3
5	1	2	3	2	2	3
AVg.	1	2	3	2	2	3

1-low, 2-medium, 3-high, '-"- no correlation

RELIABILITY IN ENGINEERING SYSTEMS **L T P C**

CC4003 **3 0 0 3**

COURSE OBJECTIVES:

1. The ability to use statistical tools to characterize the reliability of an item;
2. The working knowledge to determine the reliability of a system a
3. To suggest approaches to enhancing system reliability;
4. The ability to select appropriate reliability validation methods

UNIT– I RELIABILITY CONCEPT **9**

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazardrate–MeasuresofReliability–Designlife–Aprioriandposterioriprobabilities– Mortalityofacomponent–Bathtubcurve–Usefullife.

UNIT– II FAILURE DATA ANALYSIS **9**

Data collection –Empirical methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull– Hazardplotting– Goodnessoffittests.

UNIT–III RELIABILITYASSESSMENT **9**

Differentconfigurations–Redundancy–m/nsystem–Complexsystems:RBD–Baye'smethod– Cutandtiesets–FaultTreeAnalysis–Standbysystem.

UNIT– IV RELIABILITY MONITORING **9**

Life testing methods: Failure terminated – Time terminated – Sequential Testing – Reliabilitygrowthmonitoring–Reliabilityallocation–Softwarereliability.

UNIT– V RELIABILITY IMPROVEMENT **9**

Analysis of downtime – Repair time distribution – System MTTR – Maintainability prediction – Measures of maintainability–System Availability–Replacement theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Analysetheinterferencebetweenstrengthandstress,orlifedataforestimatingreliability;
- Applytheappropriatemethodologiesandtoolsforenhancingtheinherentandactualreliability of components and systems, taking into consideration cost aspects; specify life test plans for reliability validation

REFERENCES:

1. Charles E.Ebeling,"AnintroductiontoReliabilityandMaintainabilityengineering",TMH,2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer,2007.
3. Alessandro Birolini, Reliability Engineering: Theory and Practice 8th ed. 2017 Edition
4. Mohammad Modarres, Mark P. Kaminskiy, Vasiliy Krivtsov ''Reliability Engineering and Risk Analysis: A Practical Guide", Third Edition 3rd Edition

Mapping of CO with PO

CO	PO					
	1	2	3	4	5	6
1	2	3	3	2	3	3
2	2	3	3	2	3	3
3	2	3	3	2	3	3
4	2	3	3	2	3	3
AVg.	2	3	3	2	3	3

1-low, 2-medium, 3-high, '-'- no correlation

CC4004 PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To develop an understanding of the use and benefits of modeling and simulation in manufacturing systems design and operation.
2. To develop an understanding of techniques to assess factory performance and identify areas for improvement.
3. To develop an understanding of techniques to assess and manufacturing performance.
4. To develop an understanding of techniques to enable responsive manufacturing systems.
5. To provide the students with knowledge of a set of tools to enable them to assess the performance of a manufacturing facility

UNIT– I MANUFACTURING SYSTEMS & CONTROL **9**

Automated Manufacturing Systems- Modelling- Role of performance modelling— simulation models- Analytical models. Product cycle - Manufacturing automation - Economics of scale and scope -input/outputmodel-plantconfigurations.Performancemeasures-Manufacturingleadtime - Work in process- Machineutilization-Throughput— Capacity-Flexibility- performability-Quality. Control Systems - Control system architecture - Factory communications - Local areanetworks-Factorynetworks-Opensystemsinterconnectionmodel-Networktonetworkinterconnections-Manufacturingautomationprotocol-Databasemanagementsystem.

UNIT– II MANUFACTURING PROCESSES **9**

ExamplesofstochasticprocessesPoissonprocessDiscretetimeMarkovchainmodels-Definitionandnotation-SojourntimesinstatesExamplesofDTMCsinmanufacturing-Chapman-Kolmogorovequation-Steady-stateanalysis.ContinuousTimeMarkovChainModels - Definitionsandnotation-Sojourntimesinstates-examplesofCTMCsinmanufacturing-EquationsforCTMCevolution-Markovmodelofatransferline. Birth and Death Processes in Manufacturing- Steady state analysis of BD Processes-Typical BD processes in manufacturing.

UNIT–III QUEUING MODELS **9**

Notation for queues - Examples of queues in manufacturing systems - Performance measures - Little's result-Steady state analysis of M/M/m queue, queues with general distributions andqueues with breakdowns-An alysis of a flexible machine center.

UNIT– IV QUEUING NETWORKS **9**

Examples of QN models in manufacturing - Little's law in queuing networks - Tandem queue – An open queuing network with feed back- An open central server model for FMS- Closed transfer line-Closed server model-Garden Newell networks.

UNIT– V PETRINETS **9**

Classical Petri Nets - Definitions - Transition firing and reachability - Representational power - properties-Manufacturingmodels.StochasticPetriNets-ExponentialtimedPetriNets-GeneralizedStochastic Petri Nets- modeling of KANBAN systems-Manufacturing models.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Model and simulate the operation of a small manufacturing system.
2. Use simulation as a manufacturing system design technique.
3. Justify the use of manufacturing modeling and simulation.
4. Use techniques such as value stream mapping and IDEF to identify improvements required in a manufacturing system.

REFERENCES:

1. Gupta S.C.,&Kapoor V.K.,"Fundamentals of Mathematical Statistics",3 rd Edition,Sultan Chand and Sons,New Delhi,1988.
2. Trivedi,K.S.,"Probability and Statistics with Reliability,Queuing and ComputerScienceApplications",PrenticeHall,NewJersey,1982.
3. Viswanadham,N and Narahari,Y."PerformanceModelingofAutomatedManufacturingSystems",Prentice Hall of India,New Delhi,1994.

Mapping of CO with PO

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	3	2	2	2	1
2	1	3	2	2	2	1
3	1	3	2	2	2	1
4	1	3	2	2	2	1
AVg.	1	3	2	2	2	1

1-low, 2-medium, 3-high, '-'- no correlation

PD4151 CREATIVITY AND INNOVATION L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Applying the principles of essential theory of creativity in new product design and development.
2. Applying the principles of various methods and tools for creativity in new product design and development.
3. Applying the design principles of creativity in new product design and development.
4. Applying the various innovation principles and practices in new product design and development.
5. Applying the principles of innovation management in new product design and development.

UNIT I INTRODUCTION TO ESSENTIAL THEORY OF CREATIVITY 9

Directed creativity: The Need for Creative Thinking in the Pursuit of Quality - Essential Theory for Directed Creativity: Definitions and the Theory of the Mechanics of Mind; Heuristics and Models: Attitudes, Approaches, and Actions That Support Creative Thinking.

UNIT II METHODS AND TOOLS FOR CREATIVITY 9

Three basic principles behind the tools of directed creativity – Tools that prepare the mind for creative thought – Tools that stimulate the imagination for new idea – Development and action: the bridge between mere creativity and the rewards of innovation - ICEDIP: Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation

UNIT III DESIGN AND APPLICATION OF CREATIVITY 9

Three levels of emotional design: Visceral, Behavioral and Reflective – Process design, reengineering, and creativity – Creativity and customer needs analysis – Innovative product and service design – Creative problem solving and incremental improvement.

UNIT IV INNOVATION PRINCIPLES & PRACTICES 9

Methods of Creativity Activation: Morphological Box – Requirements for Inventive Problem Solving – Altshuller's Engineering Parameters– Altshuller's Inventive Principles–Altshuller's Contradiction Matrix Algorithm.

UNIT V INNOVATION MANAGEMENT 9

Disruptive Innovation Model – Two Types of Disruption – Three Approaches to Creating New- Growth Businesses – New Market Disruptions: Three Case Histories – Product Architectures and Integration – Process of commoditation and de-commoditation – Two Processes of Strategy Formulation – Role of senior executive in leading new growth: The Disruptive Growth Engine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Apply the principles of essential theory of creativity in new product design and development.

2. Apply the principles of various methods and tools for creativity in new product design and development.
3. Apply the design principles of creativity in new product design and development.
4. Apply the various innovation principles and practices in new product design and development.
5. Apply the principles of innovation management in new product design and development

REFERENCES

1. Clayton M. Christensen Michael E. Raynor," The Innovator's Solution", Harvard Business School Press Boston, USA, 2013
2. Donald A. Norman," Emotional Design", Perseus Books Group New York , 2004
3. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999
4. Rousing Creativity: Think New Now Floyd Hurr, ISBN 1560525479, Crisp Publications Inc. 1999
5. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA 2003.

CO	PO					
	1	2	3	4	5	6
1	2	2	2	3	2	3
2	2	2	2	3	2	3
3	2	2	2	3	2	3
4	2	2	2	3	2	3
5	2	2	2	3	2	3
AVg.	2	2	2	3	2	3

1-low, 2-medium, 3-high, '-"- no correlation

CD 4072 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To appreciate the need and scope for robotics and to understand the principles of robot kinematics
- To design the drive systems and its control
- To understand the principles of sensors and vision systems
- To envision the industrial applications of robots and its safety
- To gain knowledge on artificial intelligence and expert systems.

UNIT I INTRODUCTION AND ROBOT KINEMATICS **9**

Definition need and scope of Industrial robots- Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT II ROBOT DRIVES AND CONTROL **9**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT III ROBOT SENSORS **9**

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

UNIT IV ROBOT CELL DESIGN AND APPLICATION **9**

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

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS **9**

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques-problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

TOTAL : 45 PERIODS

OUTCOME:

On Completion of the course the student will be able to

- Understand robot kinematics
- Incorporate mechanical components and concepts in robotics
- Understand the basics of various sensors to effectively design a robot
- Design suitable robots for specific applications
- Optimize the robots using Artificial Intelligence

REFERENCES

1. K.S.Fu, Gonzalez, R.C. and Lee, C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill, 1987
2. Koren,Y., “Robotics for Engineers”, McGraw-Hill, 1987
3. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
4. Klafter,R.D., Chmielewski, T.A. and Negin,M., “Robotics Engineering – An Integrated Approach”,Prentice-Hall of India Pvt. Ltd., 1984
5. Deb, S.R.”Robotics Technology and Flexible Automation”, Tata McGraw-Hill, 1994
6. Groover,M.P., Weis,M., Nagel,R.N. and Odrey,N.G., “Industrial Robotics Technology, Programming and Applications”, McGraw-Hill, Int., 1986
7. Jordanides,T. and Torby,B.J., ,”Expert Systems and Robotics“, Springer – Verlag, New York, May 1991

Mapping of CO with PO

CO	PO					
	1	2	3	4	5	6
1	1	3	3		2	1
2	1	3	3		2	1
3	1	3	3		2	1
4	1	3	3		2	1
5	1	3	3		2	1
AVg.	1	3	3		2	1

1-low, 2-medium, 3-high, '-'- no correlation

CC4005	DESIGN FOR CELLULAR MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. At the end of this course the student should be able to understand
2. Concepts and applications of Cellular manufacturing systems
3. Traditional and non-traditional approaches of Problem solving Performance measurement
4. Human and economical aspects of CMS.

UNIT– I INTRODUCTION **9**

Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.

UNIT– II CMS PLANNING AND DESIGN **9**

Problems in GT/CMS - Design of CMS - Models, traditional approaches and non-traditional approaches -Genetic Algorithms, Simulated Annealing, Neural networks.

UNIT–III IMPLEMENTATION OF GT/CMS **9**

Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.

UNIT– IV PERFORMANCE MEASUREMENT AND CONTROL **9**

Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP – framework.

UNIT– V ECONOMICS OF GT/CMS: **9**

Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To impart knowledge on group technology, optimization algorithms
- To learn the aspects of cellular manufacturing and its design
- To know the implementation of GT/CMS
- To understand Performance measurements of CMS.
- To understand the economics of GT/CMS

REFERENCES:

1. Askin, R.G. and Vakharia, A.J., G.T " Planning and Operation, in The automated factory-Hand
2. Book: Technology and Management ", Cleland.D.I. and Bidananda, B (Eds), TAB Books , NY, 1991.
3. Burbidge, J.L. Group "Technology in Engineering Industry ", Mechanical Engineering pub.London, 1979.
4. Irani, S.A. " Cellular Manufacturing Systems ", Hand Book
5. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), " Planning, design and analysis of cellular manufacturing systems ", Elsevier, 1999

Mapping of CO with PO

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	1	3	2	1	1
2	2	1	3	2	1	1
3	2	1	3	2	1	1
4	2	1	3	2	1	1
5	2	1	3	2	1	1
AVg.	2	1	3	2	1	1

1-low, 2-medium, 3-high, '-'- no correlation

CC4006	ELECTRONICS MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge in electronic packaging technology

UNIT– I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed Circuit Boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection. Electronic packaging – Through Hole Technology (THT) and Surface Mount Technology (SMT)

UNIT– II COMPONENTS AND PACKAGING 9

Through-hole components – axial, radial, multi leaded, odd form. Surface mount components active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, Flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT–III SOLDERING AND CLEANING 9

Soldering theory, effect of elemental constituents on wetting, microstructure and soldering, solder paste technology – fluxing reactions, flux chemistry, solder powder, solder paste composition and manufacturing, solder paste rheology, Wave soldering. Adhesive and solder paste application. solder system variables. soldering temperature profile. Reflow soldering - profile generation and control, soldering quality and defects. Post solder cleaning and selection. Measurement of cleanliness levels.

UNIT– IV SURFACE MOUNT TECHNOLOGY: 11

SMT Equipment and Material Handling Systems, Handling of Components and Assemblies - Moisture Sensitivity and ESD, Safety and Precautions Needed, IPC and Other Standards, Stencil Printing Process, solder paste storage and handling, stencils and squeegees, process parameters, quality control - Component Placement, Equipment Type, Chip shooter, IC placer, Flexibility, Accuracy of Placement, Throughput, reflow soldering, adhesive, underfill and encapsulation process, applications, storage and handling, process & parameters.

UNIT– V INSPECTION, TEST AND REWORK FOR PCB: 8

Inspection Techniques, Equipment and Principle – AOI, X-ray. stencil printing process- defects & corrective action, component placement process - defects & corrective action, Reflow Soldering Process- defects & corrective action, underfill and encapsulation Process- defects & corrective action, Testing of assemblies, In-circuit testing (ICT), functional testing, concept of yield, Rework and Repair, tools, rework criteria and process, Design for - Manufacturability, Assembly, Reworkability, Testing, Reliability and Environment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

• At the end of this course the student will be able to apply knowledge in various steps in electronics packaging technology

REFERENCES:

1. Lee, N.C., "Reflow Soldering Process and Trouble Shooting – SMT, BGA, CSP and Flip Chip Technologies", Newnes Elsevier, 2001
2. Gurnett, K.W., "Surface Mount Handbook", Newnes Elsevier , 1999
3. Seraphim, D., Lasky, R.C. and Che-Yu Li, "Principles of Electronic Packaging" Mcgraw Hill, 1989.
4. Strauss, R.," SMT Soldering Handbook", Newnes Elsevier , 1998
5. Zant, P.V., " Microchip Fabrication – a practical guide to semiconductor processing "McGraw Hill, 2000
6. Landers, T.L.,"Electronics Manufacturing Processes", Prentice Hall, 1998
7. Prasad R.P., "Surface Mount Technology: Principles and Practice", New York: Chapman and Hall, 1997.
8. Coombs, Jr. C.E., " Printed Circuits Handbook " Mc Graw-Hill Hand books Sixth Edition, 2008

Mapping of CO with PO

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4	1	2	3	2	2	
AVg.	1	2	3	2	2	

1-low, 2-medium, 3-high, '-'- no correlation

ED4079	**QUALITY CONCEPTS IN DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE 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

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 SIGMA 9

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 PERIODS

COURSE OUTCOMES:

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

1. apply fundamentals of design process and material selection for developing a quality product
2. apply the quality concepts to develop a robust product
3. perform Failure Mode Effect Analysis on a product and use six sigma principles to enhance its quality
4. apply different experimental design methods in product development
5. implement various statistical tools to improve its quality and reliability

REFERENCES:

1. Amitava Mitra, "Fundamentals of Quality control and improvement", John Wiley & Sons, 2016
2. George E. Dieter, Linda C. Schmidt, "Engineering Design", McGraw Hill Education Pvt. Ltd., 2013
3. Karl T. Ulrich, Steven D. Eppinger, "Product Design And Development, ,Tata Mcgraw-Hill Education, 2015
4. Kevin N. Otto and Kristin L. Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", Prentice Hall, 2001
5. Montgomery, D.C., "Design and Analysis of experiments", John Wiley and Sons, 2017.
6. Phillip J. Ross, "Taguchi techniques for quality engineering", Tata McGraw Hill, 2005.

CO	PO					
	1	2	3	4	5	6
1	1	1	3	2	2	2
2	1	1	3	2	2	2
3	1	1	3	2	2	2
4	1	1	3	2	2	2
5	1	1	3	2	2	2
AVg.	1	1	1	2	2	2

MF4072 NON-DESTRUCTIVE TESTING L T P C
3 0 0 3

OBJECTIVES:

(1) To stress the importance of NDT in Engineering.
(2) To select the appropriate NDT Technique
(3) To familiarize with different NDT Technique
(4) To impart various knowledge to check the weld quality of various structures, pressure vessels
(5) Compare the merits of various NDT Techniques

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 9

Introduction to various non-destructive methods, Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 9

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.
Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 9

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, App lications.
Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING 9

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY 9

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.

Case studies on defects in cast, rolled, extruded, welded and heat-treated components - Comparison and selection of various NDT techniques

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students

(1) Realize the importance of various NDT Techniques
(2) Are expected to have hands on experience on all types of NDT techniques
(3) Will choose appropriate technique for testing
(4) Will Compare the merits of various NDT Techniques
(5) Characterize the flaws and defects and provide solutions

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.
3. Peter J. Shull "Non-Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002
4. www.ndt.net

CO-PO Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	-
2	-	-	3	-	-	1
3	-	-	-	2	-	-
4	-	-	-	-	1	-
5	1	-	-	2	-	1
Avg.	1	-	3	2	1	1

ED4073	DESIGN OF HYBRID AND ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

1. Fundamental concepts of electric and hybrid vehicle operation and architectures.
2. Understand the properties of batteries and its types.
3. Provide knowledge about design of series hybrid electric vehicles.
4. Provide knowledge about design of parallel hybrid electric vehicles.
5. Understand of electric vehicle drive train.

UNIT– I INTRODUCTIONTOELECTRICVEHICLES 9

Electric Vehicles (EV) system- EV History – EV advantages – EV market – vehicle mechanics:roadway fundamentals- law of motion-vehicle kinetics- dynamics of vehicle motion – propulsion power–velocity and acceleration-propulsion system design.

UNIT– II ENERGYSOURCE 9

Battery basics-lead acid battery–alternative batteries–battery parameters-technical characteristics–battery power–alternative energy sources:Fuel cells-Fuel Cell characteristics-Fuelcell types.

UNIT–III SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN 9

Operation Patterns- Control Strategies-Sizing of the Major Components -Design of peaking power source- Traction Motor Size - Design of the Gear Ratio-Verification of Acceleration Performance-.Verification of grade ability-- Design of Engine/Generator Size - Design of the Power Capacity-Design of the Energy Capacity –Fuel Consumption.

UNIT– IV PARALLELHYBRIDELECTRICDRIVETRAINDESIGN 9

Control Strategies of ParallelHybridDriveTrain-DriveTrainParameters-EnginePowerCapacity-Electric Motor Drive Powerr Capacity-Transmission Design- Energy Storage Design

UNIT–V ELECTRICVEHICLEDRIVETRAIN 9

EV Transmission configurations–Transmission components–Ideal gear box–Gearratio-torque–speed characteristics-EV motor sizing–initial acceleration-rated vehicle velocity–maximum velocity – maximum gradability

TOTAL:45PERIODS

COURSEOUTCOMES:

Upon completion of this course, the students will be ableto:

CO1. Explain how a hybrid vehicle works and describe its main components and their function.

CO2. Choose proper energy storage systems for vehicle applications

CO3. Design series hybrid electric vehicles.

CO4. Design parallel hybrid electric vehicles.

CO5. Describe the transmission components and their configurations for electric vehicles

REFERENCES:

1. Ehsani,M,"ModernElectric,HybridElectricandFuelCellVehicles:Fundamentals,TheoryandDesign",CRC Press,2005
2. "Hybrid Electric Vehicle Technology Assessment: Methodology, Analytical Issues, and Interim Results,"CenterforTransportationResearchArgonneNationalLaboratory,United States Department of Energy.
3. IqbalHussain,"Electric&HybridVehicles–DesignFundamentals",SecondEdition,CRC Press,2011.
4. JamesLarminie,"ElectricVehicleTechnologyExplained",JohnWiley&Sons,2003.
5. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000 .http://nptel.ac.in/courses/108103009/

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2	2	1	3	2	2	3
3	2	1	3	2	2	3
4	2	1	3	2	2	3
5	2	1	3	2	2	3
AVg.	2	1	3	2	2	3

1-low, 2-medium, 3-high, '-"- no correlation

ED4076 MATERIAL HANDLING SYSTEMS AND DESIGN
(Use of Approved Data Book IsPermitted)

COURSEOBJECTIVES:

1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications
3. Development of conveyer systems for material flow in different industrial production systems.
4. Design of elevators for various manufacturing and service applications.
5. Integratedmechanicalsystemdesignformachinetools,powertransmission andengineparts

UNIT– I INTRODUCTIONSAND DESIGNOFHOISTS **9**

Types,selection and applications,Design of hoisting elements: Welded and roller chains-Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets –Grabbing attachments-Design of arresting gear -Brakes:shoe,band and cone types.

UNIT– II DRIVES OF HOISTINGGEAR **9**

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorailcranes-slewing,jibandluffinggear-cogwheeldrive-selecting the motor ratings.

UNIT–III CONVEYORS **9**

Types-description-design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors,Screw conveyors and vibratory conveyors.

UNIT– IV ELEVATORS **9**

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way,guides,counter weights,hoisting machine,safety devices-Design of fork lift trucks.

UNIT– V INTEGRATED DESIGN **9**

Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Balelifter, CamTesting Machine,Power Screws,Gear Box Design more than six speed.

TOTAL:45 PERIODS

COURSEOUTCOMES:

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

CO1 Design hoists and brakes used in any handling applications.
CO2 Design drive mechanisms and hoisting gear for different handling applications.
CO3 Design different conveyor systems for material handling applications.
CO4 Design bucket, cage and fork lift elevators for to and fro transportation of. materials in vertical direction.
CO5 Design of integrated mechanical system for machine tools,power transmission and engine parts

REFERENCES:

1. Alexandrov,M.,MaterialsHandlingEquipments,MIRPublishers,1981.
2. Boltzharol, A.,MaterialsHandlingHandbook,TheRonaldPressCompany,1958
3. Norton.LRobert."MachineDesign–AnIntegratedApproach"PearsonEducation,2nd Edition, 2005.
4. Rudenko,N.,Materialshandlingequipment,ELnveePublishers,1970.
5. Spivakovsy, A.O.and Dyachkov,V.K., Conveying Machines, VolumesIandII,MIRPublishers,1985.

APPROVED DATA BOOKS:

1. P.S.G.Tech.,"DesignDataBook",KalaikathirAchchagam,Coimbatore,2003.
2. Lingaiah.K.and Narayana Iyengar,"Machine Design Data Hand Book", Vol.1&2,Suma Publishers,Bangalore,1983

CO	PO					
	1	2	3	4	5	6
1	2	1	3	2	2	1
2	2	1	3	2	2	1
3	2	1	3	2	2	1
4	2	1	3	2	2	1
5	2	1	3	2	2	1
AVg.	2	1	3	2	2	1

1-low, 2-medium, 3-high, '-"- no correlation

PD4251 DESIGNING WITH ADVANCED MATERIALS L T P C
3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. analyzing the different strengthening and failure mechanism of the metals
2. applying the effects of metallurgical parameters in the materials design
3. analyzing the relationship between the selection of materials and processing
4. developing the novel material through understanding the properties of the existing metallic materials
5. analyzing the different materials used in the engineering applications.

UNIT I INTRODUCTION TO REVERSE ENGINEERING & GEOMETRICFORM 9

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION 9

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III MATERIAL IDENTIFICATION AND PROCESS VERIFICATION 9

Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT IV DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY 9

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT V ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE 9

Legality of Reverse Engineering – Patent – Copyrights –Trade Secret – Third-Party Materials – Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry.

TOTAL : 45PERIODS

OUTCOMES:

On Completion of the course the student will be able to

1. analyze the different strengthening and failure mechanism of the metals
2. apply the effects of metallurgical parameters in the materials design
3. analyze the relationship between the selection of materials and processing
4. develop the novel material through understanding the properties of the existing metallic materials
5. analyze the different materials used in the engineering applications

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	3	-	3	1	1	2
2	3	-	3	1	1	2
3	3	-	3	1	1	2
4	3	-	3	1	1	2
5	3	-	3	1	1	2
Avg.	3	-	3	1	1	2

1-low, 2-medium, 3-high, '-"- no correlation

REFERENCES:

1. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988
2. Thomas H. Courtney, Mechanical Behavior of Materials, (2nd edition), McGraw Hill, 2000
3. Willam D. CallisterJr.and David G. Rethwisch, Callister's Materials Science and Engineering,(2nd edition)Wiley Editorial,2018
4. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials,(34d edition), Butterworth-Heiremann, 1997
5. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 1999
6. Metals Hand book, Vol.10, Failure Analysis and Prevention, (10th Edition), Jaico, 1999
7. Ashby M.F., materials selection in Mechanical Design 2nd Edition, Butter worth 1999
8. www.astm.org/labs/pages/131350.htm

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 ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், 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 ஔவைக்கு 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

<u>தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்</u>

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 வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்