SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

M.E- Mechanical Engineering

(Engineering Design)

CURRICULUM and SYLLABI

[For students admitted in 2019-2020]

M.E / M.Tech Regulation 2019

Approved by BOS and Academic Council meetings

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2019
Mechanical Engineering
Branch: M.E. Engineering Design

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	P19END101	Finite Element Analysis	3	0	0	3
2	P19END102	Computer Applications in Design	3	0	0	3
3	P19END103	Concepts of Engineering Design	3	0	0	3
4	P19END502	**Elective-**Design for Manufacture and Assembly	3	0	0	3
5	P19END503	**Elective**- Rapid Prototyping and Tooling	3	0	0	3
6	P19GE101	Research Methodology and IPR	2	0	0	2
7	P19GE701	**Audit Course-**English for Research Paper Writing	2	0	0	0
Practical						
8	P19END104	CAD Laboratory	0	0	4	2
					Total Credits	**19**

Approved by

Chairman, Mechanical Engineering BOS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.D.Senthilkumar	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/MECH, First Semester ME END Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME II Semester under Regulations 2019
Mechanical Engineering
Branch: M.E. Engineering Design

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Theory				
1	P19END201	Mechanical Vibrations	3	0	0	3
2	P19END202	Integrated Product and Processes Development	3	0	0	3
3	P19END203	Design of Hydraulic and Pneumatic System	3	0	0	3
4	P19END523	**Elective** – Product Data Management	3	0	0	3
5	P19END526	**Elective** – Mechanics of Composite Materials	3	0	0	3
6	P19GE702	**Audit Course** - Stress Management by Yoga	2	0	0	0
		Practical				
7	P19END204	Analysis and Simulation Laboratory	0	0	4	2
					Total Credits	17

Approved by

Chairman, Mechanical Engineering BOS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**
    Dr.D.Senthilkumar   **Dr.R.Shivakumar**   **Dr.S.R.R.Senthil Kumar**

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2019
Mechanical Engineering
Branch: M.E. Engineering Design

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Theory				
1	P19END520	**Elective -** Mechatronics System Design	3	0	0	3
2	P19END522	**Elective -** Productivity Management And Re-Engineering	3	0	0	3
3	P19CEM601	**Open Elective –** Disaster Mitigation and Management	3	0	0	3
		Practical				
4	P19END301	Project Work Phase - I	0	0	16	8
					Total Credits	17

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Copy to:-
HOD/MECH, Third Semester ME END Students and Staff, COE

Branch: M.E. Engineering Design

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Practical				
1	P19END401	Project Work Phase – II	0	0	28	14
					Total Credits	**14**

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Copy to:-
HOD/MECH, Fourth Semester ME END Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2019
Mechanical Engineering
Branch: M.E. Engineering Design

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Theory				
1	P19END101	Finite Element Analysis	3	0	0	3
2	P19END102	Computer Applications in Design	3	0	0	3
3	P19END103	Concepts of Engineering Design	3	0	0	3
4	P19END502	**Elective-**Design for Manufacture and Assembly	3	0	0	3
5	P19END503	**Elective**- Rapid Prototyping and Tooling	3	0	0	3
6	P19GE101	Research Methodology and IPR	2	0	0	2
7	P19GE701	**Audit Course-**English for Research Paper Writing	2	0	0	0
		Practical				
8	P19END104	CAD Laboratory	0	0	4	2
					Total Credits	19

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HOD/MECH, First Semester ME END Students and Staff, COE

Course Code	**P19END101**	L	T	P	C
Course Name	**FINITE ELEMENT ANALYSIS**	3	-	-	3

Pre-requisite subjects: Engineering Mathematics, Numerical Methods, Strength of Materials Heat and mass transfer and Finite Element Analysis

Course Outcomes

Upon completion of this course the students will be able to

CO1	Provide further Advanced FEA knowledge and techniques for solving 1D complex problems in engineering.
CO2	Gain Knowledge to solve two-dimensional problems
CO3	Provide Knowledge to expertise in basic elements, Isoparametric elements
CO4	Impart Knowledge to structural dynamics applications
CO5	Understand non linear problems and error estimates

Unit I   INTRODUCTION & ONE-DIMENSIONAL PROBLEMS   L   9   T   -
Relevance of finite element analysis in design - Variational principles and methods – Weighted-Integral statements – Weak formulations – Ritz method – Method of weighted residuals – Applications of FEA - Finite element modeling – Co-ordinates and shape functions - Potential energy approach – Galerkin's approach – One dimensional finite element models in Solid mechanics and Heat transfer – Finite element model for beams

Unit II   TWO-DIMENSIONAL PROBLEMS   L   9   T   -
Poisson equation – Laplace equation – Weak form – Element matrices for triangular and rectangular elements – Evaluation of integrals – Assembly – Axi-symmetric problems – Applications – Conduction and convection heat transfer - Torsional cylindrical member – Transient analysis - Theory of elasticity – Plane strain – Plane stress – Axi-symmetric problems – Principle of virtual displacement

Unit III   ISOPARAMETRIC ELEMENTS   L   9   T   -
Introduction – Bilinear quadrilateral elements – Quadratic quadrilaterals – Hexahedral elements - Numerical integration – Gauss quadrature – Static condensation – Load considerations – Stress calculations – Examples of 2D and 3D applications

Unit IV   STRUCTURAL DYNAMICS APPLICATIONS   L   9   T   -
Dynamic equations – Mass and damping matrices – Natural frequencies and modes – Reduction of number of DOF-response history – Model methods – Ritz vectors – Component mode synthesis – Harmonic response – Direct integration techniques – Explicit and implicit methods – Analysis by response spectra – Example problems

Unit V   NON-LINEAR PROBLEMS & ERROR ESTIMATES   L   9   T   -
Introduction – Material non-linearity – Elasto Plasticity – Plasticity – Visco plasticity – Geometric non-linearity – Large displacement – Error norms and convergence rates – H-refinement with adaptivity – adaptive refinement

Total   : 45 Hrs

Content Beyond Syllabus

1. Two-dimensional mesh generation – advancing front method
2. Three-dimensional mesh generation – Delaunay triangulation
3. Coupled problems
4. Transient response by analytical procedures

Learning Resources

Reference Books

1. Reddy J.N., "An Introduction to the Finite Element Method", McGraw Hill, International Edition 2005, 3rd Edition, ISBN-13: 978-0070607415.
2. Logan D.L, "A First Course in the Finite Element Method", Fifth Edition, Cengage Learning, 2010, ISBN-13: 978-8131517307.
3. Robert Davis Cook, Davis S. Malkus, "Concepts and Applications of Finite Element Analysis", Wiley, John & Sons, Forth Edition 2007, ISBN-13: 978-8126513369.
4. Larry J.Segerlind, "Applied Finite Element Analysis", Second Edition, John Wiley, 2010, ISBN-13**:** 978-8126528806.
5. S.S.Rao, "The Finite Element Analysis in Engineering", Butterworth-Heinemann; 5th edition, 2010, ISBN-13: 978-1856176613.
6. Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", Sixth Edition, Butterworth – Heinemann, 2005, ISBN–0–7506-6320-0.

Course Code	**P19END102**	L	T	P	C

Course Name	**COMPUTER APPLICATIONS IN DESIGN**	3	0	0	3

Pre-requisite subjects: Engineering Graphics, CAD/CAM/CIM, Design of Machine Elements and Design of Jigs, Fixtures, Press tools and Moulds.

Course Outcomes

Upon completion of this course the students will be able to

CO1	Impart knowledge on parametric sketching
CO2	Practice modeling, assembly, tolerance analysis of Mechanical components
CO3	Design Rapid tooling in computers
CO4	Impart knowledge on visual basic, pro/program, script, LISP etc
CO5	Provide standardization and design optimization for geometry.

**Unit I   INTRODUCTION TO COMPUTER APPLICATIONS   L   9   T   0
            IN NEW PRODUCT DESIGN**
Concept design – parametric sketching – constraints – computer graphics principles- 2D transformation, scaling, rotation – windowing, view ports – clipping – data exchange formats.

Unit II   COMPUTERS IN DESIGN   L   9   T   0
Solid modeling of Mechanical components – associative features – Sheet metal components, nesting and development – plastic parts with draft and shrinkage allowance – Reverse engineering of components – assembly of parts – tolerance analysis – mass property calculations

Unit III   COMPUTERS IN TOOLING DESIGN   L   9   T   0
Mould design – jigs and fixtures design – check for interferences – mechanism design and analysis – Rapid tooling

Unit IV   COMPUTERS IN DESIGN PRODUCTIVITY   L   9   T   0
Customizing various software by using visual basic, pro/program, script, LISP etc to write applications like design of shafts, gears etc.

Unit V   MANAGING PRODUCT DESIGN DATA   L   9   T   0
Version control – library creation – catalog making – standardization for design – collaborative design among peer groups – Design optimization for geometry - Design check, approval and validation.

Total: 45 Hrs

Content Beyond Syllabus
1. Basics of AUTOCAD
2. Interchangeability in Design
3. Design of Casting

Learning Resources

Reference Books

1. William M. Neumann and Robert Sproul " Principles of interactive Computer Graphics" Tata McGraw Hill Publishing Co. Ltd, 21st Reprint 2008,ISBN 13 –978-0-07-463293-2.
2. Ibrahim Zeid "CAD/CAM – Theory and Practice" – McGraw Hill, Special Indian Edition, Fifth reprint 2010 ISBN 13 – 978-0-07-015134-5.
3. P N Rao "CAD/CAM :Principles and Applications" Tata McGraw Hill Education Pvt Ltd, Third Edition. 2011, ISBN-13-978-0-07-068793-4
4. Schlechtendahl, E. G, CAD – Data transfer for Solid Models, Springer Verlag, Berlin, 1989, ISBN 9783540518266
5. Donald Hearn and M Pauline Baker "Computer Graphics" Prentice Hall Inc , Second Edition, 2002,ISBN-13: 978-8177587654

Course Code	**P19END103**	L	T	P	C
Course Name	**CONCEPTS OF ENGINEERING DESIGN**	3	-	-	3

Pre-requisite subjects: Finite element Analysis, CAD/CAM/CIM, Engineering materials and Metallurgy, Manufacturing Technology I & II, Product Quality Development.

Course Outcomes

Upon completion of this course the students will be able to

CO1	Impart knowledge on design process
CO2	Gain knowledge on mathematical modelling, geometric modelling.
CO3	Understand material selection Chart, Pugh selection method, selection with computed aided databases
CO4	Develop knowledge on material processing and design
CO5	Understand and respond Environmental and safety issues.

Unit I   THE DESIGN PROCESS   L   9   T   0
The Design Process - need identification – Design requirements – Product Life Cycle – Morphology of Design steps of Product Design – Conceptual Design, Embodiment Design, detailed Design – Concurrent Engineering – CAD & CAM, Human factors in Design.

Unit II   TOOLS IN ENGINEERING DESIGN   L   9   T   0
Creativity and problem solving, Decision Theory, Modeling – Role of models in Engineering Design, Mathematical modeling, Geometric modeling, finite element modeling, Rapid Prototyping – Simulation Finite Difference method, Monte Carlo method – Optimization – Search methods, Geometric programming, Structural and shape optimization.

Unit III   MATERIAL SELECTION AND MATERIALS IN   L   9   T   0
              DESIGN
The Classification and properties of Engineering materials, material standards and specifications – Methods of material selection – Ashby Chart and method of weight factors, Derivation of material indices, Use of material selection Chart, Pugh selection method, selection with computed aided databases – Design for brittle fracture, Design for fatigue failure, Design for corrosion resistance, Designing with plastics.

Unit IV   MATERIAL PROCESSING AND DESIGN   L   9   T   0
Classification of manufacturing processes and their role in design, Factors determining the process selection, use of process selection chart and computerized database – Design for manufacturing, Design for forging and sheet metal forming, Design for casting, Design for machining, welding and assembly, design for residual stresses and heat – treatment

Unit V   LEGAL, ETHICAL ENVIRONMENTAL AND SAFETY   L   9   T   0
              ISSUES IN DESIGN AND QUALITY ENGINEERING
The origin of laws, Contracts, - Liability – Tort Law- Product Liability – Design aspects of product liability, Codes of ethics, solving ethical conflicts. Design for environment – Life Cycle assessment – Material recycling and remanufacture, Design for safety – Potential Dangers and Guidelines for design for safety, Design for reliability failure mode effect analysis, robust Design.

Total: 45 Hrs

Content Beyond Syllabus
1. Basic concept of design
2. Design procedures
3. Design application in industries
4. Basic quality concepts

Learning Resources

Reference Books

1. Dieter, George E, Engineering Design –"A materials and processing Approach", Paperback, McGraw Hill Higher Education,5th International edition,2012, ISBN-13: 9780071326254.

2. Karl T. Vlrich and Steven D. Eppinger "Product design and Development", Mc Graw Hill, International Edition, 5th Edition,2000,ISBN: 0073404772
3. Pahlgand Beitz W "Engineering Design" Springer – London,3rd Edition, 2006,ISBN-13: 9781846283185
4. Suh. N. P. "The principles of design",Oxford University Press USA 1990, ISBN-13: 9780195043457
5. Ray M.S. "Elements of Engineering Design", Printice Hall Inc.,1st Edition, 1985, *ISBN*-13: 9780132641852

Course Code	**P19END502**	L	T	P	C
Course Name	**DESIGN FOR MANUFACTURE AND ASSEMBLY**	3	-	-	3

Pre-requisite subjects: Design of Machine Elements, Design of Jigs, fixtures, press tools and Moulds, CAD/CAM/CIM, Manufacturing Technology I & II, Product Quality Development and Concepts of Engineering design.

Course Outcomes

Upon completion of this course the students will be able to

CO1	Impart knowledge on design principles for manufacturing.
CO2	Gain knowledge on form design and forgings.
CO3	Understand component design by considering machining.
CO4	Develop knowledge on component design by considering casting.
CO5	Understand and respond Environmental and safety issues for design.

Unit I   INTRODUCTION   L   9   T   0

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

Unit II   FACTORS INFLUENCING FORM DESIGN   L   9   T   0

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

Unit III   COMPONENT DESIGN - MACHINING CONSIDERATION   L   9   T   0

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

Unit IV   COMPONENT DESIGN - CASTING CONSIDERATION   L   9   T   0

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

Unit V   DESIGN FOR THE ENVIRONMENT   L   9   T   0

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

Total: 45 Hrs

Content Beyond Syllabus

1. Stress concentration
2. Basics of environmental engineering

Learning Resources

Reference Books

1. Boothroyd, G, "Design for Assembly Automation and Product Design", Marcel Dekker, NewYork., 2nd Edition, 2002 ISBN:0750673419

2. Bralla, "Design for Manufacture handbook", McGraw hill, 2nd Edition, 2013. ISBN-13: 9780070071391

3. Boothroyd, G, Heartz and Nike," Product Design for Manufacture", Marcel Dekker, 3rd Edition 1994. ISBN: 0-8247-0584-X.

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,2011 ,ISBN-13: 978-0071776226

6. Graedel T. Allen By. B, "Design for the Environment", Angle Wood Cliff, Prentice Hall. Pearson Pub., 1996. ISBN-13 978-81-265-1336-9

7. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication,2nd Edition, 2004. ISBN 7-302-07048-2

Course Code	**P19END503**	L	T	P	C
Course Name	**RAPID PROTOTYPING AND TOOLING**	3	-	-	3

Pre-requisite subjects: Manufacturing Technology – I , Manufacturing Technology – II, CAD / CAM / CIM and Unconventional Machining Process.

Course Outcomes

Upon completion of this course the students will be able to

CO1	Describe exhaustive knowledge in RPT Tooling
CO2	Impart knowledge in stereolithography systems selective laser sintering
CO3	Describe fusion deposition modeling
CO4	Provide Knowledge in laminated object manufacturing
CO5	Apply concepts of RPT in component development

Unit I   INTRODUCTION   L   8   T   0

Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.

Unit II   STEREOLITHOGRAPHY SYSTEMS   L   9   T   0

Principle, Process parameters, Process details, Data preparation, Data files and Machine details, Applications. SELECTIVE LASER SINTERING **-** Types of machines, Principle of operation, Process parameters, Data preparation for SLS, Applications.

Unit III   FUSION DEPOSITION MODELING   L   9   T   0

Principle, Process parameters, Path generation, Applications. SOLID GROUND CURING: Principle of operation, Machine details, Applications.

Unit IV   LAMINATED OBJECT MANUFACTURING   L   9   T   0

Principle of operation, LOM materials, Process details, Applications. CONCEPT MODELERS - Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, Object Quadra System. LASER ENGINEERED NET SHAPING (LENS) – principle –applications.

Unit V   RAPID TOOLING SOFTWARE FOR RAPID   L   10   T   0
          PROTOTYPING

Indirect Rapid Tooling - Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, etc. Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, ProMetal, Sand casting tooling, Laminate tooling, soft tooling vs hard tooling. STL files, Overview of Solid view, Magics, mimics, magics communicator, etc. Internet based softwares, Collaboration tools. RAPID MANUFACTURING PROCESS OPTIMIZATION - Factors influencing accuracy, Data preparation errors, Part building errors, Errors in finishing, Influence of part build orientation. ALLIED PROCESSES - Vacuum Casting, Surface Digitizing, Surface Generation from point cloud, Surface modification, data transfer to solid models.

Total   : 45 Hrs

Content Beyond Syllabus

1. Laser 3D printing
2. Smart materials used in RPT
3. Advanced Treatment for cleaning the prototypes

Learning Resources

Reference books

1. Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", Society of Manufacturing Engineers, NY, 1996, ISBN-9780872634671.

2. Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Springer, 2001, ISBN-9781852333607

3. Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs. "Rapid Tooling: Technologies and Industrial Applications", Marcel Dekker, Inc, 2003, ISBN- 0824741595.

4. Terry Wohlers,"Wohlers Report 2006",Wohlers Associates, 2006, ISBN 0-9754429-2-9

5. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", World Scientific Publishing Company; 3 Har/Dvdr edition (January 14, 2010), ISBN-13: 978-9812778970

Course Code	**P15END104**	L	T	P	C
Course Name	**CAD LABORATORY**	-	-	4	2

Pre-requisite subjects: Machine Drawing and CAD laboratory

Course Outcomes

Upon Completion of this course the students will be able to

CO1	Understand the basic concepts of modeling and analysis softwares like PRO-E / SOLID WORKS /SOLID EDGE/CATIA / NX / ANSYS / NASTRAN etc.
CO2	Familiar with the sectioning concepts, drawing standards and Develop part models by sketching.
CO3	Assemble part models and Create detailed drawing of assembly to understand 2D views.

LIST OF EXPERIMENTS   Total : 60 Hrs

1. Introduction to CAD and solid works
2. Study of Sectional views and types of keys
3. Study of drawing standards
4. Split muff coupling – Part, Assembly and Detail drawing
5. Protected type Flange coupling – Part, Assembly and Detail drawing
6. Pipe vice – Part, Assembly and Detail drawing
7. Screw jack – Part, Assembly and Detail drawing
8. Simple eccentric – Part, Assembly and Detail drawing
9. Universal coupling – Part, Assembly and Detail drawing
10. Plummer block – Part, Assembly and Detail drawing
11. Claw coupling – Part, Assembly and Detail drawing
12. Knuckle joint – Part, Assembly and Detail drawing
13. Bushed Pin type Flexible Coupling – Part, Assembly and Detail drawing
14. Oldham's coupling – Part, Assembly and Detail drawing
15. Machine Vice – Part, Assembly and Detail drawing

List of Equipments

1. Computer workstation 20
2. Software requirement
   CREO /SOLID WORKS /SOLID EDGE/CATIA / NX / NASTRAN

COURSE OUTCOMES

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

1. Review the literature of the research problem
2. Choose appropriate data collection and sampling method according to the research problem.
3. Interpret the results of research and communicate effectively with their peers
4. Explain the Importance of intellectual property rights
5. Evaluate trade mark, develop and register patents

UNIT 1   INTRODUCTION TO RESEARCH METHODS   6

Definition and Objective of Research, Various steps in Scientific Research, Types of Research, Criteria for Good Research, Defining Research Problem, Research Design , Case Study Collection of Primary and Secondary Data, Collection Methods: Observation, Interview, Questionnaires, Schedules,

UNIT 2   SAMPLING DESIGN AND HYPOTHESIS TESTING   6

steps in Sampling Design, Types of Sample Designs, Measurements and Scaling Techniques - Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), concerning variance – one tailed Chi-square test.

UNIT 3   INTERPRETATION AND REPORT WRITING   6

Techniques of Interpretation, Precaution in Interpretation, Layout of Research Report, Types of Reports, Oral Presentation, Mechanics of Writing Research Report

UNIT 4   INTRODUCTION TO INTELLECTUAL PROPERTY   6

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, Innovations and Inventions trade related intellectual property rights.

UNIT 5   TRADE MARKS, COPY RIGHTS AND PATENTS   6

Purpose and function of trade marks, acquisition of trade mark rights, trade mark registration processes, trademark claims –trademark Litigations- International trademark law

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

THEORY: 30 Hours   TUTORIAL: -   PRACTICAL: -   TOTAL: 30 Hours

TEXT BOOKS

1. C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques ,4th Edition, New Age International Publishers, 2019.

2. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets", Delmar Cengage Learning, 4th Edition, 2012.

3. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", Tata Mc Graw Hill Education, 1st Edition, 2008.

REFERENCE BOOKS

1. Panneerselvam, R., Research Methodology, Second Edition, Prentice-Hall of India, New Delhi, 2013.

2. Ranjith Kumar, Research Methodology – A step by step Guide for Begineers, 4th edition, Sage publisher, 2014.

3. D Llewelyn & T Aplin W Cornish, "Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights", Sweet and Maxwell, 1st Edition, 2016.

4. Ananth Padmanabhan, "Intellectual Property Rights-Infringement and Remedies", Lexis Nexis, 1st Edition, 2012.

5. Ramakrishna B and Anil Kumar H.S, "Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers", Notion Press, 1st Edition, 2017.

6. M.Ashok Kumar and Mohd.Iqbal Ali :"Intellectual Property Rights" Serials Pub

P19GE701   **English for Research Paper Writing**

2 0 0 0

Course Outcomes:

At the end of the course, the students will be able to
- Demonstrate research writing skills both for research articles and thesis
- Frame suitable title and captions as sub-headings for articles and thesis
- Write each section in a research paper and thesis coherently
- Use language appropriately and proficiently for effective written communication
- Exhibit professional proof-reading skills to make the writing error free

Unit – I   **6**
Planning and preparation, word order, breaking up long sentences, organising ideas into paragraphs and sentences, being concise and avoiding redundancy, ambiguity and vagueness

Unit – II   **6**

Interpreting research findings, understanding and avoiding plagiarism, paraphrasing sections

of a paper/ abstract.

Unit- III   **6**

Key skills to frame a title, to draft an abstract, to give an introduction

Unit – IV   **6**

Skills required to organise review of literature, methods, results, discussion and conclusions

Unit – V   **6**

Usage of appropriate phrases and key terms to make the writing effective - proof-reading to ensure error-free writing.

Text Books:

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

Total: 30 hours

REFERENCES

Martin Cutts, Oxford Guide to Plain English, Oxford University Press, Second Edition, 2006

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Theory				
1	P19END201	Mechanical Vibrations	3	0	0	3
2	P19END202	Integrated Product and Processes Development	3	0	0	3
3	P19END203	Design of Hydraulic and Pneumatic System	3	0	0	3
4	P19END523	**Elective** – Product Data Management	3	0	0	3
5	P19END526	**Elective** – Mechanics of Composite Materials	3	0	0	3
6	P19GE702	**Audit Course** - Stress Management by Yoga	2	0	0	0
		Practical				
7	P19END204	Analysis and Simulation Laboratory	0	0	4	2
					Total Credits	17

Approved by

Chairman, Mechanical Engineering BOS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**
   Dr.D.Senthilkumar   **Dr.R.Shivakumar**   **Dr.S.R.R.Senthil Kumar**

Copy to:-
HOD/MECH, Second Semester ME END Students and Staff, COE

Course Code	**P19END201**	L	T	P	C
Course Name	**MECHANICAL VIBRATIONS**	3	-	-	3

Pre-requisite subjects: Engineering Mechanics, Strength of materials, Kinematics and Dynamics of Machinery

Course Outcomes

Upon completion of this course the students will be able to

CO1	Understand fundamentals of vibrations and virtual work.
CO2	Gain knowledge on two degree freedom system, vibration absorber and isolator.
CO3	Impart knowledge on multi degree freedom system and numerical methods for fundamental frequencies.
CO4	Explain vibration of continuous systems like strings, rods and plates.
CO5	Provide the experimental methods in measuring vibration.

Unit I   FUNDAMENTALS OF VIBRATION   L   8   T   3

Introduction – Single degree freedom free vibration systems – Damped vibrations – Single degree freedom forced vibration with elastically coupled viscous dampers, System Identification from frequency response, Support motion, Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation-– Transient Vibration

Unit II   TWO DEGREE FREEDOM SYSTEM   L   8   T   3

Free vibration of spring-coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation.

Unit III   MULTI-DEGREE FREEDOM SYSTEM   L   12   T   3

Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – orthogonal properties – Modal matrix-Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

Unit IV   VIBRATION OF CONTINUOUS SYSTEMS   L   8   T   3

Systems governed by wave equations – Vibration of strings – vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation – Vibration of plates.

Unit V   EXPERIMENTAL METHODS IN VIBRATION   L   9   T   3
            ANALYSIS

Vibration instruments – Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.

                                                                    Total   : 45 Hrs

Content Beyond Syllabus
1. Basics mechanics
2. Basics of matrix

1.   Benson H.Tongue, Principles of Vibration, 2nd edn., Oxford University Press, NY, 2002 ISBN: 9780195142464
2.   Thomson, W.T. – "Theory of Vibration with Applications", (5th Edition) CBS Publishers and Distributors, New Delhi, 1990. ISBN-13: 978-0136510680.
3.   Rao, J.S., & Gupta, K. – "Ind. Course on Theory and Practice Mechanical Vibration", New Age International(P)Ltd.,1984. ISBN:978-81-224-1215-4 PublicationYear Edition:2nd Reprint : Aug, 2014
4.   Den Hartog, J.P, "Mechanical Vibrations," Dover Publications, 4th Edition, 1990. ISBN 0-486-65407-9,
5.   Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 13th Edition, 1995. ISBN 13: 9780201065503

Course Code	**P19END202**	L	T	P	C
Course Name	**INTEGRATED PRODUCT AND PROCESSES DEVELOPMENT**	3	0	0	3

Pre-requisite subjects: Process planning and cost estimation, Concept of Engineering design, Industrial Management and Engineering.

Course Outcomes

Upon completion of this course the students will be able to

CO1	Impart knowledge on product development processes and organizations.
CO2	Identify customer needs, product planning processes and allocating resources and timing.
CO3	Apply knowledge on product specifications.
CO4	Define the concept selection and measure customer response.
CO5	Provide product architecture and level design issues.

Unit I   INTRODUCTION   L   9   T   0

Characteristics of Successful Product Development-Interdisciplinary activity-Duration and Costs of Product Development- Challenges of Product Development -Development Processes and Organizations-A Generic Development Process-Concept Development: The Front-End Process Adapting the Generic Product Development Process- The AMF Development Process-Product   Development Organizations-The AMF Organization

Unit II   PRODUCT PLANNING   L   9   T   0

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

Unit III   PRODUCT SPECIFICATIONS   L   9   T   0

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

Unit IV   CONCEPT SELECTION   L   9   T   0

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

Unit V   PRODUCT ARCHITECTURE   L   9   T   0

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

Total: 45 Hrs

Content Beyond Syllabus

1. Supply chain mechanism
2. Cost estimation

Learning Resources

Reference Books

1. Product Design and Development, Karl T. Ulrich and Steven .D Epinger, McGraw-Hill International Edns. 4th edition 2013. ISBN-13: 978-0070658110
2. Kevien Otto and Kristin Wood, "Product Design" Pearson Publication,3rd Edition, 2012, ISBN-13: 9780130212719
3. Stuart Pugh, "Tool Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, Neyork, 1991,ISBN: 020141639.
4. Stephen Rosenthal, Business One Orwin "Effective Product Design and Development", Homewood, 1992,ISBN:1-55623-603-4
5. Kemnneth Crow,"Concurrent Engg. /Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book.

Course Code	**P19END203**	L	T	P	C
Course Name	**DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS**	3	-	-	3

Pre-requisite subjects: Fluid mechanics, Hydraulic and pneumatics and Mechatronics

Course Outcomes

Upon completion of this course the students will be able to

CO1	To impart knowledge on hydraulic systems and its characteristics
CO2	To create expertise in control of pressure - direction and flow control valves
CO3	To gain knowledge of hydraulic equipment and to design hydraulic and electro-hydraulic systems for automation, pneumatic circuits.
CO4	To learn about pneumatic systems and circuits - cascade methods - mapping methods - step counter method
CO5	Plc, cascade, step counter and k-v mapping methods and to design low cost automation systems

Unit I	**OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS**	L	9	T	0

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics- Determination of volumetric, mechanical and overall efficiencies of positive displacement pumps. Linear and Rotary Actuators – selection, specification and characteristics.

Unit II	**CONTROL AND REGULATION ELEMENTS**	L	9	T	0

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems. Electrical control solenoid valves, relays, Electro hydraulic servo valves.

Unit III	**HYDRAULIC CIRCUITS**	L	9	T	0

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

Unit IV	**PNEUMATIC SYSTEMS AND CIRCUITS**	L	9	T	0

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

Unit V	**INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS**	L	9	T	0

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

Total   : 45 Hrs

Content Beyond Syllabus
1. PLC programming
2. SCADA

Learning Resources
Reference books
1. Bolton. W., "Pneumatic and Hydraulic Systems ", Butterworth –Heinemann, 1997.
2. Antony Espossito, "Fluid Power with Applications", Prentice Hall, 1980.
3. Dudleyt, A. Pease and John J. Pippenger, Industrial Hydraulics, Tata MGraw Hill Prentice Hall, 1985.
4. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 2004.
5. Majumdar, S.R., Oil Hydraulic Systems, Principles and Maintenance, Tata MGraw Hill Prentice Hall, 2001.

Course Code	**P19END523**	L	T	P	C
Course Name	**PRODUCT DATA MANAGEMENT**	3	-	-	3

Pre-requisite subjects: Industrial Management and Engineering, Total Quality Management and Integrated product and process development.

Course Outcomes

Upon completion of this course the students will be able to

CO1	Explain software development in PDM
CO2	List the components of PDM
CO3	Construct Configuration Management
CO4	Demonstrate work flow and life cycle of products
CO5	List the configuration methods

Unit I   INTRODUCTION   L   9   T   0

Introduction to PDM-present market constraints-need for collaboration - internet and developments in server-client computing.

Unit II   COMPONENTS OF PDM   L   9   T   0

Components of a typical PDM setup-hardware and software-document management-creation and viewing of documents-creating parts-versions and version control of parts and documents-case studies.

Unit III   CONFIGURATION MANAGEMENT   L   9   T   0

Base lines-product structure-configuration management-case studies.

Unit IV   PROJECTS AND ROLES   L   9   T   0

Creation of projects and roles-life cycle of a product- life cycle management-automating information flow-work flows- creation of work flow templates-life cycle-work flow integration-case studies.

Unit V   CHANGE MANAGEMENT GENERIC PRODUCTS AND   L   9   T   0
**   VARIANTS**

Change issue- change request- change investigation- change proposal - change activity - case studies. Data Management Systems for FEA data **-** Product configurator - comparison between sales configuration and product configurator-generic product modeling in configuration modeler-use of order generator for variant creation-registering of variants in product register-case studies.

Total : 45 hrs

Content Beyond Syllabus

1. Basics of FEA
2. Cloud computing

Learning Resources

Reference Books

1. Kevin Otto, Kristin Wood, "Product Design", Pearson, 2001.
2. Daniel Amor, "The E-Business Revolution",   Prentice-Hall, 2000.
3. David Bed worth. Mark Henderson & Phillip Wolfe. "Computer Integrated Design and Manufacturing ". McGraw Hill Inc...1991.
4. Terry Quatrain. "Visual Modeling with Rational Rose and UML ". Addison Wesley...1998.
5. Wind-Chill R5.0Reference Manuals...2000.

Course Code	**P19END526**	L	T	P	C
Course Name	**MECHANICS OF COMPOSITE MATERIALS**	3	-	-	3

Pre-requisite subjects: Engineering Materials and metallurgy, Engineering Mechanics, Manufacturing Technology – I & II

Course Outcomes

Upon completion of this course the students will be able to

CO1	To understand the basic of composite materials
CO2	To provide knowledge of simple stresses, strains and deformation due to external loads and their relations
CO3	To provide knowledge of simple stresses, strains and deformation due to external loads and their relations
CO4	To impart knowledge in orthotropic materials and their manufacturing.
CO5	To learn the design guidelines

Unit I   INTRODUCTION   L   9   T   0

Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Fiber surface treatments, Fillers and additives, Fiber content, density and void content.

Unit II   MECHANICS   L   9   T   0

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi-Empirical model- Longitudinal Young's modulus-transverse Young's modulus–major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina–laminates–lamination theory, Interlaminar stresses

Unit III   PERFORMANCE   L   9   T   0

Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance.

Unit IV   MANUFACTURING   L   9   T   0

Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes – Quality Inspection methods. Processing of MMC –diffusion bonding – stir casting – squeeze casting.

Unit V   DESIGN   L   9   T   0

Failure Predictions, Laminate Design Consideration-design criteria-design allowables -design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – design of a compression member – design of a beam-design of a torsional member, Application of FEM for design and analysis of laminated composites.

Total   : 45 Hrs

Content Beyond Syllabus
1. Smart Materials
2. Performance study

Learning Resources

Reference books

1. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc, 1993.
2. Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, 2006
3. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
4. Ronald Gibson, "Principles of Composite Material Mechanics", Tata McGraw Hill, 1994.
5. Chawla K.K., "Composite materials", Springer – Verlag, 1987

Course Code	**P19END204**	L	T	P	C
Course Name	**ANALYSIS AND SIMULATION LABORATORY**	-	-	4	2

Pre-requisite subjects: Machine Drawing and CAD laboratory
Course Outcomes

Upon Completion of this course the students will be able to

CO1	Understand the basic concepts of modeling and analysis softwares like ANSYS / NASTRAN/ADAMS/MATLAB
CO2	Familiar with the meshing concepts and boundary conditions.
CO3	Know the solutions under various conditions.

Analysis of Mechanical Components – Use of FEA Packages, like ANSYS/ NASTRAN etc., include FEA analysis of

i) Machine elements under static loads ,Heat transfer in mechanical systems
ii) Determination of natural frequency ,Axi-Symmetric elements
iii) Non-linear systems

Use of kinematics and dynamics simulation software like ADAMS software. Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

LIST OF EXPERIMENTS   **Total : 45 Hrs**
1. Nodal Displacement of 1-D Bar
2. Displacement of Taper Plate
3. Displacement and Thermal Stress due to Static and Thermal
4. Nodal Displacement of Truss Member
5. Nodal Displacement of Thermal Stress due to Static and Thermal Load
6. Deflection of Beam Under UDL
7. Deflection of a Beam With Roller
8. Displacement and Von-Misses Stress Rectangular Plate Under Plane Stress
9. Displacement in a Thin Plane with a Circular Hole
10. Thermal Analysis of a Beam
11. Stress Analysis of an Axi-Symmetric Component
12. Model Analysis of a Cantilever-2D Plate
13. Structural Analysis of an L-Bracket
14. Harmonic Analysis of a Cantilever Beam
15. Heat Transfer in a Fin

List of Equipments

1. Computer workstation 20
2. Software requirement
       ANSYS / NASTRAN/ADAMS/MATLAB

P19GE702   **Stress Management by Yoga**

2 0 0 0

Course Outcomes:

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

1. Develop physical and mental health thus improving social health
2. Increase immunity power of the body and prevent diseases
3. Acceleratememory power
4. Achieve the set goal with confidence and determination
5. Improve stability of mind, pleasing personality and work with awakened wisdom

UNIT – I   **6**

Yoga-Introduction - Astanga Yoga- 8 parts-Yam and Niyam etc.- Do`s and Don'ts in life-Benefits of Yoga and Asana- Yoga Exercise- and benefits- Pranayam Yoga- Nadisuthi, Practice and Spinal Sclearance Practice-Regularization of breathing techniques and its effects-Practice and kapalapathy practice.

UNIT – II   **6**
Neuromuscular breathing exercise and Practice- Magarasa Yoga, 14 points Acupressure techniques and practice- Body relaxation practice and its benefits- Raja Yoga- 1.Agna –explanation and practice- Activation of Pituitary- Raja Yoga-2. Santhi Yoga-Practice-Balancing of physical and mental power.

UNIT – III   **6**
Raja Yoga-3.Sagasrathara yoga –practice- Activation of dormant brain cells-Kayakalpa-theory- Kayakalpa –practice-Yogic exercise to improve physical and mental health and practice-Asanas –explanation-Practice-benefits

UNIT –IV   **6**
Sun namaskar- 12 poses-explanation and practice-Yoga –Asana-Padmasana, vajrasana,chakrasana, viruchasanaetc-Stress management with Yoga-Role of women and Yoga
Equality, nonviolence, Humanity,Self- control- Food and yoga Aware of self-destructive habits
Avoid fault thinking (thought analysis-Practice)-Yoga Free from ANGER (Neutralization of anger)& practice

UNIT – V   **6**
Moralisation of Desire & practice- Punctuality-Love-Kindness-CompassionEradication ofworries-Practice -Personality development, positive thinking-Good characters to lead a moral life
How to clear the polluted mind- Benefits of blessing- Five- fold culture –explanation- Karma Yoga Practice In Geetha- Sense of duty-Devotion, self- reliance, confidence, concentration, truthfulness, cleanliness.

Total : 30 hours
Reference Books
1. 'Yogic Asanas for Group Tarining-Part-I" Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama
   (Publication Department), Kolkata

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Theory				
1	P19END520	**Elective -** Mechatronics System Design	3	0	0	3
2	P19END522	**Elective -** Productivity Management And Re-Engineering	3	0	0	3
3	P19CEM601	**Open Elective –** Disaster Mitigation and Management	3	0	0	3
		Practical				
4	P19END301	Project Work Phase - I	0	0	16	8
					Total Credits	17

Approved by

Chairman, Mechanical Engineering BOS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**
Dr.D.Senthilkumar   **Dr.R.Shivakumar**   **Dr.S.R.R.Senthil Kumar**

Copy to:-
        HOD/MECH, Third Semester ME END Students and Staff, COE

Course Code	P19END520		L	T	P	C
Course Name	**MECHATRONICS SYSTEM DESIGN**		3	-	-	3

Pre-requisite subjects: Mechatronics and Engineering Robotics

Course Outcomes

Upon completion of this course the students will be able to

CO1	Recall Mechatronics in products
CO2	Identify various sensors and transducers
CO3	Demonstrate the microprocessor in various applications
CO4	Experiment the various program in PLC
CO5	Discuss the case study of Mechatronics system

Unit I   INTRODUCTION   L   9   T   0

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.

Unit II   SENSORS AND TRANSDUCERS   L   9   T   0

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.

Unit III   MICROPROCESSORS IN MECHATRONICS   L   9   T   0

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller.

Unit IV   PROGRAMMABLE LOGIC CONTROLLERS   L   9   T   0

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

Unit V   DESIGN AND MECHATRONICS   L   9   T   0

Designing - Possible design solutions - Case studies of Mechatronics systems.

                                                    Total : 45 hrs

Content Beyond Syllabus
1. System modeling.
2. Continues system.
3. Discrete system.

Learning Resources

Reference Books

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.

2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, A J., " Macaronis ", Chapman and Hall, 1993.

3. Ramesh.S, Gaonkar, " Microprocessor Architecture, Programming and Applications, "Wiley Eastern, 1998.

4. Lawrence J.Kamm,"Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall, 2000.

5. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 1995.

Course Code	P19END522	L	T	P	C
Course Name	**PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING**	3	-	-	3

Pre-requisite subjects: Industrial Management and Engineering, Total Quality Management and Integrated product and process development.

Course Outcomes

Upon completion of this course the students will be able to

CO1	• Explain productivity concepts.
CO2	List productivity models and techniques.
CO3	Construct organizational transformation and re-engineering.
CO4	Explain re-engineering process improvement models.
CO5	Describe re-engineering tools and implementation, re-opportunities and process redesign.

Unit I   INTRODUCTION   L   9   T   0

Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle.

Unit II   PRODUCTIVITY MODELS   L   9   T   0

Productivity measurement at International, National and Organizational level, Total productivity models. Productivity management in manufacturing and service sector. Productivity evaluation models, Productivity improvement models and techniques.

Unit III   ORGANIZATIONAL TRANSFORMATION   L   9   T   0

Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and reengineering, methodology, guidelines, DSMCQ and PMP model.

Unit IV   RE-ENGINEERING PROCESS IMPROVEMENT MODELS   L   9   T   0

PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC   model.

Unit V   RE-ENGINEERING TOOLS AND IMPLEMENTATION   L   9   T   0

Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE-opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability

Total : 45 hrs

Content Beyond Syllabus
1. Lean manufacturing.
2. SAP.
3. Line organization.

Learning Resources

Reference Books

1   Sumanth, D.J., " Productivity engineering and management ", TMH, New Delhi, 1990.
2   Edosomwan, J.A., "Organizational transformation and process re-engineering", British Library cataloging in pub. data, 1996.
3   Rastogi, P.N. "Re-Engineering and Re-inventing the enterprise ", Wheeler pub. New Delhi, 1995.
4   Premvrat, Sardana, G.D. and Sahay, B.S, "Productivity Management - A systems approach   ", Narosa Pub. New Delhi, 1998.
5   Nick Obolensky "Practical Business Re-engineering: Tools and Techniques for Achieving Effective Change", Kogan Page, illustrated, reprint, 1996,ISBN:0749419652.

Course Code	**P19END301**	L	T	P	C

| Course Name | **PROJECT WORK PHASE - I** | - | - | 16 | 8 |

Pre-requisite subjects: Design of Machine Elements, Finite Element Analysis and Manufacturing Technology – I & II

Course Outcomes

Upon Completion of this course the students will be able to

CO1	Use their theoretical knowledge for understanding real situations
CO2	Use their skills to design / fabricate safe systems
CO3	Use various software packages to analyze the behavior and recommend appropriate remedies

OBJECTIVE:

It is proposed to carryout detailed design calculations and analysis of any mechanical Component or mechanical system. This helps the students to get familiar with respect to the design methodologies applied to any component or mechanical system subjected to static, dynamic and thermo-mechanical loads.

OUTCOME:

It helps the students to get familiarized with respect to design standards, design calculations, analysis in designing and fabricate any mechanical component or system. Each student is required to select any new component or an integrated mechanical system that involves various sub components which are to be designed as per design standards and further required to be analyzed for optimum dimensions with respect to the strength and stiffness

Course Code	P19END601	L	T	P	C
Course Name	**PRODUCT DESIGN AND MANUFACTURING**	3	-	-	3

Pre-requisites subjects: Engineering Graphics and Basic Mechanical Engineering

Course Outcomes

Upon completion of this course the student will be able to

CO1 Apply different ideas enabling people to manage to work with innovation and development in organization.

CO2 Examine the product specification select concept, product performance and manufacturing.

CO3 Develop product geometry, layout, fundamental and incidental interaction.

CO4 Design the integrated process robust design, conceptualization and management of industrial design.

CO5 Estimate and Analyze the manufacturing components and assembly cost, planning for prototypes.

Unit I	**INTRODUCTION**	L	9	T	0

Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

Unit II	**CONCEPT GENERATION, SELECTION AND TESTING**	L	9	T	0

Plan and establish product specifications. Task - Structured approaches - clarification – search externally and internally-Explore systematically - reflect on the solutions and processes -concept selection - methodology - benefits. Implications - Product change - variety – component standardization - product performance – manufacturability.

Unit III	**PRODUCT ARCHITECTURE**	L	9	T	0

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system

level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

Unit IV   INDUSTRIAL DESIGN   L   9   T   0

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs – conceptualization- refinement - management of the industrial design process.

Unit V   DESIGN FOR MANUFACTURING   L   9   T   0

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping – Planning for prototypes - Economic Analysis.

Total Number of hours: 45

Learning Resources

Text Books

1. Ulrich K.T. and Eppinger S.D., "Product Design and Development" McGraw –HillInternational Editions, 1999.

Reference Books

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Rosenthal S., "Effective Product Design and Development", Business One Orwin,Homewood, 1992, ISBN 1-55623-603-4.
3. Pugh S., "Total Design – Integrated Methods for successful Product Engineering",Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.

Branch: M.E. Engineering Design

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Practical				
1	P19END401	Project Work Phase – II	0	0	28	14
					Total Credits	14

Approved by

Chairman, Mechanical Engineering BOS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**
Dr.D.Senthilkumar   **Dr.R.Shivakumar**   **Dr.S.R.R.Senthil Kumar**

Copy to:-
    HOD/MECH, Fourth Semester ME END Students and Staff, COE