MARRI LAXMAN REDDY
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M. Tech in CAD/CAM

Course Structure and Syllabus (MLRS - R20)

Applicable From 2020-2021 Admitted Batch

I YEAR - I SEMESTER

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C	Scheme of Examination Maximum Marks		
THEORY							Internal (CIE)	External (SEE)	Total
1.	2014001	Advanced CAD	3	0	0	3	30	70	100
2.	2014002	Advanced CAM	3	0	0	3	30	70	100
3.	20140XX	**Professional elective -1**	3	0	0	3	30	70	100
4.	20140XX	**Professional elective -2**	3	0	0	3	30	70	100
5.	MC	Research Methodology and IPR	2	0	0	2	30	70	100
6.	AC	Audit Course-I	2	0	0	0	30	70	100
PRACTICAL									
7.	2014040	Advanced CAD Laboratory	0	0	4	2	30	70	100
8.	2014041	Advanced CAM Laboratory	0	0	4	2	30	70	100
TOTAL			**16**	**0**	**8**	**18**	**240**	**560**	**800**

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I YEAR II – SEMESTER

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C	Scheme of Examination Maximum Marks		
THEORY							Internal (CIE)	External (SEE)	Total
1.	2024003	Advanced Finite Element Method.	3	0	0	3	30	70	100
2.	2024004	Modeling & Simulation of Manufacturing Systems	3	0	0	3	30	70	100
3.	20240XX	**Professional elective -3**	3	0	0	3	30	70	100
4.	20240XX	**Professional elective -4**	3	0	0	3	30	70	100
5.	2024045	Mini Project With seminar	0	0	4	2	30	70	100
6.	AC	Audit Course-II	2	0	0	0	30	70	100
PRACTICAL									
7.	2024042	Computer Aided Engineering Lab	0	0	4	2	30	70	100
8.	2024043	Modeling & Simulation of Manufacturing Systems Lab	0	0	4	2	30	70	100
TOTAL			**14**	**0**	**12**	**18**	**240**	**560**	**800**

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II YEAR I – SEMESTER

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C	Scheme of Examination Maximum Marks		
THEORY							Internal (CIE)	External (SEE)	Total
1.	20340XX	**Professional elective -5**	3	0	0	3	30	70	100
2.	OE*	Open elective	3	0	0	3	30	70	100
PRACTICAL									
3.	2034046	Dissertation Phase – I	0	0	20	10	100	0	100
TOTAL			**6**	**0**	**20**	**16**	**160**	**140**	**300**

*Important: *Open Elective subject must be chosen from the list of open electives offered by OTHER departments.
Ex: A M.Tech CAD/CAM student cannot take Open Elective offered by CAD/CAM Dept, but can select from open electives offered by OTHER departments.

II YEAR II SEMESTER

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C	Scheme of Examination Maximum Marks		
PRACTICAL							Internal (CIE)	External (SEE)	Total
1.	2044047	Dissertation Phase – II	0	0	32	16	100	100	200
TOTAL			**0**	**0**	**32**	**16**	**100**	**100**	**200**

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Professional elective -1

2014011	1.Atomation in Manufacturing
2014012	2.Computer Aided Processes Planning
2014013	3.Performance Modeling and Analysis of Manufacturing Systems

Professional elective -2

2014014	1.Mechanical Behavior of Materials
2014015	2.Stress Analysis and Vibration
2014016	3. Additive Manufacturing Technologies

Professional elective -3

2024017	1. Advanced Tool Design
2024018	2.Advanced Manufacturing Process
2024019	3.Optimization Techniques and Applications

Professional elective -4

2024020	1. Design of Hydraulic and Pneumatic Systems
2024021	2. Metrology and Non-Destructive Testing
2024022	3. Mechanics of Composite Materials

Professional elective -5

2034023	1. Design for Manufacture, Assembly and Environments
2034024	2. Industrial Robotics.
2034025	3. Flexible Manufacturing Systems

List of Open Elective

2034030	Business Analytics
2034031	Industrial Safety
2034032	Energy from Waste

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M. Tech. I Year I Sem

ADVANCED CAD

L	T	P	C
3	0	0	3

COURSE OBJECT :

- This course aims at imparting knowledge on computer applications in design.
- To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture.

COURSE OUTCOMES :

After successful completion of this course, the Students will be able to

- **Describe** the Surface Modeling techniques such as interpolation and approximation
- **Relate** Graphics and computing standards
- **Assemble** and modeling various mechanical components
- **Analysis** of various types of fits and tolerances
- **Categorize** the capabilities of modeling and analysis packages such as solid works, Pro-E and ANSYS.

UNIT – 1 INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation

UNIT – 2 CURVES AND SURFACES MODELING 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: Hermite bicubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT – 3 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.

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UNIT – 4 VISUAL REALISM	**9**
Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry-based software's and their principles creation of prismatic and lofted parts using these packages	
UNIT – 5 ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE	**9**
Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.	

TEXT BOOK :

1. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.
2. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.

REFERENCE BOOK :

1. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
2. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", Mc Graw Hill Book Co. Singapore, 1989.

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M. Tech. I Year I Sem

ADVANCED CAM

L	T	P	C
3	0	0	3

COURSE OBJECT:

The course should enable the students to:

- Develop an understanding of the advanced aspects of enabling computer aided technologies used in design, engineering, manufacturing and rapid product development
- Develop a degree of ability in the development and application of modern CAD/CAM system.
- Apply knowledge on advances in modern techniques of rapid prototyping and rapid tooling

COURSE OUTCOMES:

At the end of the course student should be able to

1. Explain about APT programming and tool path generation.
2. Discuss in detail about tooling system, DNC and adaptive control.
3. Explain post processes required for CNC.
4. Explain computer aided process planning and its types.

UNIT – 1 COMPUTER-AIDED PROGRAMMING 9

General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation.

UNIT – 2 TOOLING FOR CNC MACHINES 9

Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

UNIT – 3 POST PROCESSORS FOR CNC 9

Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, the creation of a DAPP — Based Post Processor.

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UNIT – 4 MICRO CONTROLLERS	**9**
Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications, and Programming of Micro Controllers. Programming Logic Controllers (PLC' s):Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.	
UNIT – 5 COMPUTER AIDED PROCESS PLANNING	**9**
: Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.	

TEXT BOOK :

1. P.N. Rao, N. K. Tewari, T K Kundra " Computer Aided Manufacturing" McGraw Hill
2. CAD/CAM Principles and Applications, P.N. Rao, TMH.

REFERENCE BOOK :

1. Computer Control of Manufacturing Systems / Yoram Koren / McGraw Hill. 1983.
2. CAD / CAM / CIM, Radha krishnan and Subramanian, New Age
3. CAD/CAM Design and manufacturing, Groover, McGraw Hill.

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M. Tech. I Year I Sem

AUTOMATION IN MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OBJECT:

The course should enable the students to:

- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods.

COURSE OUTCOMES:

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

1. Illustrate the basic concepts of automation in machine tools.
2. Analyze various automated flow lines, Explain assembly systems and line balancing methods.
3. Describe the importance of automated material handling and storage systems.
4. Interpret the importance of adaptive control systems, automated inspection systems.

UNIT – 1 OVER VIEW OF MANUFACTURING AND AUTOMATION 9

Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers.

UNIT – 2 MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES 9

Material handling, equipment, Analysis. Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Automatic identification methods, Barcode technology, RFID.

UNIT – 3 MANUFACTURING SYSTEMS AND AUTOMATED PRODUCTION LINES 9

Manufacturing systems: components of a manufacturing system, Single station manufacturing cells; Manual Assembly lines, line balancing Algorithms, Mixed model Assembly lines, Alternative Assembly systems. Automated production lines, Applications, Analysis of transfer lines

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UNIT – 4 AUTOMATED ASSEMBLY SYSTEMS	**9**
Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.	
UNIT – 5 QUALITY CONTROL AND SUPPORT SYSTEMS	**9**
Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.	

TEXT BOOK :

1. Automation, production systems and computer integrated manufacturing/ Mikell.P Groover/PHI/3rd edition/2012.
2. Automation, Production Systems and CIM/ MikeJ P. Grower/PHI

REFERENCE BOOK :

1. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanyarn and Raju/New Age International Publishers/2003.
2. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/2009

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M. Tech. I Year I Sem

COMPUTER AIDED PROCESS PLANNING

L	T	P	C
3	0	0	3

COURSE OBJECT :

The course should enable the students to:

- understand what is process planning and CAPP,
- know the various steps involved in CAPP,
- classify the various methods of CAPP,
- understand the feature recognition in CAPP

COURSE OUTCOMES :

At the end of the course students should be able to

1. Understand CAPP, its features and advantages.
2. Explain principles of generative CAPP systems and knowledge-based systems
3. Explain retrieval CAPP system and selection of manufacturing sequence.
4. Determine various machining parameters.
5. Explain tool path generation and implementation of various techniques for CAPP.

UNIT – 1 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 – 2 Part Design Representation **9**

Design Drafting-Dimensioning-Conventional Tolerance- Geometric Tolerance-CAD-input/output devices-Topology - Geometric Transformation-Perspective Transformation-Data Structure-Geometric modeling for process planning--GT Coding-The OPITZ system-The MICLASS System

UNIT – 3 Process Engineering and Process Planning **9**

Experience based planning-Decision table and Decision trees-Process capability analysis-Process planning-Variant process planning-Generative approach-Forward and backward planning, Input format, AI.

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UNIT – 4 Computer Aided Process Planning Systems	**9**
Logical Design of process planning- Implementation Considerations-Manufacturing system components, Production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.	
UNIT – 5 An Integrated Process Planning Systems	**9**
Totally integrated process planning systems-An Overview Modulus Structure-Data Structure-Operation-Report Generation, Expert process planning	

TEXT BOOK:

1. Gideon Halevi and Roland D. Weill, "Principle of process planning- A Logical Approach", Chapman & Hall, 1995.
2. Chang T. C. & Richard A.Wysk, "An Introduction to automated process planning systems", Prentice Hall 1985

REFERENCE BOOK:

1. Chang, T.C., "An Expert Process Planning System", Prentice Hall, 1985
2. Rao P.N., "Computer Aided Manufacturing", Tata McGraw Hill Publishing Co., 2000.

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M. Tech. I Year I Sem

PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECT:

- This course aims at imparting knowledge on modeling and analysis of manufacturing system.
- To develop the manufacturing system control technics
- To develop the new manufacturing process control

COURSE OUTCOMES:

After successful completion of this course, the Students will be able to

1. Explain the Quality, Control Systems
2. Derive the Equations for CTMC evolution
3. Analyze the flexible machine center
4. Compose the Generalized Stochastic Petri Net
5. Arrange the cards for KAMBAN system.

UNIT – 1 MANUFACTURING SYSTEMS & CONTROL **9**

Automated Manufacturing Systems – Modeling – Role of performance modeling – simulation models-Analytical models. Product cycle – Manufacturing automation – Economics of scale and scope – input/output model – plant configurations. Performance measures – Manufacturing lead time – Work in process – Machine utilization – Throughput – Capacity– Flexibility – Performability – Quality Control Systems – Control system architecture – Factory communications – Local area network interconnections – Manufacturing automation protocol –Database management system.

UNIT – 2 MANUFACTURING PROCESSES **9**

Examples of stochastics processes – Poisson process - Discrete time Markov chain models – Definition and notation – Sojourn times in states – Examples of DTMCs in manufacturing – Chapman – Kolmogorov equation – Steady-state analysis. Continuous Time Markov Chain Models – Definitions and notation – Sojourn times in states – examples of CTMCs in manufacturing – Equations for CTMC evolution – Markov model of a transfer line. Birth and Death Processes in Manufacturing – Steady state analysis of BD Processes – Typical BD processes in manufacturing.

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UNIT – 3 QUEUING MODEL	**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 and queues with breakdowns – Analysis of a flexible machine center.	
UNIT – 4 QUEUING NETWORKS	**9**
Examples of QN models in manufacturing – Little's law in queuing networks – Tandem queue – An open queuing network with feedback – An open central server model for FMS – Closed transfer line – Closed server model – Garden Newell networks.	
UNIT – 5 PETRINETS	**9**
Classical Petri Nets – Definitions – Transition firing and reachability – Representational power – properties – Manufacturing models. Stochastic Petri Nets – Exponential timed Petri Nets – Generalized Stochastic Petri Nets – modeling of KANBAN systems – Manufacturing models.	

TEXT BOOK :

1. Trivedi, K.S, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Prentice Hall, New Jersey, 1982.

REFERENCE BOOK :

1. Gupta S.C., Kapoor V.K, "Fundamentals of Mathematical Statistics ", Sultan Chand and Sons, 3rd Edition, New Delhi, 1988.
2. Viswanadham, N, Narahari, Y, "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1994.

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M. Tech. I Year I Sem

MECHANICAL BEHAVIOR OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECT:

- This course aims at imparting knowledge on mechanical behavior of materials

COURSE OUTCOMES:

After successful completion of this course, the Students will be able to

1. Explain the basic concept of stresses
2. Describe the true stress and true strain
3. Analyze the properties composite high strength low alloy steel
4. Summarize the modern metallic materials.
5. Explain the application nonmetallic materials

UNIT – 1 BASIC CONCEPTS OF STRESS **9**

Definition, State of Stress at a point, Stress tensor, invariants of stress tensor, principal stresses, stress ellipsoid, derivation for maximum shear stress and planes of maximum shear stress, octahedral shear stress, Deviatoric and Hydrostatic components of stress, Invariance of deviatoric stress tensor, plane stress.

UNIT – 2 TRUE STRESS AND TRUE STRAIN **9**

von-Mises and Tresca yield criteria, Haigh–Westergard stress space representation of von - Mises and Tresca yield criteria, effective stress and effective strain, St. Venants theory of plastic flow, Prandtle–Reuss and Levy–Mises constitutive equations of plastic flow, Strain hardening and work hardening theories, work of plastic deformation.

UNIT – 3 MICROMECHANICS OF COMPOSITES **9**

Introduction about composites Mechanical properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

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UNIT – 4 MODERN METALLIC MATERIALS	**9**
Dual phase steels, High strength low alloy steel, Transformation induced plasticity Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.	
UNIT – 5 NON METALLIC MATERIALS	**9**
Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.	

TEXT BOOK :

1. George E.Dieter, "Mechanical Metallurgy", McGraw Hill,1988.
2. Thomas H. Courtney, "Mechanical Behavior of Materials", McGraw Hill, 2nd edition, 2000.

REFERENCE BOOK :

1. Ashby M.F, "materials selection in Mechanical Design", Butter worth, 2nd Edition, 1999.
2. Timoshenko and Goodieer, "Theory of Elasticity", Mcgraw Hill Publications, 3rd Edition.
3. Madleson, "Theory of Plasticity".
4. Chakrabarty.J, "Theory of Plasticity", 2nd Edition, McGraw Hill, 1998.
5. Metals Hand book, "Failure Analysis and Prevention" 10th Edition, jaico, 1999.

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M. Tech. I Year I Sem

STRESS ANALYSIS AND VIBRATION

L	T	P	C
3	0	0	3

COURSE OBJECT :

- Variational Principles interpreted in terms of projections in computational subspaces.
- How FE strains occur as best fits at the element level.
- Pathological problems; Shear Locking in Timoshenko beam elements.
- How reduced integration and an-isoperimetric formulations eliminate locking problems.
- principle and operations of various vibrations measuring instruments.

COURSE OUTCOMES :

1. To Provides knowledge about different experimental stress analysis techniques and to develop schematic models for physical systems and formulate governing equations
2. To analyze rotating and reciprocating systems and design machine supporting structures,
3. To describe the fundamentals of vibrations and to analyze the damped motion without external force for under damped, over damped and critically damped motion.
4. Determine the natural frequencies and mode shapes of different two degree and multi degree freedom systems
5. Calculate free and forced vibration responses of multi degree freedom systems using modal analysis.

UNIT – 1 ELASTICITY THEORY **9**

Two dimensional elasticity theory in Cartesian coordinates, plane stress problem in polar coordinates Thick cylinders, Rotating discs - stress concentration.

UNIT – 2 TORSION **9**

Torsion of non circular prismatic sections, rectangular and axisymmetric, Circular plates, introduction to shell theory — contact stresses.

UNIT – 3 FREE AND FORCED VIBRATIONS **9**

Single degree freedom, two degree freedom system without and with damping - Free and forced vibrations. Transient vibrations.

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UNIT – 4 TRANSIENT VIBRATIONS	**9**
Transient vibrations of single and two degree freedom systems, multi-degree of freedom systems - applications of matrix methods , continuous systems.	
UNIT – 5 VIBRATIONS OF STRINGS BARS AND BEAMS	**9**
Free and forced vibrations of strings bars and be CAD/CAM. Principle of orthogonality - classical and energy methods.	

TEXT BOOK :

1. Theory of Elasticity/Timoshenko S.P. and Goodier J.N./Koakusha Publishers
2. Mechanical Vibrations/ Gorge G K, new age.

REFERENCE BOOK :

1. Theory of machine, kurmi R S, chand publication.

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M. Tech. I Year I Sem

ADDITIVE MANUFACTURING TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECT :

- To provide in depth knowledge in different types of Rapid Prototyping systems and their applications in various fields.
- Understand the need of digital fabrication.

COURSE OUTCOMES :

1. This course would make familiar of basic concepts in Rapid Prototyping, its development and applications.
2. Course would be helpful to understand the basic principle behind different types of Rapid Prototyping systems.
3. Students would be trained to find innovative solutions for designing of supporting structures and to use standard practices.
4. One would be able to make use of a suitable Rapid Prototyping technique for a component after analyzing its design requirements, structural strength and functionality.
5. Summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.

UNIT – 1 INTRODUCTION **9**

Need for Rapid Prototyping - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital Prototyping - Classification of RP process- Virtual Prototyping- Rapid Tooling - Benefits- Applications.

UNIT – 2 LIQUID BASED ADDITIVE MANUFACTURING SYSTEMS **9**

Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT – 3 SOLID BASED ADDITIVE MANUFACTURING SYSTEMS **9**

Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

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UNIT – 4 POWDER BASED ADDITIVE MANUFACTURING SYSTEMS	**9**
Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Process, materials, products, advantages, limitations and applications– Case Studies.	
UNIT – 5 OTHER RAPID PROTOTYPING TECHNOLOGIES	**9**
Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, Mould SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing.	

TEXT BOOK:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2003.
2. Ali K. Kamrani, Emad Abouel Nasr, "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Liou W.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.

REFERENCE BOOK:

1. D.T. Pham and S.S. Dimov, Rapid Manufacturing, Springer.
2. PaulF.Jacobs, Rapid Prototyping and Manufacturing, ASME.
3. Peter D.Hilton, Hilton/Jacobs, Paul F. Jacobs, "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
4. Andreas Gebhardt, Hanser. "Rapid prototyping", Gardener Publications, 2003.

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M. Tech. I Year I Sem

RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

COURSE OBJECT:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

UNIT – 1 INTRODUCTION 9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT – 2 RESEARCH METHODOLOGY 9

Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report.

UNIT – 3 PROPOSAL WRITING 9

Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

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UNIT – 4	NATURE OF INTELLECTUAL PROPERTY	9

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

UNIT – 5	PATENT RIGHTS	9

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

TEXT BOOK:

1. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

REFERENCE BOOK:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
3. Otto, Kevin, "Product Design", Person.

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M. Tech. I Year I Sem

ADVANCED CAD LABORATORY

(Lab - I)

L	T	P	C
0	0	4	2

1. Two- dimensional drawing using CADsoftware.
2. Three-dimensional drawing using CADsoftware.
3. Various Dimensioning and tolerance techniques on typical products using CADsoftware.
4. Assembly and animation of simple assemblies like screw jack, bolt-nut mechanism,etc.
5. Truss analysis using FEAsoftware.
6. Beam analysis using FEAsoftware.
7. Frame analysis using FEAsoftware.
8. Buckling analysis of columns using FEAsoftware.
9. Harmonic analysis using FEAsoftware.
10. Fracture analysis using FEAsoftware.
11. Analysis of laminated composites using FEAsoftware.
12. Couple-field analysis using FEAsoftware.
13. ModalAnalysis
14. Transient dynamicanalysis.
15. Spectrumanalysis.

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M. Tech. I Year I Sem

ADVANCED CAM LABORATORY

(Lab - II)

L	T	P	C
0	0	4	2

List of Experiments:

1. CNC programs for turning- 4exercises
2. CNC programs for milling- 4exercises
3. Robot programming- Lead through programming using teach product, forward kinematics, inverse kinematics, trajectory planning.

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ADVANCED FINITE ELEMENT METHOD

M.Tech. II Year I Sem

L	T	P	C
3	-	-	3

COURSE OBJECTIVES:

The course should enable the students to:

- Develop and build appropriate finite element models to solve complex engineering problems.
- Critique numerical results and their validity.
- Synthesize information and ideas for use in the evaluation process

COURSE OUTCOMES:

At the end of the course students should be able to

1. Explain finite element method and its applications.
2. Understand, formulate and solve finite element equations of 1-D & 2-D problems
3. Formulate and solve finite element equations of heat transfer problems.
4. Evaluate natural frequencies and mode shapes of bar, beam and truss.
5. Understand the use basic finite elements of structural applications.

UNIT – 1 INTRODUCTION TO FEM **10**

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, Co-ordinates, basic element shapes, interpolation function, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.

UNIT – 2 1-D STRUCTURAL PROBLEMS **9**

1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
Analysis of Trusses: Plane Trusses and Space Truss elements and problems
Analysis of Beams: Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT – 3 2-D PROBLEMS **9**

2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Iso parametric elements – Jacobian matrix – Stiffness matrix -quadrilateral element, Tetrahedran element - shape functions. Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

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UNIT – 4 HEAT TRANSFER PROBLEMS	**9**
One dimensional heat conduction - Shape function – stiffness matrix – problems – heat conduction with free convection – internal heat generation. Two dimensional – shape function – stiffness and load factor – problems	
UNIT – 5 DYNAMIC CONSIDERATIONS, DYNAMIC EQUATIONS	**8**
Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.	

TEXT BOOK:

1. Chandrupatla, Tirupathi R., Ashok D. Belegundu, T. Ramesh, and Chaitali Ray. Introduction to finite elements in engineering. Vol. 10. Upper Saddle River, NJ: Prentice Hall, 2002.
2. S.Md. Jalaludeen, Finite Element Analysis in Engineering, 2ed, Anuradha Publications, 2016.

REFERENCE BOOK:

1. Reddy, Junuthula Narasimha. Introduction to the finite element method. McGraw-Hill Education, 1993.
2. Krishnamoorthy, C. S. Finite element analysis: theory and programming. Tata McGraw-Hill Education, 1994.
3. Gokhale, Nitin S. Practical finite element analysis. Finite to infinite, 2008.

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MODELING AND SIMULATION OF MANUFACTURING SYSTEMS

M. Tech. I Year II Sem

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The course should enable the students to:

- Learn way of analyzing the systems.
- To develop simulation model for dynamic discrete – event stochastic system.
- To run the model and collect the data.
- To analyze the output data of simulation for specified for performance measures bases on type of simulation and method of output data analysis.

COURSE OUTCOMES:

At the end of the course students should be able to

6. Define the state of system W.R.T specified performance measures.
7. Identify Dynamic Discrete- event stochastic system.
8. Develop simulation model for the said system
9. Analyse the model and present the results to specified confidence level
10. Classification of systems based nature of dynamics and knowledge of elements.

UNIT – 1 INTRODUCTION
CLASSES:9

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates

UNIT – 2 **SIMULATION MODEL**
CLASSES:9

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT – 3 **SIMULATION LANGUAGES**
CLASSES :9

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poison. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN-SIMSCRIPT.

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UNIT – 4 OUTPUT DATA ANALYSIS	**9**
tput data analysis – Types of Simulation with respect to output data analysis – warm up period Welch algorithm – Approaches for Steady – State Analysis – replication.	
UNIT – 5 APPLICATIONS OF SIMULATION	**9**
Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinit and finite capacities – Simple fixed period inventory system.	

TEXT BOOK:

1. Simulation Modelling and Analysis by Law, A.M. & Kelton, McGraw Hill, 2nd Edition New York, 1991.
3. 2. Discrete Event System Simulation by Banks J. & Carson J.S., PH, Englewood Cliffs NJ, 1984.

REFERENCE BOOK:

1. Simulation of Manufacturing Systems by Carrie A., Wiley, NY, 1990.
2. A Course in Simulation by Ross, S.M., McMillan, NY, 1990.
3. Simulation Modelling and SIMNET by Taha H.A., PH, Englewood Cliffs, NJ, 1987.

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M. Tech. I Year II Sem

ADVANCED TOOL DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECT:

- This course aims at imparting knowledge on advanced tool design

COURSE OUTCOMES:

After successful completion of this course, the Students will be able to

1. Select the materials for cutting tools
2. Explain about the Oblique and orthogonal cutting
3. Describe the design procedure for jig.
4. Calculate the Clearance and cutting force of press die.
5. List out the tool holding methods.

UNIT – 1	INTRODUCTION TO TOOL DESIGN	08

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives –Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials-Carbides, Ceramics and Diamond –Non metallic tool materials-Designing with relation to heat treatment.

UNIT – 2	DESIGN OF CUTTING TOOLS	09

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools-Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT – 3	DESIGN OF JIGS AND FIXTURES	10

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages –Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

UNIT – 4	DESIGN OF PRESS TOOL DIES	10

Types of Dies –Method of Die operation–Clearance and cutting force calculations-Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies Drawing Dies-Design and drafting

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UNIT – 5	DESIGN FOR CNC MACHINE TOOLS	08

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine

TEXT BOOK :

1. Cyrll Donaldson, George H.LeCain and, Goold V.C, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
2. Hoffman E.G, "Jig and Fixture Design", Thomson Asia Pvt Ltd., Singapore, 2004.

REFERENCE BOOK :

1. Venkataraman K, "Design of Jigs, Fixtures and Press tools", TMH, 2005.
2. Haslehurst M, "Manufacturing Technology", the ELBS, 1978

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M. Tech. I Year II Sem

ADVANCED MANUFACTURING PROCESS

L	T	P	C
3	0	0	3

COURSE OBJECT :

- To impart the principles of various basic micro manufacturing process.
- The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

COURSE OUTCOMES :

After successful completion of this course, the Students will be able to

1. Understand the concept of AWJM, AJM, Chemical and Electro Chemical Machining Process.
2. Describe the concept of beam energy micro machining.
3. Explain various types of micro polishing method.
4. Analysis of various types of micro forming and welding process

Understand various types application in micro manufacturing process.

UNIT – 1 MICRO MACHINING I

10

Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.

UNIT – 2 MICRO MACHINING II

10

Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam MicroMachining – Hybrid Micro machining – Electro Discharge Grinding – Electro Chemical spark micromachining – Electrolytic in process Dressing

UNIT – 3 NANO POLISHING

09

Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemomechanical Polishining.

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UNIT – 4	**MICRO FORMING AND WELDING**	**09**
Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.		
UNIT – 5	**RECENT TRENDS AND APPLICATIONS**	**07**
Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications		
		TOTAL PERIODS: 45

TEXT BOOK:

1. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012
2. Jain V.K., 'Introduction to Micro machining' Narosa Publishing House, 2011

REFERENCE BOOK :

1. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002
2. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.

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M. Tech. I Year II Sem

OPTIMIZATION TECHNIQUES AND APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECT:

- This course aims at imparting knowledge on various optimization techniques.

COURSE OUTCOMES:

After successful completion of this course, the Students will be able to

1. Apply the optimization techniques in various problems
2. Formulate the Optimization with equality and inequality constraints
3. Design the simple truss members
4. Discuss the Application linkage Mechanisms
5. Describe the various steps involved in GA.

UNIT – 1 UNCONSTRAINED OPTIMIZATION TECHNIQUES 09

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

UNIT – 2 CONSTRAINED OPTIMIZATION TECHNIQUES 09

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

UNIT – 3 ADVANCED OPTIMIZATION TECHNIQUES 09

Multi stage optimization – dynamic programming; stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques; Neural network and Fuzzy logic principles in optimization.

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UNIT – 4	**STATIC APPLICATIONS**	**09**
Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.		
UNIT – 5	**DYNAMIC APPLICATIONS**	**09**
Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.		

TEXT BOOK :

1. Rao, Singaresu, S, "Engineering Optimization – Theory & Practice", New Age International (P) Limited, New Delhi, 2000.
2. Johnson Ray, C, "Optimum design of mechanical elements", Wiley, John & Sons, 1990.

REFERENCE BOOK :

1. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples ", Prentice Hall of India Pvt, 1995.
2. Goldberg, D.E, "Genetic algorithms in search, optimization and machine", Barnen,Addison-Wesley, New York, 1989.

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M. Tech. I Year II Sem

DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECT :

- To know about the Hydraulic and pneumatic systems used in industries
- To learn about the installation and maintenance of hydraulic and pneumatic systems.

COURSE OUTCOMES :

After successful completion of this course, the Students will be able to

1. Illustrate the specification, characteristics, and selection of pumps and accelerators
2. Explain the application and working principles of valves
3. Design the hydraulic circuit for real time applications
4. Design the pneumatic circuit for real time applications.
5. Describe about the illustration and maintenance of circuits

UNIT – 1	**OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS**	**09**

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

UNIT – 2	**CONTROL AND REGULATION ELEMENTS**	**08**

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

UNIT – 3	**HYDRAULIC CIRCUITS**	**10**

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 – 4	**PNEUMATIC SYSTEMS AND CIRCUITS**	**09**

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

UNIT – 5	**INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS**	**09**

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

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TEXT BOOK :

1. Antony Espossito, "Fluid Power with Applications", Prentice Hall, 1980.
2. Dudleyt, A. Pease andJohn J. Pippenger, "Basic fluid power", Prentice Hall, 1987.

REFERENCE BOOK :

1. Bolton. W, "Pneumatic and Hydraulic Systems", Butterworth – Heinemann, 1997.
2. K.Shanmuga Sundaram, "Hydraulic and Pneumatic Controls: Understanding made Easy " S. Chand and Co Book publishers, New Delhi, 2006.
3. Majumithar, Pneumatics systems principles and maintenance, Tata mchill.

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M. Tech. I Year II Sem

METROLOGY AND NON DESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

COURSE OBJECT :

1. To introduce different types of sensors, transducers and strain gauges used for Measurement.
2. To give knowledge about Statistical measures and tools
3. To familiarize students with non-destructive testing on machine components.

COURSE OUTCOMES :

After successful completion of this course, the Students will be able to

1. Identify the sensors and transducers used for stress analysis.
2. Apply the Control charts for variables and for fraction defectives.
3. Explain the Principles of operation of magnetic particle test.
4. Review the different types of waves.
5. List out the benefits and limitation of acoustic emission techniques.

UNIT – 1 MEASURING MACHINES 09

Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Image shearing microscope – Use of computers - Machine vision technology - Microprocessors in metrology.

UNIT – 2 STATISTICAL QUALITY CONTROL 09

Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.

UNIT – 3 LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS 09

Characteristics of liquid penetrants - different washable systems - Developers -applications - methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications –Advantages and limitations.

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UNIT – 4	RADIO GRAPHY	09
Sources of ray-x-ray production - properties of d and x rays - film characteristics -exposure charts - contrasts - operational characteristics of x ray equipment -applications.		
UNIT – 5	**ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES**	**09**
Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques Advantages and limitations - Instrumentation - applications.		

TEXT BOOK :

1. Jain R.K, "Engineering Metrology", Khanna Publishers, 1997.
2. Barry Hull and Vernon John, "Non Destructive Testing", MacMillan, 1988.

REFERENCE BOOK :

1. American Society for Metals, "Metals Hand Book", 1976.

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M. Tech. I Year II Sem

MECHANICS OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECT:

The course should enable the students to:

- An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
- An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.
- An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.

COURSE OUTCOMES:

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

1. Identify and explain the types of composite materials and their characteristic features.
2. Understand the differences in the strengthening mechanism of composite and its corresponding.
3. Effect on performance and application.
4. Understand and explain the methods employed in composite fabrication.
5. Learn simple micromechanics and failure modes of composites.

UNIT – 1	INTRODUCTION TO COMPOSITE MATERIALS	09

Introduction, classification, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon-carbon composites, fiber, reinforced composites and nature-made composites and applications.

REINFORCEMENTS**:** Fibers Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide, fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT – 2	MANUFACTURING METHODS	09

Autoclave, tape production, moulding methods, filament winding, Hand lay up, pultrusion, RTM, Stirr casting.

UNIT – 3	ENGINEERING MECHANICS ANALYSIS AND DESIGN	09

concepts of isotropy vs. anisotropy, composite micromechanics (effective stiffness/strength predictions, load-transfer mechanisms), Classical Lamination Plate theory (CLPT).

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UNIT – 4	**PROPERTIES AND PERFORMANCE OF COMPOSITES**	**09**
Properties and microstructure of high-strength fiber materials (glass, carbon, polymer, ceramic fibers) and matrix materials (polymer, metal, ceramic, and carbon matrices). Specific strength and stiffness of high-performance composites. Rule of mixtures. Stress, strain transformations.		
UNIT – 5	**FAILURE CRITERIA**	**09**
Hygrothermal stresses, bending of composite plates, analysis of sandwich plates, buckling analysis of laminated composite plates, inter-laminar stresses, First Order Shear Deformation Theory (FSDT).		

TEXT BOOK:

1. Principles of Composite Material Mechanics, Fourth EditionBy Ronald F. Gibson
2. Introduction to Composite Materials Design, Third EditionBy Ever J. Barbero.

REFERENCE BOOK:

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
3. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley-Interscience, New York, 1980.

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COMPUTER AIDED ENGINEERING LAB
(Lab - 3)

M.Tech. IYear II Sem

L	T	P	C
0	0	4	2

2-D stress analysis of bar

1. Plane stress analysis
2. Plain strain analysis
3. Beam analysis beam
    a) simply supported beam
        i. Point load
        ii. UDL
        iii. UVL
    b) over hanging beam
        i. Point load
        ii. UDL
        iii. UVL

4. Truss analysis

3-D analysis

1. Modal analysis
2. Buckling analysis - Ansys

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Modeling & Simulation of Manufacturing Systems Lab
(Lab - 4)

M.Tech. IYear II Sem

L T P C
0 0 4 2

A. MANUFACTURING SIMULATION

The students will be given training on the use and application of the following software to manufacturing problems:

1. Auto MOD Software.
2. Flexsim

They also learn how to write sub routines in C-language and interlinking with the above packages. Problems for modelling and simulation experiments:

1. AGV planning
2. ASRS simulation and performance evaluation
3. Machines, AGVs and AS/RS integrated problems
4. JIT system
5. Kanban flow
6. Material handling systems
7. M.R.P. Problems
8. Shop floor scheduling etc.

B. PRECISION ENGINEERING

1. Hydraulic and Pneumatic circuits
2. Study of the chip formation in turning process
3. Determination of cutting forces in turning
4. Experiments in unconventional manufacturing processes-AJM and study of USM, EDM, Laser Machining and Plasma spraying
5. Inspection of parts using tool makers microscope, and roughness
6. Study of micro-controllers, programming on various CNC machine tools and also controllers
7. Studies on PLC programming
8. Study and programming of robot

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MINI PROJECT WITH SEMINAR

L T P C
0 0 4 2

DESCRIPTION:

This course is introduced to enrich the communication skills of the student and to create awareness on recent development in Electrical and Electronics Engineering through Technical presentation. In this course, a student has to present at least two Technical papers or recent advances in Engineering / Technology that will be evaluated by a Committee constituted by the Head of the Department.

Students should work on a small research problem. Students have to carry out the project under the guidance of faculty member using the knowledge of subjects that he/she has learned. The student should submit the report at the end of the semester. The product should be demonstrated at the time of examination.

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DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS

M. Tech. II Year I Sem

L	T	P	C
3	0	0	3

COURSE OBJECT:

- To Design for Manufacture, Assembly and Environments is to create new and better ideas and improving the existing one
- To analyze and Redesign the component by the influence of man, machine, material and process.

COURSE OUTCOMES:

After successful completion of this course, the Students will be able to

1. Arrange the Geometric tolerances
2. Discus the minimize moulding core requirement
3. categorize of materials on form design
4. Identify the different part family in group technology
5. Assess the Techniques to reduce environmental impact

UNIT – 1 INTRODUCTION 8

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 – 2 FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT – 3 COMPONENT DESIGN - MACHINING CONSIDERATION 10

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

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UNIT – 4	COMPONENT DESIGN - CASTING CONSIDERATION	9

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

UNIT – 5	DESIGN FOR THE ENVIRONMENT	9

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

TEXT BOOK:

1. Boothroyd, Geoffrey. Assembly automation and product design. CRC press, 2005.
2. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker, 1994.

REFERENCE BOOK:

1. Dickson, John. R and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
2. Fixel, J, "Design for the Environment", McGraw hill, 1996.
3. Lewis, Helen, et al. Design+ environment: a global guide to designing greener goods. Routledge, 1st Edition 2001.

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INDUSTRIAL ROBOTICS
(PE-5)

M. Tech. II Year I Sem

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The course should enable the students to:

After watching the program and reviewing this printed material, the viewer will learn the basics of industrial

- Robot technology and how robots are used in a variety of manufacturing and assembly operations.
- An overview of robot technology is provided
- The primary types of industrial robots are shown
- Programming methods are demonstrated
- Robot tooling and sensors are detailed

COURSE OUT COMES:

1. To know the robot systems and their applications in agile manufacturing.
2. To have knowledge of robotic peripherals, their selection and their utility.
3. To have knowledge of basic robot kinematics.
4. Be acquainted with various image processing techniques.
5. To know path control and different trajectory planning.

UNIT – 1 INTRODUCTION 9

Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control - precision of movement.

UNIT – 2 COMPONENTS AND OPERATIONS 9

Basic control system concepts - control system analysis - robot actuation and fed back Manipulators - director and inverse kinematics, Coordinate transformation - Brief Robot dynamics Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

UNIT – 3 SENSING AND MACHINE VISION 9

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

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UNIT – 4	ROBOT PROGRAMMING	9
Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation - Search techniques - A1 and Robotics.		

UNIT – 5	INDUSTRIAL APPLICATIONS	9
Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading – CIM - Hostile and remote environments.		

TEXT BOOK :

1. K.S. Fu., R.C. Gonalez, C. S. G. Lee, Robotics Control sensing , Vision and Intelligence, McGraw Hill International Edition, 1987.
2. Groover, Mikell P., et al. Industrial robotics: technology, programming, and applications. McGraw-Hill, 2012.

REFERENCE BOOK :

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, " Robotic engineering - An Integrated Approach ", Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.
2. Bolton, William. Mechatronics: a multidisciplinary approach. Vol. 10. Pearson Education, 2008.
3. Groover, Mikell P. "Automation." Production Systems, and (2001).

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FLEXIBLE MANUFACTURING SYSTEMS

M.Tech. II Year I Sem

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

At the end of this course the student should be able to understand

- Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems.
- To impart knowledge on group technology, simulation, computer control, automatic manufacturing systems and factory of the future.

COURSE OUTCOMES:

1. Apply the concepts of PPC and GT to the development of FMS
2. Discuss the planning and scheduling methods used in manufacturing systems
3. Identify various workstations, system support equipment's and hardware components of FMS
4. Select suitable database and software required for FMS
5. Summarize the concepts of modern manufacturing such as JIT, supply chain management and lean manufacturing etc.

UNIT – 1 INTRODUCTION TO FMS 9

Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

UNIT – 2 +COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

UNIT – 3 FMS SIMULATION AND DATA BASE 9

Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

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UNIT – 4	**GROUP TECHNOLOGY AND JUSTIFICATION OF FMS**	**9**
Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.		
UNIT – 5	**APPLICATIONS OF FMS AND FACTORY OF THE FUTURE**	**9**
FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.		

TEXT BOOK:

1. Jha, Nand K., ed. Handbook of flexible manufacturing systems. Academic Press, 2012
2. Groover M.P., "Automation, production systems and computer integrated manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.

REFERENCE BOOK:

1. Radhakrishnan P. and Subramanian S., "CAD/CAM/CIM", Wiley Eastern Ltd. New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995.
3. Kalpark Jain, "Manufacturing engineering and technology", Addison-Wesley Publishing Co., 1995.

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BUSINESS ANALYTICS
(Open Elective)

M.Tech. II Year I Sem

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.

COURSE OUTCOMES:

6. Students will demonstrate knowledge of data analytics.
7. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
8. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
9. Students will demonstrate the ability to translate data into clear, actionable insights.
10. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

UNIT – 1 BUSINESS ANALYTICS
CLASSES:9

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, sampling and estimation methods overview.

UNIT – 2 TRENDINESS AND REGRESSION ANALYSIS
CLASSES:9

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Exploring Data, Business Analytics Technology.

UNIT – 3 ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS
CLASSES :9

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, nonlinear Optimization.

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UNIT – 4	**FORECASTING TECHNIQUES**	**9**

recasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis:

UNIT – 5	**DECISION ANALYSIS**	**9**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcom Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Dat Storytelling and Data journalism.

TEXT BOOK:

4. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
5. James, R. E. "Business analytics: Methods, models and decisions." (2013).

REFERENCE BOOKS

1. Zanakis, Stelios H., and James R. Evans. "Heuristic "optimization": Why, when, and how to use it." Interfaces 11.5 (1981):
2. Mithani.M., G.K.Murthy,Fundamentals of Business Economics,Himalaya Publishing House,New Delhi. 16th edition, 2007
3. Dr.P.K.Gosh,BusinessEnvironment,Sultanchand&Company,NewDelhi, 1980.

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INDUSTRIAL SAFETY
(Open Elective)

M. Tech. II Year I Sem

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

At the end of this course the student should be able to understand

- To understand the operational safety
- To understand the safety management

COURSE OUTCOMES:

After successful completion of this course, the Students will be able to

11. Evaluate the concept of accident prevention& accident investigation
12. Identify the human behaviour
13. Demonstrate hazards and their control
14. Prepare the fire prevention and protection
15. Summarize the safety management techniques

UNIT – 1 ACCIDENT INVESTIGATION AND ANALYSIS
CLASSES:9

Concept of an Accident, reportable and non-reportable accidents, reporting to statutory authorities. Principles of accident prevention-accident investigation and analysis-Unsafe act and unsafe condition- Domino sequence-cost of accidents-permanent total disabilities, Permanent partial disabilities, Temporary total disabilities-Calculation of frequency rate and severity rate of accidents.

UNIT – 2 ERGONOMICS AND HUMAN BEHAVIOUR
CLASSES:9

Introduction to ergonomics and its area of application in the work system. Anatomy, Posture and body mechanics-low back pain, risk factors for musculoskeletal disorders in the work place behavioral aspects of posture - effectiveness. Individual differences, Factors contributing to personality, fitting the man to the job. Motivation -job satisfaction - Frustration and conflicts reaction to frustration, emotion and frustration. Attitudes - determination of attitudes- changing attitudes.

UNIT – 3 HAZARDS AND THEIR CONTROL
CLASSES :9

Physical hazards-Noise, heat, vibration, ionizing and non-ionizing radiations, and effects. Chemical hazards-dusts, fumes, mist, vapor, fog, gases, types, concentration, exposure Vs dose, TLV. Mechanical hazards. Engineering control methods- use of personal protective equipments.

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UNIT – 4	FIRE PREVENTION AND PROTECTION	9

Fire triangle-principles of fire extinguishing- various classes of fires- A, B, C, D types of fire extinguishers- Industrial fire protection systems. Sprinklers- Fire hydrants- Alarm and detection systems- other suppression systems- CO2 system, foam system and DCP system.

UNIT – 5 SAFETY MANAGEMENT TECHNIQUES, EDUCATION AND TRAINING	9

Incident Recall Technique (IRT), disaster control, Job safety Analysis, Safety survey, safety inspection. Safety training programs, seminars, conferences, competitions- method of promoting safe practice- motivation- creating awareness, awards, celebrations, safety posters, safety displays safety incentive scheme- domestic safety and training.

TEXT BOOK:

1. Heinrich.H.W. "Industrial Accident Prevention", McGraw Hill Company, New York 1980.
2. John V. Grimaldi and Rollin H. Simonds, "Safety Management" , All India Traveller Book Seller, New Delhi, 1989.

REFERENCE BOOK:

1. Krishnan.N.V. "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Lees, F. P. "Loss Prevention in Process Industries", Butter Worth publications, London, 2nd Edition, 1990.
3. Dan Peterson, "Techniques of Safety Management", McGraw Hill Company, Tokyo, 1981

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ENERGY FROM WASTE
(Open Elective)

M.Tech. II Year I Sem

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

At the end of this course the student should be able to understand.

- Interpret the various types of wastes from which energy can be generated.
- Develop knowledge on biomass pyrolysis process and its applications.
- Develop knowledge on various types of biomass gasifiers and their operations.
- Invent knowledge on biomass combustors and its applications on generating energy.
- Summarize the principles of bio-energy systems and their features.

COURSE OUTCOMES:

16. Understand the various types of wastes from which energy can be generated
17. Gain knowledge on biomass pyrolysis process and its applications
18. Develop knowledge on various types of biomass gasifiers and their operations
19. Gain knowledge on biomass combustors and its applications on generating energy
20. Understand the principles of bio-energy systems and their features

UNIT – 1 INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT – 2 BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT – 3 BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

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UNIT – 4	**BIOMASS COMBUSTION**	**9**
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.		

UNIT – 5	**BIO ENERGY**	**9**
Properties of biogas (Calorific value and composition), Biogas plant technology and status – Bio energy system – Design and constructional features – Biomass resources and their classification - Biomass conversion processes – Thermo chemical conversion – Direct combustion – biomass gasification – pyrolysis and liquefaction – biochemical conversion – anaerobic digestion – Types of biogas Plants – Applications – Alcohol production from biomass – Bio diesel production –Urban waste to energy conversion – Biomass energy programme in India.		

TEXT BOOK:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

REFERENCE BOOK:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
3. Breeze, Paul. Solar power generation. Academic Press, 2016.