JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D94101	Theory of Metal Cutting & Tool Design	PC	3	0	0	3
2.	21D94102	Advanced Welding Technology	PC	3	0	0	3
3.	21D04201 21D90301b 21D90202c	**Program Elective Course - I** Advanced Optimization Techniques Quality Engineering Advanced Metal Forming Processes	PE	3	0	0	3
	21D15101c 21D94103a 21D94103b	**Program Elective Course – II** Materials Technology Friction and Wear in machinery Nanotechnology	PE	3	0	0	3
5.	21D94104	Production Engineering Laboratory	PC	0	0	4	2
6.	21D94105	Metal Forming Laboratory	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D94201	Advanced Casting Technology	PC	3	0	0	3
2.	21D87201	Simulation of Manufacturing Systems	PC	3	0	0	3
3.	 21D87101 21D94202 21D04203b	**Program Elective Course – III** Automation in Manufacturing Machine Tool Design Computer Graphics	PE	3	0	0	3
4.	 21D94203 21D90301a 21D04203c	**Program Elective Course – IV** Analysis & Control of Production Systems Design and Manufacturing of MEMS and MICRO Systems Artificial Intelligence & Expert Systems	PE	3	0	0	3
5.	21D87205	Manufacturing Simulation Laboratory	PC	0	0	4	2
6.	21D94204	Advanced Casting & Welding Laboratory	PC	0	0	4	2
7.	21D94205	Technical seminar	PR	0	0	4	2
8.	 21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
Total							**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D04103a 21D90101 21D94301	**Program Elective Course – V** Advances in Manufacturing Technology Rapid Prototyping Machine Tool Dynamics	PE	3	0	0	3
2.	21DOE301c 21DOE301g 21DOE301h	**Open Elective** Business Analytics Internet Of Things Mechatronics	OE	3	0	0	3
3.	21D94302	Dissertation Phase – I	PR	0	0	20	10
4.	21D94303	Co-curricular Activities		-	-	-	2
		Total					**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D94401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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Course Code	THEORY OF METAL CUTTING & TOOL DESIGN	L	T	P	C
21D94101		3	0	0	3
	Semester	I			

Course Objectives: Student will be able to

- Understand Fundamental knowledge and principles in material removal processes.
- Apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc.
- Demonstrate the fundamentals of machining processes and machine tools.
- Develop knowledge and importance of metal cutting parameters.
- Develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
- Apply knowledge of basic mathematics to calculate the machining parameters for different Machining processes.

Course Outcomes (CO): Student will be able to

- Students will be able to analyze cutting forces in turning, drilling and milling.
- Students will be able to adjust varies parameters and reduce temperature developed during machining.
- Students will be able to reduce the cost of machinery
- Students will be able to prevent failures of cutting tool.

UNIT - I		Lecture Hrs:09

Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip Thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut - Types of Chips, Chip breakers.

Orthogonal and Oblique cutting processes-definition, Forces and energy calculations (Merchant's Analysis). - Power consumed – MRR – Effect of Cutting variables on Forces, Force measurement using Dynamometers.

UNIT - II		Lecture Hrs: 09

Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

Cutting tool Materials: Carbon and Medium alloy steels, High Speed steels, Cast-Cobalt alloys, Carbides, Coated tools, Alumina based ceramics, Carbon boron Nitride, SNB Ceramics, Whisker-Reinforced tool materials.

UNIT - III		Lecture Hrs: 09

Multipoint Cutting Tools: Drill geometry, design of drills, Rake and Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, end and face milling cutters, cutting speed and feed – machining time – design - form cutters.

Grinding: Specifications of grinding of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature, power.

UNIT - IV		Lecture Hrs: 09

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Tool Life and Tool Wear: Theories of tool wear-adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index.

Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect of Tool angle.

Cutting Temperature: Types of cutting fluids, Sources of heat in metal cutting, influence of metal conditions. Temperature distribution, zones, experimental techniques, analytical approach. Use of tool-work thermocouple for determination of temperature. Temperature distribution in Metal Cutting.

UNIT - V		Lecture Hrs: 09

Tool Design: Determination of shank size for single point carbide tools, Determining the insert thickness for carbide tools.
Design of jigs and fixtures: Basic principles of location and clamping; Locating methods and devices. Jigs- Definition, Types. General consideration in the design of Drill jigs, Drill bushing, Methods of construction. Fixtures- Vice fixtures, Milling, Boring, Lathe Grinding fixtures**.**

Textbooks:

1. Metal Cutting Principles , M C Shaw , Oxford and IBH Publications, New Delhi,1969
2. Fundamentals of Machining , Boothryd , Edward Amold publishers Ltd. 1975

Reference Books:

1. Fundamentals of Metal cutting and Machine tools , B.L.Juneja, G. S. Sekhom and Nitin Seth , New Age International publishers
2. Tool Engineering, G.R.Nagpal, Khanna Publishers

Online Learning Resources:

1. https://www.sathyabama.ac.in/course-materials/theory-metal-cutting-and-tool-design
2. https://kcgcollege.ac.in/pdf/mech/study%20materials/ME%206402-MT-II/Metal%20cutting%20basics-min.pdf
3. https://nptel.ac.in/courses/112/105/112105233/
4. https://slideplayer.com/slide/9762146/
5. https://www.youtube.com/watch?v=cE-GPE6HtqM
6. https://www.youtube.com/watch?v=BvMrxFCd-3Y
7. https://www.youtube.com/watch?v=8CV3K6k-g-0

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Course Code	**ADVANCED WELDING TECHNOLOGY**	**L**	**T**	**P**	**C**
21D94102		**3**	**0**	**0**	**3**
Semester		**I**			

Course Objectives: Student will be able

- To impart knowledge about welding behaviour of machine and process during welding, analysis of common and newer welding techniques and metallurgical and weldability aspects of different common engineering materials.

Course Outcomes (CO): Student will be able to

- Deeper knowledge of materials technology of welding
- Deeper knowledge of different metals and their properties in welded constructions
- Knowledge of quality techniques at production by welding
- Knowledge of current computer systems and cost for welding operations
- Knowledge of applications of strength of materials on welded constructions
- Knowledge of applications of fracture mechanics on welded constructions, pressure vessels etc.

UNIT - I		Lecture Hrs: 09

Laser Beam Welding: Type of lasers, equipment, power calculation, applications, dual laser beam welding, use of fibre optics in LBW
Electron Beam Welding; The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies.

UNIT - II		Lecture Hrs: 09

Friction and friction stir welding: Details of process and process parameters, specific applications.
Ultrasonic Welding; Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies, cutting and gauging, flame cutting plasma arc welding, laser assisted cutting.

UNIT - III		Lecture Hrs: 09

Heat flow in Welding: Significance, theory of heat flow cooling rate determination, selection of welding parameters based on heat flow analysis, residual stresses and distortion. Join design, analysis of fracture and fatigue of welded joints. Automated welding systems.

UNIT - IV		Lecture Hrs: 09

Physics of welding arc - characteristics of arc and mode of metal transfer, welding fluxes and coatings - type and classification; electrode codes and their critical evaluation; welding machine characteristics - conventional and pulsed power sources, inverter type determination of preheat temperature, use of Schaefflers diagram, weldability tests,

UNIT - V		Lecture Hrs: 09

NDT methods for welds-visual inspection methods, magnetic particle inspection method, Dye penetration method,- Eddy current testing and acoustic emission methods, ultrasonic inspection method, Radiographic method. Analysis of welding defects-types, causes and remedies.

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Textbooks:
1.Richard L Little, "Welding and Welding Technology" Tata McGraw Hill, 2004. 2. Welding Engineering and Technology,R. S. Parmar, Khanna Publishers, 2010
Reference Books:
1. Larry Jeffus, "Welding Principles and Applications" Delmar Publishers, 2004 2. Klas Weman, "Welding Processes Handbook",2003 3. Howard B Cary, "Modern Welding Technology" Prentice Hall, 2002 4. Larry Jeffus, "Welding for Collision Repair, "Delmar Publishers, 1999
Online Learning Resources:
1. https://nptel.ac.in/courses/112/103/112103263/ 2. https://nptel.ac.in/courses/112/103/112103244/ 3. https://nptel.ac.in/courses/112/107/112107089/ 4. https://nptel.ac.in/courses/112/107/112107213/ 5. https://nptel.ac.in/courses/113/106/113106087/

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Course Code	**ADVANCED OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
21D04201	**Program Elective Course-I**	**3**	**0**	**0**	**3**
Semester		**I**			

Course Objectives: Student will be able

- To introduce the fundamental concepts of Optimization Techniques;
- To make the learners aware of the importance of optimizations in real scenarios;
- To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

Course Outcomes (CO): Student will be able to

- Formulate optimization problems;
- Understand and apply the concept of optimality criteria for various type of optimization problems.
- Solve various constrained and unconstrained problems in single variable as well as multivariable;
- Apply the methods of optimization in real life situation.

UNIT - I		Lecture Hrs: 09

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method.

UNIT - II		Lecture Hrs: 09

Integer programming- cutting plane method and branch and bound technique**. Geometric Programming:** Unconstrained & Constrained Minimization

UNIT - III		Lecture Hrs: 09

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, solving differential equations using GP.

UNIT - IV		Lecture Hrs: 09

Multi-Objective Optimization : Introduction to goal programming , Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems . Introduction to Analytical hierarchical process, analytical network process.

UNIT - V		Lecture Hrs: 09

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Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Textbooks:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers
4. Operation Research by Hamdy A. Taha, Pearson publications

Reference Books:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers
4. Fundamentals of Metal cutting and Machine tools , B.L.Juneja, G. S. Sekhom and Nitin Seth , New Age International publishers
5. Tool Engineering, G.R.Nagpal, Khanna Publishers

Online Learning Resources:

1. https://www.youtube.com/watch?v=eo2tOPV3AoE
2. https://www.youtube.com/watch?v=4t3z8y4CAcs
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/lecture-videos/lecture-1-introduction-and-optimization-problems/
4. https://ocw.mit.edu/courses/sloan-school-of-management/15-093j-optimization-methods-fall-2009/lecture-notes/
5. https://web.eng.fiu.edu/arleon/courses/Optimization/Lectures/Classical_Optimization.pdf
6. https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L4_LN.pdf
7. https://www.iare.ac.in/sites/default/files/OT%20Complete%20Notes_1.pdf

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Course Code	**QUALITY ENGINEERING**	**L**	**T**	**P**	**C**
21D90301b	**Program Elective Course-I**	**3**	**0**	**0**	**3**
Semester		**I**			

Course Objectives: Student will be able to

- Impart knowledge about the significance of quality and the various tools/ concepts of building quality into products.
- Learn the techniques used for quality control and quality improvement.

Course Outcomes (CO): Student will be able to

- Apply the tools and techniques of quality to resolve industrial engineering issues.
- Estimate the obvious and hidden quality costs for a given production system.
- Apply a system based approach for quality management.

UNIT - I		Lecture Hrs:09

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.
Loss function and quality level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT - II		Lecture Hrs:09

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components.

Parameter and tolerance design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the Taguchi loss function, identification of tolerance design factors.

UNIT - III		Lecture Hrs:09

Design of Experiments: Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description.

Analysis of variance (ANOVA): One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT - IV		Lecture Hrs:09

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean.

UNIT - V		Lecture Hrs:09

ISO-9000 Quality system, BDRE, Quality improvement Techniques, 6-sigma, bench marking, quality

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circles-brain storming-fishbone diagram-problem analysis.
Textbooks:
1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition, 1995. 2. Total Quality Management by Dale H. Besterfield, Glen Besterfield
Reference Books:
1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl. Edition, 1989. 2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.
Online Learning Resources:
1. https://nptel.ac.in/courses/112/106/112106253/ 2. https://nptel.ac.in/courses/112/107/112107259/ 3. https://quality-one.com/quality-engineering/ 4. https://en.wikipedia.org/wiki/Quality_engineering 5. https://youtu.be/5_hng9rgVHE 6. https://www.youtube.com/watch?v=oIG_NDb2g3U 7. https://nptel.ac.in/courses/110/104/110104080/ 8. https://nptel.ac.in/courses/110/105/110105088/

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Course Code	**ADVANCED METAL FORMING PROCESSES**	**L**	**T**	**P**	**C**
21D90202c	**Program Elective Course – I**	**3**	**0**	**0**	**3**
Semester		**I**			

Course Objectives: Student will be able to

- Demonstration the metal forming processes (Rolling, Forging and Sheet metal forming).

Course Outcomes (CO): Student will be able to

- Acquire a deeper knowledge about metal forming under different conditions and in various processes.
- Understand Metal forming fundamentals and applications.
- Understand Metal forming mechanics.
- Understand Workability of testing techniques.

UNIT - I		Lecture Hrs:09

Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method. Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

UNIT - II		Lecture Hrs:09

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. problems on flow stress ,true strain and forging load. Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes. Problems on extrusion load.

UNIT - III		Lecture Hrs:09

Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming. Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.

UNIT - IV		Lecture Hrs:09

Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing. Problems on draw force. Design of drawing dies.

UNIT - V		Lecture Hrs:09

Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, inprocess heat treatment and computer applications in metal forming. Problems on Blanking force, Blank diagram in Cup Diagram, Maximum considering shear.

Textbooks:

1. Mechanical Metallurgy, G.E. Dieter , Tata McGraw Hill, 1998. III Edition

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2. Principles of Metal Working , Sunder Kumar.
Reference Books:
1. Principles of Metal Working processes , G.W. Rowe 2. ASM Metal Forming Hand book.
Online Learning Resources:
1. https://www.coursera.org/lecture/aerospace-materials/1-3a-metal-forming-processes-part1-xi5hQ 2. slideplayer.com/slide/6642769/ 3. nptel.ac.in/courses/112/107/112107250/

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Course Code	MATERIALS TECHNOLOGY	L	T	P	C
21D15101c	Program Elective Course-II	3	0	0	3
	Semester	I			

Course Objectives: Student will be able to

- Able to understand the concept of materials i.e., conventional materials such as metallic and non-metallic materials with their structures and applications
- Explain the differences in properties of different materials, including metals, alloys, ceramics, polymers and composites
- Relate the properties of materials to microstructure (quantitative skills)
- Describe the basics of processing techniques for altering the microstructure and properties of different materials.

Course Outcomes (CO): Student will be able to

- Students are capable to define the concept of materials i.e., conventional materials with their structure, such as electronic configuration, structure of atom, etc.
- Students become aware of different conventional materials such as metallic and nonmetallic materials, structures and their applications.
- Students will be able to demonstrate the need for newer materials by comparing the limitations of conventional materials.
- They will be able to compare the types of newer materials along with their properties and applications.
- They will be able to compile about the properties, structure of ceramic materials and their need for newer applications and processing techniques

UNIT - I		Lecture Hrs:9

Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

UNIT - II		Lecture Hrs:9

Griffth's Theory of brittle fracture stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller Parameter, Deformation and Fracture mechanism maps. Simple problems.

UNIT - III		Lecture Hrs:9

Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, effect of creep on fatigue. Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing

UNIT - IV		Lecture Hrs:9

Modern Metallic Materials: Dual Phase Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides. Smart Materials, Shape Memory alloys, Metallic Glass, Quasi Crystal and Nano

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Crystalline Materials. Metal-Matrix composites

UNIT - V		Lecture Hrs:9

Non-metallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, Structure, Properties and Applications of engineering Polymers. Advanced structure of ceramics –WC, TiC, Al2O3, SiC, CBN and diamond- properties and applications, Composite Materials.

Textbooks:

1. Mechanical Behaviour of Materials, Thomas H. Courtney, 2nd Edition, McGraw Hill,2000.

2. Mechanical Metallurgy, George E. Dieter, McGraw Hill,1998.

Reference Books:

1.Selection and use of Engineering Materials,Charles J.A, Butterworth Heiremann

Online Learning Resources:

1. https://nptel.ac.in/courses/112/108/112108150/
2. https://ocw.mit.edu/courses/materials-science-and-engineering/3-012-fundamentals-of-materials-science-fall-2005/lecture-notes/
3. https://www.vssut.ac.in/lecture-notes.php?url=metallurgical-materials-engineering
4. https://www.researchgate.net/publication/305356293_Advanced_metallic_materials_and_processes
5. https://www.youtube.com/watch?v=yXHlIowQntk
6. https://nptel.ac.in/courses/112/104/112104251/
7. https://www.youtube.com/watch?v=b5IPJeCDEPw
8. https://nptel.ac.in/courses/112/108/112108092/

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COURSE STRUCTURE & SYLLABI

Course Code	**FRICTION AND WEAR IN MACHINERY**	**L**	**T**	**P**	**C**
21D94103a	**Program Elective Course-II**	**3**	**0**	**0**	**3**
Semester		**I**			

Course Objectives: Student will be able to

- Develop an understanding on the principles and engineering significance of tribology.
- Understand the tribological considerations for the design of various machine elements.

Course Outcomes (CO): Student will be able to

- Identify the causes of wears and friction in different contact surfaces.
- Perform design calculations of hydrostatic and hydrodynamic lubrication for basic problems.
- Design and analyze the performance of bearings.

UNIT - I		Lecture Hrs:09

Introduction to Tribology- History of Tribology, interdisciplinary approach- economic benefits.

UNIT - II		Lecture Hrs:09

Friction causes of friction- Adhesion Theory- abrasive theory- Junction growth theory- Laws of rolling friction – Friction instability.

UNIT - III		Lecture Hrs:09

Wear- Wear mechanisms- Adhesive wear- Corrosive wear- abrasive wear- Fretting wear- wear analysis.

UNIT - IV		Lecture Hrs:09

Lubricants and lubrication- Importance to lubrication- Boundary lubrication- mixed lubrication- Full Fluid Film Lubrication Hydrodynamic lubrication- Elasto Hydrodynamic lubrication- Types and properties of lubricants- lubricants additives.

UNIT - V		Lecture Hrs:09

Fluid Film Lubrication –Fluid Mechanics Concepts- Equation of Continuity and motion, Generalised Reynolds Equation with Compressible and Incompressible lubricants.
Rolling contact bearings –Gears-Journal Bearings- Finite Bearing.

Textbooks:

1. Friction And WearBy A.D. Sarkar
2. Friction, Wear, Lubrication: A Textbook in Tribology by Kenneth C Ludema

Reference Books:

1.Ludema K.C- Friction, Wear, Lubrication- A Text Book in Tribology – CRC Press 2010

Online Learning Resources:

1. https://nptel.ac.in/courses/113/108/113108083/
2. https://youtu.be/NfIC-CpSjw4

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3. https://youtu.be/WeF6FNF10tM
4. https://youtu.be/mI8AHUwmrDo
5. https://youtu.be/9FBrhsnOIjg
6. https://www.youtube.com/watch?v=tfSUNjBh7Wc
7. https://prog.lmu.edu.ng/colleges_CMS/document/books/MCE321%20-%20Lubrication%20and%20Lubricants.pdf

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COURSE STRUCTURE & SYLLABI

Course Code	NANO TECHNOLOGY	L	T	P	C
21D94103b	Program Elective Course-II	3	0	0	3
	Semester	I			

Course Objectives: Student will be able to

- Understand the characteristics of nano materials and know the techniques of preparing the nano materials, to study the physical and chemical properties of the nana materials.

Course Outcomes (CO): Student will be able to

- Identify the properties of nano materials.
- Design and analyze the performance of nano materials.

UNIT - I		Lecture Hrs:09

Characterization and characterization techniques of nanomaterials : Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy dispersive X-ray analysis (EDAX), Low Energy Electron Diffraction (LEED), scanning probe microscopy (SPM) – principle of operation, instrumentation and probes, Atomic force microscopy (AFM), Optical spectroscopy, luminescence spectroscopy, UV-vis spectroscopy (liquid and solid state), UV Photo electron spectroscopy (UPS), Infrared spectroscopy, Raman spectroscopy, XPS, ESCA, Auger, Thermal Analysis Methods etc.

UNIT - II		Lecture Hrs:09

Fabrication of nanomaterials: Top Down Approach Grinding, Planetary milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Microemulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

UNIT - III		Lecture Hrs:09

Functional coatings and thin films: Philosophy of functional surface engineering, general applications and requirements, Principles and design of optical coatings, Physics of the plasma state and plasma surface interactions, Surface engineering as part of a manufacturing process, Integrating coating systems into the design process, Coating, manufacturing processes; Electro deposition.

UNIT - IV		Lecture Hrs:09

Auto-catalytic deposition, Physical and chemical vapor deposition, Ion-beam techniques, plasma spray deposition, overview of synchrotron-radiation based techniques for thin films, Data interpretation and approaches to materials analysis, Coating systems for mechanical applications, Multilayered coating architectures, Applications of functional films in electronic, catalysis and biomedical applications.

UNIT - V		Lecture Hrs:09

Nanocomposites - design and synthesis: Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity. Synthesis methods for various nanocomposite materials: mechanical alloying, thermal spray

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synthesis etc. Nano composites for hard coatings; DLC coatings; Thin film nanocomposites; Modeling of nanocomposites.
Textbooks:
1. Charles P.Poole.Jr.& Frank J.ownes, Introduction to Nano technology - John wielly&sons Inc. Publishers -2006 2. Guozhong Cao, Nano structures and Nano materials: Synthesis, properties and applications - Imperial College press.
Reference Books:
1. Kulkarni Sulabha K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007 2. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009. 3. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, England 2005. 4. Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore Introduction to Nanoscience and Nanotechnology CRC Press 5. Davies, J.H. „The Physics of Low Dimensional Semiconductors: An Introduction", Cambridge University Press, 1998.
Online Learning Resources:
1. https://nptel.ac.in/courses/118/104/118104008/ 2. https://youtu.be/qUEbxTkPIWI 3. https://nptel.ac.in/courses/113/106/113106093/ 4. https://youtu.be/PHHbw52kfaU 5. https://nptel.ac.in/courses/118/102/118102003/ 6. https://nptel.ac.in/courses/118/107/118107015/

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Course Code	**PRODUCTION ENGINEERING LAB**	**L**	**T**	**P**	**C**
21D94104		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives: Student will be able to

- Train the students about the mould making techniques, mould hardness testing metal cutting and measuring machining parameters.

Course Outcomes (CO): Student will be able to

- Understand the mould parts manufacturing technique
- Attain knowledge in machining process

List of Experiments:

a) Sand moulding with cores and spilt cores

b) Mould hardness testing

c) Evaluation of green sand mould parameters such as permeability, moisture etc.

d) Friction stir welding

e) Gear cutting – at least two types on gear hobbing machine

f) Measurement of machining parameter such as force, temperature etc.

g) At least two experiments on Rapid Prototyping

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Course Code	**METAL FORMING LABORATORY**	**L**	**T**	**P**	**C**
21D94105		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives: Student will be able to

- Train the students about the mould making techniques, mould hardness testing metal cutting and measuring machining parameters.

Course Outcomes (CO): Student will be able to

- understand the mould parts manufacturing technique
- attain knowledge in Metal forming process

List of Experiments:

1. Study of the construction and operating parameters of metal spinning Lathe.
2. Study of the water hammer equipment and hydrostatic extrusion setup.
3. Studies on PLC programming for Sheet Forming
4. Ericksen Cup Test – Plot Forming Limit Diagram
5. To study the spring back effect on Bending Test
6. Deep Drawing of Cups – For a given size of the cup, find the size of the blank and draw the cup.
7. Washer Manufacturing on Mechanical/ Hydraulic Press
8. Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.
9. Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.
10. Experiment on Roll Pass Designs
11. Plastic Bottle and Cap Manufacturing

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COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- 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.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:

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

UNIT - II		Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs:

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 - IV		Lecture Hrs:

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

UNIT - V		

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.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

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1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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COURSE STRUCTURE & SYLLABI

Course Code	**ADVANCED CASTING TECHNOLOGY**	**L**	**T**	**P**	**C**
21D94201		**3**	**0**	**0**	**3**
Semester		**II**			

Course Objectives: Student will be able to

- To inculcate the principle, thermal and metallurgical aspects during solidification of metal and alloys.
- To impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving sound casting.

Course Outcomes (CO): Student will be able to

- Analyze the thermal, metallurgical aspects during solidification in casting,their role on quality of cast objects.
- Design the gating and riser system needed for casting and requirements to achieve defect free casting.

UNIT - I	Lecture Hrs:09

Processes, parameters and applications of Investment casting, Centrifugal casting, Continuous Casting, shell moulding, Gravity die/ permanent mold casting, pressure die casting, squeeze casting, vacuum casting, counter-gravity flow-pressure casting, squeeze casting, semisolid metal casting, rheocasting. Non metal Molding /Ceramic Molding.

UNIT - II	Lecture Hrs:09

Solidification Gating and Risering, Nucleation and growth, solidification of pure metals, short and long freezing range alloys, directional and monocrystal solidification. Gating and risering desining calculation, Feeding of metals / alloys, design of feeder, Chvorinov's rule,, Fluidity and its measurement.

UNIT - III	Lecture Hrs:09

Need, Areas for Mechanization, Typical Layout, Sand Reclamation Techniques, Material Handling, Pollution Control in Foundry, Application of Computers in Casting Processes, safety aspects.

UNIT - IV	Lecture Hrs:09

Various Fettling, Finishing and Heat Treatment of Casting, Casting defects-causes and remedies-design principles, Economics of Casting: Cost estimation in foundry shop including material cost, labor cost, direct and other expenses, overhead expenses.,

UNIT - V	Lecture Hrs:09

Design of castings, general principles, case studies: Use of CAD-CAE and Rapid Prototyping in foundry - A case study using CAD/CAE/CAM for developing pattern and core box for castings.

Textbooks:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Casting", Tata McGraw Hill, New Delhi, 2004.
2. Ravi B, “Metal Casting: Computer Aided Design and Analysis” Prentice Hall, 2005.

Reference Books:

1. Jain P L, “Principles of Foundry Technology”, Tata McGraw Hill, New Delhi, 2006.
2. Elliot R, “Cast Iron Technology”, Jaico Publications, 2005.
3. Taylor H F, Flemings M C and Wulff J, "Foundry Engineering", 1993.
4. ASM Metals Handbook - Castings, Vol .15, ASM Int. Metals Park, OHIO, 1991.
5. Indian Foundry Journal (Institute of Indian Foundrymen - IIF).
6. Manuals on CAD/CAM Software (like ProEngineer, Unigraphics, etc.).

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Online Learning Resources:
https://nptel.ac.in/courses/112/107/112107215/
https://nptel.ac.in/courses/112/104/112104301/
https://nptel.ac.in/courses/112/107/112107083/
https://nptel.ac.in/courses/112/107/112107084/

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COURSE STRUCTURE & SYLLABI

Course Code	SIMULATION OF MANUFACTURING SYSTEMS	L	T	P	C
21D87201		3	0	0	3
Semester		II			

Course Objectives: Student will be able

- To impart knowledge about the energy interaction of different components of a system.
- To model systems residing in different energy domains and to control directly the theoretical and real systems. Provide students with the ability to apply modeling technique for analysis and synthesis of thermal, mechanical, biological systems etc.

Course Outcomes (CO): Student will be able to

- Introducing simulation tool.
- Explaining the concept and types of models.
- Understanding discrete and continuous simulation.
- Introducing various simulation languages and software.
- Understanding the role of probability distributions in simulation.
- Explaining the verification and validation of simulation models.

UNIT - I		Lecture Hrs:09

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages and Disadvantages.

Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1 & 2 errors – Framing – Strang law of large numbers.

UNIT - II		Lecture Hrs:09

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model.

UNIT - III		Lecture Hrs:09

Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

Generation of random variants – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – Weibull – normal Bernoullie – Binomial – uniform – Poisson.

UNIT - IV		Lecture Hrs:09

Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN-SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.QUEST, WITNESS, PROMODEL and AUTOMOD.

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UNIT - V		Lecture Hrs:09

Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem.

Textbooks:

1. Charles P.Poole.Jr.& Frank J.ownes, Introduction to Nano technology - John wielly&sons Inc. Publishers -2006
2. Guozhong Cao, Nano structures and Nano materials: Synthesis, properties and applications - Imperial College press.
3. Kulkarni Sulabha K, Nanotechnology: Principles and Practices, Capital Publishing Company, 2007
4. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
5. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, England 2005.
6. Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore Introduction to Nanoscience and Nanotechnology CRC Press

Reference Books:

1. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, England 2005.
2. Gabor L. Hornyak , H.F. Tibbals , Joydeep Dutta , John J. Moore Introduction to Nanoscience and Nanotechnology CRC Press
3. Davies, J.H. „The Physics of Low Dimensional Semiconductors: An Introduction", Cambridge University Press, 1998.

Online Learning Resources:

1. https://nptel.ac.in/courses/112/107/112107220/
2. https://youtu.be/Ej26SZrcPAg
3. https://nptel.ac.in/courses/112/107/112107214/
4. https://nptel.ac.in/courses/110/104/110104096/

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COURSE STRUCTURE & SYLLABI

Course Code	**AUTOMATION IN MANUFACTURING**	**L**	**T**	**P**	**C**
21D87101	**Program Elective Course-III**	**3**	**0**	**0**	**3**
Semester		**II**			

Course Objectives: Student will be able to

- Solve the line balancing problems in the various flow line systems with and without use buffer storage.
- Understand the different automated material handling, storage and retrieval systems and automated inspection systems.
- Use of Adaptive Control principles and implement the same online inspection and control.

Course Outcomes (CO): Student will be able to

- Introducing simulation tool.
- Explaining the concept and types of models.
- Understanding discrete and continuous simulation.
- Introducing various simulation languages and software.
- Understanding the role of probability distributions in simulation.
- Explaining the verification and validation of simulation models.

UNIT - I		Lecture Hrs:09

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

UNIT - II		Lecture Hrs:09

Introduction to Material Handling, Overview of Material Handling Equipment, Material Handling System Design considerations, Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems.

UNIT - III		Lecture Hrs:09

Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

UNIT - IV		Lecture Hrs:09

Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, assembly line design considerations.

Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with and without Storage buffers.

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UNIT - V		Lecture Hrs:09

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines , Partial Automation.

Textbooks:

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover, Pearson Eduction.
2. 1. CAD CAM : Principles, Practice and Manufacturing Management, Chris Mc Mohan, Jimmie Browne , Pearson edu. (LPE)

Reference Books:

1. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961
2. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

Online Learning Resources:

1. https://nptel.ac.in/courses/112/104/112104288/
2. https://nptel.ac.in/courses/112/103/112103293/
3. https://nptel.ac.in/courses/112/103/112103174/
4. https://youtu.be/v-3TmN4HhLc
5. https://youtu.be/-NINgz6KQTA
6. https://youtu.be/CmQa2xoQdzk
7. https://youtu.be/yeHE4se7u5M

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COURSE STRUCTURE & SYLLABI

Course Code	**MACHINE TOOL DESIGN**	**L**	**T**	**P**	**C**
21D94202	**Program Elective Course-III**	**3**	**0**	**0**	**3**
Semester		**II**			

Course Objectives: Student will be able

- To impart the fundamental notions of the machine tools including the different types, construction, applications and their technological capabilities.
- To provide exposure to the systematic methods for solving the problems of designing machine tools and their components by exploring the various design aspects of machine tools elements like transmissions, structures, materials, kinematics, dynamics and construction of machine tools, etc.

Course Outcomes (CO): Student will be able to

- Analyze constructions and kinematic schemata of different types of machine tools.
- Construct ray diagrams and speed spectrum diagrams for speed and feed box.
- Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools.
- Apply the design procedures on different types of machine tool and/or machine tool components. 2. Explaining the concept and types of models.
- Understanding discrete and continuous simulation.
- Introducing various simulation languages and software.
- Understanding the role of probability distributions in simulation.
- Explaining the verification and validation of simulation models.

UNIT - I		Lecture Hrs:09

Kinematics of Machine Tools: Shaping of geometrical and real surfaces, Developing and designing of kinematic schemes of machine tools, kinematics structures of lathe, drilling, milling, grinding, gear shaping and gear hobbing machines.

Kinematic design of speed and feed boxes. Stepped and stepless regulation, clutched drive.

UNIT - II		Lecture Hrs:09

Strengths and Rigidity of Machine tool Structures: Basic principles of design for strength. Different types of structures. Overall compliance of machine tools.

Structure Design: Design of beds, bases, columns, tables, cross rail for various machines. Various types of guide ways, their relative advantages.

UNIT - III		Lecture Hrs:09

Analysis of Spindles, Bearings and Power Screws: Design of spindles subjected to combined bending and torsion. Layout of bearings. Pre-loading. Anti-friction slide ways. Rolling contact hydrodynamic, hydrostatic, Hydrodynamic design of Journal bearings, Magneto bearings.

UNIT - IV		Lecture Hrs:09

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Machine Tool Vibrations: Effect of vibrations on machine tool. Free and Forced vibrations. Machine tool chatter. Elimination of vibrations.

Testing, Maintenance and Erection of Machine Tools: Testing equipment, Preventive and Corrective maintenance, general inspection, Installation of machine tools.

UNIT - V		Lecture Hrs:09

Economics of machine tool selection: Estimation and comparison of costs, operation time, various methods of machine selection: Method of total cash flow, present worth, break even analysis.

Textbooks:

1. Sen and Battacharya, " Principles of Machine Tools", Central Book publishers, Calcutta 1995.
2.G.R. Nagpal, " Machine Tool Engineering", Khanna Publishers.

Reference Books:

1.SK BASU "Design of Machine Tools" – Oxford and IBH Publishing Co.Pvt. Ltd.,

2.N.K. Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill, 1997.

Online Learning Resources:

1. https://nptel.ac.in/courses/112/104/112104121/
2. https://nptel.ac.in/courses/112/105/112105268/
3. https://www.youtube.com/watch?v=MJeRFzs4oRU
4. https://www.digimat.in/nptel/courses/video/112105233/L01.html
5. https://www.youtube.com/watch?v=hWNpID0TWYU
6. https://www.digimat.in/nptel/courses/video/112105268/L01.html

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	COMPUTER GRAPHICS	L	T	P	C
21D04203b	Program Elective Course-III	3	0	0	3
	Semester	II			

Course Objectives:

- The students can understand the Basics of computer Graphics like drawing line, arc etc.,
- Drawing of spline curves , Creation of surfaces, Algorithms for 3D viewing, Available drawing standards.

Course Outcomes (CO): Student will be able to

- Basics of computer Graphics like drawing line, arc etc.
- Drawing of spline curves
- Creation of surfaces
- Algorithms for 3D viewing
- Available drawing standards
- Basics of computer Graphics like drawing line, arc etc.

UNIT - I — Lecture Hrs:

Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.
Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

UNIT - II — Lecture Hrs:

Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

UNIT - III — Lecture Hrs:

Line CLIPPING: Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, midpoint sub division algorithm.
Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

UNIT - IV — Lecture Hrs:

Transformations: Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

UNIT - V — Lecture Hrs:

Rendering: Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Z-buffer algorithm.
Shading algorithms: Constant intensity algorithm, Phong's shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

Textbooks:

1. Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.
2. Computer Graphics-Donald Hearn & M.P. Bakers.
3. Computer graphics-Harrington.

Reference Books:

1. Principles of Metal Working processes , G.W. Rowe
2. ASM Metal Forming Hand book.
3.N.K. Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill, 1997.

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Online Learning Resources:
1. https://lecturenotes.in/subject/59/computer-graphics-cg 2. https://www.dgp.toronto.edu/~hertzman/418notes.pdf 3. http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html 4. http://personal.ee.surrey.ac.uk/Personal/J.Collomosse/pubs/cm20219.pdf 5. http://www.svecw.edu.in/Docs%5CCSECGLNotes2013.pdf 6. https://www.youtube.com/watch?v=fwzYuhduME4 7. https://nptel.ac.in/courses/106/103/106103224/ 8. https://nptel.ac.in/courses/106/102/106102065/

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ANAYLYSIS AND CONTROL OF PRODUCTION SYSTEMS (PE-IV)	L	T	P	C
21D94203		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- Strategy and Competition Forecasting Aggregate Planning Inventory Control Subject to Known Demand Inventory Control Subject to Uncertain Demand Supply Chain Management Push and Pull Production Control Systems: MRP and JIT Operations Scheduling Facilities Layout and Location

Course Outcomes (CO): Student will be able to

- Illustrate qualitative and quantitative forecasting techniques and their influence on production planning and control.
- Solve aggregate planning problems.
- Solve inventory control and planning issues using either deterministic or stochastic modeling.
- Understand the push and pull philosophies in production planning.
- Demonstrate operation scheduling methods in variety shop environment.
- Analyzing queuing models.
- Utilize production systems management knowledge to solve real world problems as a group

UNIT - I	Lecture Hrs:09

The Production Paradigm – Production as a system- Types of Production systems- Job type, Batch type, flow type and Project type – Group Technology – Lean Anile manufacturing

UNIT - II	Lecture Hrs:09

Facility Location and Layout – Multi Plant Location- Locational dynamics – Use of REL charts and Travel charts – Computer based layout technique viz. CRAFT, CORELAP etc.

UNIT - III	Lecture Hrs:09

Planning- Manufacturing and service Strategies – Aggregate Planning - Graphical Analysis- Forecasting – Moving Average, Exponential Smoothing, Assembly Line Balancing- Heuristics for Line Balancing.

UNIT - IV	Lecture Hrs:09

Operations Scheduling - Job shops and flow shops Sequencing n jobs- 2 machines, n jobs 3 machines, n jobs m machines – 2 jobs m machines. Priority Scheduling rules – Criteria and effectiveness- Travelling salesman Problems

UNIT - V	Lecture Hrs:09

Controlling –Project Planning and controlling with PERT / CPM – MRP, JIT, KANBAN systems- LOB technique- MRP- II

Textbooks:

1. Adam and Ebert: Production and Operations Management, 5th Edition Prentic Hall 2007.
2. Elwood S Buffa Modern Production Management 8th Edition Wiley India 2010

Reference Books:

1. M. P. Groover : Automatation Production Systems and CIM 3 rd Edition Prentice Hall 2007
2. Joseph Monks Operations Management 3rd Edition McGraw-Hill 1987
3. Seetharama L Narasimhan Dennis W. McLeavey, Peter Billington Production Planning and

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Inventory Control, 2nd Edition Prentice Hall 1995
4. Elsayed A. Elsayed Thomas O. Boucher: Analysis and Control of Production Systems 2nd Edition Prentice Hall 1994

Online Learning Resources:

1. nptel.ac.in/courses/110/106/110106044/
2. /nptel.ac.in/courses/110/107/110107141/
3. nptel.ac.in/courses/110/105/110105155/

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS (PE-IV)	L	T	P	C
21D90301a		3	0	0	3
	Semester	II			

Course Objectives:

- To introduce students to the basics MEMS and Microsystems.
- To help the students to design MEMS based structures.
- To make students understand the various methods of fabrication.

Course Outcomes (CO): Student will be able to

- Understand the basics of MEMS and analyze a MEMS based structure.

UNIT - I — Lecture Hrs:09

Overview and working principles of MEMS and Microsystems: MEMS and Microsystems, Evolution of Micro fabrication, Microsystems and Microelectronics, Microsystems and miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics.
Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

UNIT - II — Lecture Hrs:09

Engineering Mechanics for Microsystems Design: Static Bending of Thin plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis.
Overview of Basics of Fluid Mechanics in Macro and Mesoscales, Basic equations in Continuum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale.

UNIT - III — Lecture Hrs:09

Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design.

UNIT - IV — Lecture Hrs:09

Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT - V — Lecture Hrs:09

Materials for MEMS and Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

Textbooks:

1. MEMS and Microsystems. Design and Manufacturing, Tia-Ran Hsu, TMH 2002
2. Foundation of MEMS, Chang Liu,Pearson, 2012

Reference Books:

1. An Introduction to Microelectromechanical Systems Engineering. Maluf, M., Artech House, Boston 2000

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COURSE STRUCTURE & SYLLABI

2. "Micro robots and Micromechnaical Systems", Trimmer , W.S.N., Sensors & Actuators, Vol 19, 1989
3. Applied Partial Differential Equations, Trim., D.W., PWS-Kent Publishing, Boston, 1990

Online Learning Resources:

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://nptel.ac.in/courses/112/107/112107298/
3. https://nptel.ac.in/courses/112/103/112103174/
4. https://www.youtube.com/watch?v=gzgMWRIl-Fg
5. https://www.youtube.com/watch?v=27GSZFjk1ZQ
6. https://www.youtube.com/watch?v=hCGaiFgmkfg
7. https://www.youtube.com/watch?v=j9y0gfN9WMg

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	**ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS**	**L**	**T**	**P**	**C**
21D04203c	**Program Elective Course-IV**	**3**	**0**	**0**	**3**
Semester		**II**			

Course Objectives: Student will be able to

- Understand the concepts of Artificial Intelligence and expert systems.
- Learn, how to represent knowledge and interface in manufacturing application

Course Outcomes (CO): Student will be able to

- Fundamental theories, concepts, and applications of computer science in solving real-time problems.
- Able to Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information.
- Ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems.

UNIT - I		Lecture Hrs:

Artificial Intelligence : Introduction, definition, underlying assumption, Important of Al, Al & related fields State space representation, defining a problem, production systems and its characteristic, search and control strategies –Introduction, preliminary concepts, examples of Search , problems.
Uniformed or Blind Search, Informed Search, Or Graphs, Heuristic Search techniques- Generate and Test, Hill climbing, Best first search, Problem reduction, Constraint satisfaction, Means- Ends Analysis.

UNIT - II		Lecture Hrs:

Knowledge Representation Issues: Representations and Mapping, Approaches, Issues in Kr, Types of knowledge procedural Vs Declarative, Logic programming, Forward Vs Backward reasoning, Matching, Non monotonic reasoning and it logic.
Representing simple facts, Instance and is a relationships, Syntax and Semantics for Propositional logic, FOPL, and properties of Wffs, conversion to casual form, Resolution, Natural deduction.

UNIT - III		Lecture Hrs:

Statistical and Probabilistic Reasoning: Symbolic reasoning under uncertainly, Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster- Shafer Theory, Fuzzy Logic.

UNIT - IV		Lecture Hrs:

Expert Systems: Introduction, Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition, introduction, Recognition and classification process, learning classification patterns, recognizing and understanding speech.

UNIT - V		Lecture Hrs:

Introduction to Knowledge Acquisition: Types of learning, General learning model, and performance measures.
Typical Expert Systems: MYCIN, Variants of MYCIN, PROSPECTOR DENDRAL, PRUFF etc.
Introduction to Machine Learning: Perceptons, Checker Playing examples, Learning, Automata, Genetic Algorithms, Intelligent Editors.

Textbooks:

1. " Artificial Intelligence" , Elaine Rich & Kevin Knight,M/H 1983
2. **"**Artificial Intelligence in Business**"**, Wendry B.Ranch**,** Science & Industry –Vol -II application, Ph 1985.

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3. " A Guide to Expert System" Waterman, D.A., Addison,– Wesley inc. 1986.
4. "Building expert system" Hayes, Roth, Waterman, D.A (ed), AW 1983.
5. **"**Designing Expert System**"**, S.M. and Kulliknowske Weis, London Champion Hull 1984.

Reference Books:

1**.** " Artificial Intelligence**"** , Elaine Rich & Kevin Knight**,**M/H 1983
2. "Artificial Intelligence in Business", Wendry B.Ranch, Science & Industry –Vol -II application, Ph 1985.
3**. "** A Guide to Expert System**"** Waterman, D.A., Addison,**–** Wesley inc. 1986.

Online Learning Resources:

- https://nptel.ac.in/courses/112/103/112103280/
- https://nptel.ac.in/courses/106/106/106106226/
- https://nptel.ac.in/content/storage2/courses/126104006/LectureNotes/Week-Expert%20Systems.pdf

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	**MANUFACTURING SIMULATION LAB**	**L**	**T**	**P**	**C**
21D87205		**0**	**0**	**4**	**2**
Semester		**II**			

Course Objectives: Student will be able to

- Define the basics of simulation modeling and replicating the practical situations in organizations
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods
- Analysis of Simulation models using input analyzer, and output analyzer
- Explain Verification and Validation of simulation model.

Course Outcomes (CO):

- 1Design and run simulation experiments using software packages including PROMODEL, FLEXSIM, AUTOMOD.
- Model and study a given manufacturing scenario using simulation.
- Analyze the behaviour of manufacturing system using simulation.

List of Experiments:

1. Study of elements , entities , activities and basic models of a simulation package modeling and simulation
2. Throughput analysis of a individual production facility using simulation.
3. Modeling of a typical manufacturing facility and study its performances.
4. Breakdown analysis of a production facility with one machine
5. Breakdown analysis of a production system having multiple machines
6. Modeling and Simulation of layouts
7. Study of transport system in a shop floor
8. Buffer size design
9. Identification of bottleneck machine on a given shop floor
10. Study of conjunction, collision and dead locks through simulation.

Lab Facilities:
Adequate number of Computer Systems in Networked Environment
Packages : 1. QUEST
2.PROMODEL
3.FLEXSIM
4.AUTOMOD
5.WITNESS

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED CASTING & WELDING LABORATORY	L	T	P	C
21D94204		0	0	4	2
	Semester	II			

Course Objectives:

- Understand Tensile Strength & Hardness Evaluation of TIG Welded Specimens
- Understand Tensile Strength & Hardness Evaluation of MIG Welded Specimens
- Study inclusion analysis of cast specimen
- Size analysis of Grains for cast specimens.
- Study of Non destructive Testing of welded joint and Blow moulding

Course Outcomes (CO):

- PerformTensile Strength & Hardness Evaluation of TIG Welded Specimens
- Perform Tensile Strength & Hardness Evaluation of MIG Welded Specimens
- Analyze inclusion analysis of cast specimen
- Develop Size analysis of Grainsfor cast specimens.
- To conduct of Non destructive Testing of welded joint and Blow moulding**.**

List of Experiments:

1. Tensile Strength Evaluation of TIG Welded Specimens under variable conditions.
2. Hardness Evaluation of TIG Welded Specimens under variable conditions.
3. Tensile Strength Evaluation of MIG Welded Specimens under variable conditions.
4. Hardness Evaluation of MIG Welded Specimens under variable conditions.
5. Inclusion Analysis of Cast Specimens
6. Size Analysis of Grains fore Cast Specimens under different input variables
7. Design of Runner & Riser
8. Non-Destructive Testing of Welded Joint
9. Study of Blow Moulding
10. Study of Injection Moulding

Note: Each experiment involves preparation of Joint/ Casting, specimen preparation, testing, evaluation and reporting may be chosen from the above list.

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	**ADVANCES IN MANUFACTURING TECHNOLOGY**	**L**	**T**	**P**	**C**
21D04103a	**Program Elective Course – V**	**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives:

- Machining principles and processes in the manufacturing of precision components and products that use conventional, nonconventional, and surface engineering technologies;
- A basic understanding of the machining capabilities, limitations, and productivity of advanced manufacturing processes.

Course Outcomes (CO): Student will be able to

- Apply the working principles and processing characteristics of ultra-precision machining, high-speed machining methods, and nontraditional machining to the production of precision components.
- Determine the quality and surface integrity of products treated by surface engineering processes.
- Determine the formability of a given material and geometric combination using fine-blanking processes.
- Prescribe a laser materials processing technique suitable for a given product with material, size, precision, and surface quality requirements.

UNIT - I	Lecture Hrs:09

Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapour Deposition, Chemical Vapour Deposition, Organic Coatings, Porcelain Enamelling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT - II	Lecture Hrs:09

Un-conventional Machining Methods
Abrasive jet machining **-** Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments. Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

UNIT - III	Lecture Hrs:09

Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.
Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT - IV	Lecture Hrs:09

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes. Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

UNIT - V	Lecture Hrs:09

Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications, and limitations.
Rapid Prototyping: Working principle, methods-Stereo lithography, Laser sintering, Fused deposition method, applications and limitations.

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Textbooks:
1. Manufacturing Technology - P. N. Rao, TMH Publishers 2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers
Reference Books:
1. Production Technology - HMT 2. Manufacturing Science - Cambel 3. Welding Technology - R.S, Parmar, 4. Introduction to Nanotechnology - Poole and Owens, Wiley (2003).
Online Learning Resources:
1. https://nptel.ac.in/courses/112/107/112107078/ 2. https://youtu.be/t3y_Ys3LgGM 3. https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s 4. https://youtu.be/-tcaR7oSx_w 5. https://youtu.be/Uybg6VDLoRQ 6. https://youtu.be/Uybg6VDLoRQ 7. https://youtu.be/aWQsEX1TrSI

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	**RAPID PROTOTYPING**	**L**	**T**	**P**	**C**
21D90101	**Program Elective Course – V**	**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives: Student will be able to

- At the end of this course the students would have developed a thorough understanding of the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies

Course Outcomes (CO): Student will be able to

It helps the students to get familiarized with the various methods of rapid prototyping technologies and rapid tooling.

UNIT - I	Lecture Hrs:09

Introduction: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.
Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

UNIT - II	Lecture Hrs:09

Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.
Solid ground curing: Principle of operation, Machine details, Applications,

UNIT - III	Lecture Hrs:09

Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details, Applications.
Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genesis Xs printer HP system 5, Object Quadra system.

UNIT - IV	Lecture Hrs:09

LASER ENGINEERING NET SHAPING (LENS)
Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, 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.
Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

UNIT - V	Lecture Hrs:09

Rapid Manufacturing Process Optimization: Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation

Textbooks:

1. " Stereo lithography and other RP & M Technologies", Paul F.Jacobs, SME, NY 1996
2. " Rapid Manufacturing **",** Flham D.T & Dinjoy S.S, Verlog London 2001

Reference Books:

1. "Rapid automated**"**, Lament wood, Indus Press New York.

Online Learning Resources:

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1. https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
2. https://slideplayer.com/slide/6927137/
3. https://www.mdpi.com/2073-4360/12/6/1334
4. https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf
5. https://lecturenotes.in/subject/197
6. https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
7. https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
8. https://www.youtube.com/watch?v=NkC8TNts4B4

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	MACHINE TOOL DYNAMICS	L	T	P	C
21D94301	Program Elective Course – V	3	0	0	3
	Semester	III			

Course Objectives: Student will be able to

- To impart the fundamental notions of the machine tools including the different types, construction, applications and their technological capabilities.
- To provide exposure to the systematic methods for solving the problems of designing machine tools and their components by exploring the various design aspects of machine tools elements like transmissions, structures, materials, kinematics, dynamics and construction of machine tools, etc.

Course Outcomes (CO): Student will be able to

- Analyze constructions and kinematic schemata of different types of machine tools.
- Construct ray diagrams and speed spectrum diagrams for speed and feed box.
- Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools.
- Apply the design procedures on different types of machine tool and/or machine tool components.

UNIT - I Lecture Hrs:09

Kinematics of Machine Tools: Shaping of geometrical and real surfaces, Developing and designing of kinematic schemes of machine tools, kinematics structures of lathe, drilling, milling, grinding, gear shaping and gear hobbing machines.
Kinematic design of speed and feed boxes. Stepped and stepless regulation, clutched drive

UNIT - II Lecture Hrs:09

Strengths and Rigidity of Machine tool Structures: Basic principles of design for strength. Different types of structures. Overall compliance of machine tools.
Structure Design: Design of beds, bases, columns, tables, cross rail for various machines. Various types of guide ways, their relative advantages.

UNIT - III Lecture Hrs:09

Analysis of Spindles, Bearings and Power Screws: Design of spindles subjected to combined bending and torsion. Layout of bearings. Pre-loading. Anti-friction slide ways. Rolling contact hydrodynamic, hydrostatic, Hydrodynamic design of Journal bearings, Magneto bearings.

UNIT - IV Lecture Hrs:09

Machine Tool Vibrations: Effect of vibrations on machine tool. Free and Forced vibrations. Machine tool chatter. Elimination of vibrations.
Testing, Maintenance and Erection of Machine Tools: Testing equipment, Preventive and Corrective maintenance, general inspection, Installation of machine tools.

UNIT - V Lecture Hrs:09

Economics of machine tool selection: Estimation and comparison of costs, operation time, various methods of machine selection: Method of total cash flow, present worth, break even analysis.

Textbooks:

1.Sen and Battacharya, " Principles of Machine Tools", Central Book publishers, Calcutta 1995.

Reference Books:

1.G.R. Nagpal, " Machine Tool Engineering", Khanna Publishers.
2.SK BASU "Design of Machine Tools" – Oxford and IBH Publishing Co.Pvt. Ltd.,
3.N.K. Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill, 1997.

Online Learning Resources:

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1. https://nptel.ac.in/courses/112/104/112104121/
2. https://nptel.ac.in/courses/112/105/112105268/
3. https://www.youtube.com/watch?v=MJeRFzs4oRU
4. https://www.digimat.in/nptel/courses/video/112105233/L01.html
5. https://www.youtube.com/watch?v=hWNpID0TWYU
6. https://www.digimat.in/nptel/courses/video/112105268/L01.html

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AUDIT COURSE-I

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COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I	Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II	Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III	Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV	Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V	Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from
- Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT - II

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

UNIT - III

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

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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COURSE STRUCTURE & SYLLABI

Course Code	**SANSKRITFOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
21DAC101c		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I		
Alphabets in Sanskrit,		
UNIT - II		
Past/Present/Future Tense, Simple Sentences		
UNIT - III		
Order, Introduction of roots		
UNIT - IV		
Technical information about Sanskrit Literature		
UNIT - V		
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics		

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

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AUDIT COURSE-II

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

- Students will be able to understand:
- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what
- conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions. Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head
teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections:Researchdesign,Contexts,Pedagogy,Teachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education.

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Oxford and Boston: Blackwell.
Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I		
Definitions of Eight parts of yog.(Ashtanga)		
UNIT - II		
Yam and Niyam.		
UNIT - III		
Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan		
UNIT - IV		
Asan and Pranayam		
UNIT - V		
i)Variousyogposesand theirbenefitsformind &body ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam		

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE	L	T	P	C
21DAC201c	ENLIGHTENMENTSKILLS	2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

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OPEN ELECTIVE

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M.TECH. IN PRODUCTION ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	BUSINESS ANALYTICS	L	T	P	C
21DOE301c		3	0	0	3
Semester		III			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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COURSE STRUCTURE & SYLLABI

Course Code	INTERNET OF THINGS (IOT)	L	T	P	C
21DOE301g		3	-	-	3
	Semester	III			

Course Objectives: Student will be able

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT
- Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies and architecture of IoT systems.
- Use sensors and actuators for design of IoT.
- Understand and apply various protocols for design of IoT systems
- Use various techniques of data storage and analytics in IoT
- Understand various applications of IoT
- Understand APIs to connect IoT related technologies

UNIT – I — Lecture Hrs:09

Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M

UNIT – II — Lecture Hrs: 09

Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

UNIT – III — Lecture Hrs: 09

Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.
IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols

UNIT – IV — Lecture Hrs: 09

Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications

UNIT - V — Lecture Hrs: 09

Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.

Textbooks:

1.Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications
2.Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications
3.Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
4.J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
5.Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design

and Test", Application Note, 2016.
Reference Books:
1.Daniel Minoli, ― "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publication 2.Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
Online Learning Resources:
https://onlinecourses.nptel.ac.in/noc17_cs22/course http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

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COURSE STRUCTURE & SYLLABI

Course Code	**MECHATRONICS**	**L**	**T**	**P**	**C**
21DOE301h		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives: Student will be able

- To study fundamental concepts of Signal condition
- To understand the concepts of precision mechanical systems
- To Learn different electronic interface subsystems
- To be familiar with microcontrollers overview.
- To understand the concepts of programmable logic controllers

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies of Signal condition
- Understand the basics electronic interface subsystems
- Understand and apply various precision mechanical systems
- Understand various applications of microcontrollers overview
- Understand the controlling of programmable logic and programmable motion.

UNIT – I	Lecture Hrs:09

INTRODUCTION : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.

SIGNAL CONDITIONING : Introduction – Hardware - Digital I/O, Analog input – ADC, resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering.

UNIT – II	Lecture Hrs: 09

PRECISION MECHANICAL SYSTEMS : Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

UNIT – III	Lecture Hrs: 09

ELECTRONIC INTERFACE SUBSYSTEMS : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

ELECTROMECHANICAL DRIVES : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation

UNIT – IV	Lecture Hrs: 09

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - DigitalInterfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly , C (LED Blinking , Voltage measurement using ADC).

UNIT - V	Lecture Hrs: 09

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

PROGRAMMABLE MOTION CONTROLLERS : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices :Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive ,

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Textbooks:
1. A text book of Mechatronics by Er.R.K. RAJPUT ., S.CHAND publications 2. A text book of Mechatronics by Nitalgour Premchand Mahalik ., McGraw Hill publications
Reference Books:
1. A text book of Mechatronics by W.Bolton ., Pearson Publications