



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA - 533 003, Andhra Pradesh, India**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**COURSE STRUCTURE & SYLLABUS M.Tech ME**  
**ADVANCED MANUFACTURING & MECHANICAL SYSTEM DESIGN**  
**Programme**  
*(Applicable for batches admitted from 2019-2020)*



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### I Semester

S.No	Course Code	Course Name	L	T	P	Credits
1	MM 101	Automation in Manufacturing	3	0	0	3
2	MM 102	Advanced Manufacturing Processes-I	3	0	0	3
3	MM 103	<b>Program Elective – 1</b>	3	0	0	3
	MM 1031	Design for Manufacturing & Assembly				
	MM 1032	Quality Engineering in Manufacturing				
	MM 1033	Total Quality Management				
4	MM 104	<b>Program Elective – 2</b>	3	0	0	3
	MM 1041	Optimization & Reliability				
	MM 1042	Materials Technology				
	MM 1043	Precision Engineering				
5	MM 105	Advanced CAD Lab	0	0	4	2
6	MM 106	Advanced Manufacturing Lab	0	0	4	2
7	MM 107	Research Methodology and IPR	2	0	0	2
8	MM 108	Writing Skills for Scientific Communication	2	0	0	0
<b>Total</b>						<b>18</b>

### II SEMESTER

S.No	Course Code	Course Name	L	T	P	Credits
1	MM 201	Advanced Manufacturing Processes-II	3	0	0	3
2	MM 202	Computer Integrated Manufacturing	3	0	0	3
3	MM 203	<b>Program Elective – 3</b>	3	0	0	3
	MM 2031	Finite Element Methods				
	MM 2032	Concurrent Engineering				
	MM 2033	MEMS & Micro systems				
4	MM 204	<b>Program Elective – 4</b>	3	0	0	3
	MM 2041	Production and Operation Management				
	MM 2042	Advanced CNC Technologies				
	MM 2043	Supply Chain Management				
5	MM 205	Material Characterization Lab	0	0	4	2
6	MM 206	Simulation of Manufacturing Systems Lab	0	0	4	2
7	MM 207	Mini Project With Seminar	2	0	0	2
8	MM 208	Personality development through life Enlightenment skills	2	0	0	0
<b>Total</b>						<b>18</b>

\*Students are encouraged to go to industrial training/internship for at least 2-3 months during semester break.



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### III SEMESTER

S.No	Course Code	Course Name	T	P	Credits
1	MM 301	<b>Program Elective - 5</b>	3	0	3
	MM 3011	Surface Integrity Processes			
	MM 3012	Signal Analysis and Condition Monitoring			
	MM 3013	Industrial Robotics			
	MM 3014	MOOCS/ NPTEL *			
2	MM 302	<b>Open Elective</b>	3	0	3
	MM 3021	Nano Technology			
	MM 3022	Advanced Materials and Processing			
	MM 3023	Intelligent Manufacturing Systems			
3		<b>Project /Dissertation Phase-I</b>	0	20	10
<b>Total</b>					<b>16</b>

\*MOOCS/NPTEL Certification courses as per the approved list of internal BoS at the time of registration.

IV SEMESTER						
S.No	Course Code	Course Name	L	T	P	Credits
1		Project /Dissertation Phase-II	0	0	32	16
<b>Total</b>						<b>16</b>



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I Year I Semester	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

**UNIT – IV**

AUTOMATED ASSEMBLY SYSTEMS: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.

**UNIT – V**

QUALITY CONTROL AND SUPPORT SYSTEMS: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

**TEXT BOOK**

1.Automation, production systems and computer integrated manufacturing/ Mikell.P Groover/PHI/3rd edition/2012,

**REFERENCES**

1. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahmanyarn and Raju/New Age International Publishers/2003.
2. System Approach to Computer Integrated Design and Manufacturing/ Singh/John Wiley /96.
3. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang/ Pearson/ 2009
4. Manufacturing and Automation Technology / R Thomas Wright and Michael Berkeihiser / Good Heart/Willcox Publishers



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I Year I Semester	ADVANCED MANUFACTURING PROCESSES-I	L	T	P	C
		3	0	0	3

### UNIT – I

#### Advanced Mechanical Machining Processes

Introduction, Need for Advanced Machining process, Introduction, Need for Advanced Machining process, Characteristics of AMPs, Classification of Advanced Machining Processes, Process selection, Ultrasonic Machining(USM): Machining set up, Mechanics of cutting, Parameter Analysis, Process capabilities ,Applications, Abrasive jet Machining (AJM), Abrasive Water Jet Machining(AWJM)

### UNIT – II

#### Advanced Chemical and Thermal Machining Processes

Electrochemical Machining, Electrochemical Grinding, Electrochemical Honing ,Chemical Machining, Electric Discharge Machining, Wire-cut EDM, Electron Beam Machining, Laser Beam Machining.

### UNIT – III

#### Advanced Casting Processes

Solidification processing: principles of solidification, processing and applications of recent solidification techniques like infiltration techniques, rheocasting, squeeze casting, compocasting Metal mould casting: Low and High pressure, Continuous casting, Squeeze casting, Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting

### UNIT – IV

**Advanced Welding Processes** Details of electron beam welding (EBW), laser beam welding (LBW), Ultrasonic welding (USW), Pulsed TIG

### UNIT – V

#### Advanced Metal Forming Processes

Advances in Metal Forming: Conventional processes-High Energy Rate Forming techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming, super plastic forming, rubber forming , flow forming - Principles and process parameters Advantages -Limitations and Applications. Overview of powder metal forming technique-Advantages-applications-Powder perform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters. Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming



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**Text Book:**

1. Kalpakjian , S. and Schmid ,S R, “Manufacturing Engineering and Technology”, Pearson Publication, 5<sup>th</sup> Edition,.

**References:**

1. Benedict ,G.F., Dekker , M., “ Non-traditional Manufacturing Processes”, Inc. New York, CRC press, 1987
2. DeGarmo, E. P.,Black, J.T., Kohser, R.A., “Materials and Processes in Manufacturing”, Prentice Hall of India, 8<sup>th</sup> Edition
3. Jain, V.K, “Advanced Machining Processes”, Allied publisher, 2009.
4. Ghosh, A and Mallik, A.K, “Manufacturing Science” Affiliated East-West Press Pvt. Ltd., 2010
5. Fundamentals of Solidification by W.Kurtz and D.J.Fisher, Trans. Tech Publication.  
Rapidly Solidified Metals by T.R.Anantharaman and C.Suryanarayana, Trans. Tech Publications.

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I Year I Semester	DESIGN FOR MANUFACTURING AND ASSEMBLY (PROGRAM ELECTIVE-1)	L	T	P	C
		3	0	0	3

**UNIT – I**

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design, Typical DFMA Case Studies, Overall Impact of DFMA on Industry. Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

**UNIT - II**

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

**UNIT - III**

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting. Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

**UNIT - IV**

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld jointsdesign of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.



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**UNIT – V**

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

**TEXT BOOKS:**

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla

**REFERENCE:**

1. ASM Hand book Vol.20

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I Year I Semester	QUALITY ENGINEERING IN MANUFACTURING (PROGRAM ELECTIVE-1)	L	T	P	C
		3	0	0	3

**UNIT - I**

**QUALITY VALUE AND ENGINEERING:** An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratle 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:**

**TOLERANCE DESIGN AND TOLERANCING:** Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

**UNIT – III**

**DOE:** DOE process steps, Observation method, Ranking method, Column effects method and Plotting method.

**ANALYSIS OF VARIANCE (ANOVA):** Introduction to ANOVA, Need for ANOVA, NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

**UNIT - IV**

**ORTHOGONAL ARRAYS:** Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

**UNIT - V**

**SIX SIGMA AND THE TECHNICAL SYSTEM:** Six sigma DMAIC methodology, tools for process improvement, six sigma in services and small organizations, statistical foundations, statistical methodology.

**TEXT BOOK:**

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill/ Intl. II Edition, 1995.

**REFERENCES:**

1. Quality Engineering in Production systems by G. Taguchi, A. Elsayed et al, McGraw Hill Intl. Pub 1989.
2. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi / Prentice Hall Pvt. Ltd., New Delhi.



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I Year I Semester	TOTAL QUALITY MANAGEMENT (PROGRAM ELECTIVE-1)	L	T	P	C
		3	0	0	3

**UNIT – I:**

**INTRODUCTION:** The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

**UNIT – II:**

**CUSTOMER FOCUS AND SATISFACTION:** The importance of customer satisfaction and loyalty- Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

**UNIT – III:**

**ORGANIZING FOR TQM:** The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

**UNIT – IV:**

**THE COST OF QUALITY:** Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

**UNIT – V:**

**ISO9000:** Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

**TEXT BOOKS:**

1. Total Quality Management / Joel E.Ross/Taylor and Franscis Limited
2. Total Quality Management/P.N.Mukherjee/PHI

**REFERENCES:**

- 1 Beyond TQM / Robert L.Flood
- 2 Statistical Quality Control / E.L. Grant/ McGraw Hill.
- 3 Total Quality Management- A Practical Approach/H. Lal
- 4 Quality Management/Kanishka Bedi/Oxford University Press/2011
- 5 Total Engineering Quality Management/Sunil Sharma/Macmillan

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I Year I Semester	OPTIMIZATION AND RELIABILITY (PROGRAM ELECTIVE-2)	L	T	P	C
		3	0	0	3

**UNIT - I**

**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, merits and demerits of classical optimization techniques.

**UNIT - II**

**NUMERICAL METHODS FOR OPTIMIZATION:** Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.

**UNIT - III**

**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, random population generation, solving differential equations using GP.

**MULTI-OBJECTIVE GA:** Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems .

**UNIT – IV**

**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.



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**UNIT V**

**RELIABILITY:** Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis.

**TEXT BOOKS:**

1. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
2. Engineering Optimization – S.S.Rao, New Age Publishers
3. Reliability Engineering by L.S.Srinath
4. Multi objective genetic algorithm by Kalyanmoy Deb, PHI Publishers.

**REFERENCES:**

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers
3. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
4. An Introduction to Reliability and Maintainability Engineering by CE Ebeling, Waveland Printers Inc., 2009
5. Reliability Theory and Practice by I Bazovsky, Dover Publications, 2013

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I Year I Semester	MATERIALS TECHNOLOGY (PROGRAM ELECTIVE-2)	L	T	P	C
		3	0	0	3

### UNIT I

Elasticity in metals, mechanism of plastic deformation, slip and twinning, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, Yield criteria: Von-mises and Tresca criteria.

### UNIT II

Griffith's Theory, 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.

### UNIT III

Fatigue, fatigue limit, features of fatigue fracture, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis. Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep.

### UNIT IV

**MODERN METALLIC MATERIALS:** Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Inter metalics, Ni and Ti Aluminides. Processing and applications of Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

### UNIT V

**NONMETALLIC MATERIALS:** Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, CBN and Diamond – properties, Processing and applications.

### TEXT BOOKS:

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2 nd Edition/2000
2. Mechanical Metallurgy/George E. Dieter/McGraw Hill, 1998.

### REFERENCES:

- 1 Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
- 2 Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson
- 3 Material Science and Engineering/William D Callister/John Wiley and Sons
- 4 Plasticity and plastic deformation by Arizur.
- 5 Introduction to Ceramics, 2nd Edition by W. David Kingery, H. K. Bowen, Donald R. Uhlmann



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I Year I Semester	PRECISION ENGINEERING (PROGRAM ELECTIVE-2)	L	T	P	C
		3	0	0	3

**UNIT I:**

**CONCEPTS OF ACCURACY:** Introduction – Concept of Accuracy of Machine Tools – Spindle and Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity lags.

**UNIT II:**

**GEOMETRIC DIMENSIONING AND TOLERANCING:** Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datums – Datum Feature of Representation – Form controls, Orientation Controls – Logical Approach to Tolerancing.

**UNIT III:**

**DATUM SYSTEMS:** Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

**UNIT IV:**

**TOLERANCE ANALYSIS:** Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Surface finish, Review of relationship between attainable tolerance grades and different machining process, Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

**UNIT V:**

**TOLERANCE CHARTING TECHNIQUES:** Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples, Design features to facilitate machining; Datum Features – functional and manufacturing Components design – Machining Considerations, Redesign for manufactured, Examples.

**TEXT BOOKS:**

1. Precision Engineering in Manufacturing/Murthy R.L./New Age International (P) limited, 1996.
2. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker inc. 1995.

**REFERENCES:**

- 1 Engineering Design – A systematic Approach / Matousek / Blackie & Son Ltd., London
- 2 Precision Engineering/VC Venkatesh & S Izman/TMH



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I Year I Semester	ADVANCED CAD LAB	L	T	P	C
		0	0	4	2

1. Trussess – 2D and 3D
2. Beams
3. Plate with Plane stress condition
4. Plate with Plane strain condition
5. Cylinders – Axi-symmetric condition
6. Natural frequencies of Beam
7. 1D and 2D heat transfer problems

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I Year I Semester	ADVANCED MANUFACTURING LAB	L	T	P	C
		0	0	4	2

1. Casting processes - Study of Solidification, temperatures, metallurgical phases.
2. Forging processes - Study of hot working processes and extrusion
3. Forming Processes – Study of blanking, bending and deep drawing
4. Welding Processes – Study of arc, and spot welding processes
5. Powder metallurgy- Study of Green Density and sintering density
6. Additive Manufacturing – Study of simple parts in 3D printing
7. Machining- Estimation of chip reduction coefficient and shear angle in orthogonal turning, Measurement of cutting forces and average cutting temperature, and Estimation of tool life of a single point turning tool.



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I Year I Semester	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

**Unit 1**

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

**Unit 2**

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 3**

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 4**

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

**Unit 5**

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.



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**References:**

- (1) Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
- (2) Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- (3) Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- (4) Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- (5) Mayall, "Industrial Design", McGraw Hill, 1992.
- (6) Niebel, "Product Design", McGraw Hill, 1974.
- (7) Asimov, "Introduction to Design", Prentice Hall, 1962.
- (8) (8) Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
- (9) T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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I Year I Semester	WRITING SKILLS FOR SCIENTIFIC COMMUNICATION	L	T	P	C
		2	0	0	0

**Unit-1:**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness, Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising.

**Unit-2:**

Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**Unit-3:**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

**Unit-4:**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

**Unit-5:**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

**Suggested Studies:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
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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I Year II Semester	ADVANCED MANUFACTURING PROCESSES-II	L	T	P	C
		3	0	0	3

#### UNIT-I

##### POWDER METALLURGY:

Powder metallurgy processing: Metal and ceramic powder production, powder characterization, mixing techniques; Mechanical alloying and process variables; Various compaction techniques and the process variables; sintering and relevant theories, Mechanism of sintering and various sintering techniques, viz., solid state sintering, liquid phase sintering, reaction sintering, hot pressing, HIP and self propagating combustion sintering; Recent advances in powder metallurgy like spray and Deposition techniques.

#### UNIT-II

RAPID PROTOTYPING AND TOOLING: Geometrical modeling, Reverse engineering, Virtual / Augmented reality, DFX, RP Methods, Stereo lithography, Fused-deposition modeling, Selective laser sintering, Laminated-object manufacturing, Ballistic particle Manufacturing, Solid-base curing and Direct manufacturing and rapid tooling

#### UNIT-III

Fabrication of Micro-Devices Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication

#### UNIT-IV

NANO MATERIALS: Introduction to Nano phase Materials, effect of reduced size and dimension of materials, properties of nano structured materials, Processing of nano materials - Sol-gel, electro-deposition, plasma assisted deposition, Molecular beam epitaxy etc. Applications of Nanostructured Materials

#### UNIT-V

PROCESSING OF CERAMICS: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics.

PROCESSING OF COMPOSITES: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.



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**Reference Books:**

1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, M P Groover Wiley India.
2. Manufacturing Engineering and Technology, 4/e, Serope Kalpakjian, Steven R Schmid, Pearson Education.
3. Manufacturing Processes for Engineering Materials, 5/e, Serope Kalpakjian Pearson Education
4. Fundamentals of Microfabrication Mark Madou CRC Press
5. Modern Ceramic Engineering by D.W.Richardson, Marcel Dekker Inc..

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I Year II Semester	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

**UNIT I**

INTRODUCTION- Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control Introduction to CAD/CAM – CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In Time Production

**UNIT II****PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING**

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

**UNIT III****CELLULAR MANUFACTURING**

Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

**UNIT IV**

FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety



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**UNIT V**

**INDUSTRIAL ROBOTICS**

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

**TEXT BOOK:**

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

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I Year II Semester	FINITE ELEMENT METHODS (PROGRAM ELECTIVE-3)	L	T	P	C
		3	0	0	3

**UNIT - I**

**FORMULATION TECHNIQUES:** Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

**UNIT – II**

**ONE-DIMENSIONAL ELEMENTS:** Bar, trusses, beams and frames, displacements, stresses and temperature effects.

**UNIT – III**

**TWO DIMENSIONAL PROBLEMS:** CST, LST, four noded and eight noded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

**UNIT – IV**

**ISOPARAMETRIC FORMULATION:** Concepts, sub parametric, super parametric elements, numerical integration, Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle, Patch test.

**UNIT – V**

**FINITE ELEMENTS IN STRUCTURAL ANALYSIS:** Static and dynamic analysis, eigen value problems, and their solution methods, case studies using commercial finite element packages.

**TEXT BOOK :**

1. Finite element methods by Chandrabatla & Belagondur, PHI, 2011, 4<sup>th</sup> Edition

**REFERENCES:**

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 1994
2. Zienkiewicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill, 1983.
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
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I Year II Semester	CONCURRENT ENGINEERING (PROGRAM ELECTIVE-3)	L	T	P	C
		3	0	0	3

#### UNIT I

INTRODUCTION, Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development USE OF INFORMATION TECHNOLOGY IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design.

#### UNIT II

DESIGN STAGE Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design – Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

#### UNIT III

MANUFACTURING CONCEPTS AND ANALYSIS Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative, physical approach - An intelligent design for manufacturing system –

#### UNIT IV

JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing. PROJECT MANAGEMENT Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost

#### UNIT V

Concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development.

TEXT BOOKS: 1. Integrated Product Development / Anderson MM and Hein, L. Berlin, Springer, 1987.

2. Concurrent Engineering: Automation Tools and Technology / Andrew Kusaik, John Wiley.

REFERENCES: 1. Design for Concurrent Engineering / Cleetus, J, Concurrent Engg. Research Centre, Morgantown, WV, 1992.

2. Concurrent Engineering Fundamentals: Integrated Product Development/ Prasad, Prentice Hall, 1996.

3. Successful Implementation of Concurrent Product and Process / Sammy G Sinha, Wiley, John and Sons Inc., 1998.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
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I Year II Semester	MEMS & MICRO SYSTEMS (PROGRAM ELECTIVE- 3)	L	T	P	C
		3	0	0	3

**UNIT-I**

**OVERVIEW AND WORKING PRINCIPLES OF MEMS AND MICROSYSTEMS**

MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & Miniaturization, Applications of MEMS in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics.

**UNIT II:**

**ENGINEERING SCIENCE FOR MICROSYSTEMS DESIGN AND FABRICATION:**

Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Force, Doping of Semiconductors, The diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics

**UNIT III:**

**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

**UNIT IV:**

**THERMO FLUID ENGINEERING & MICROSYSTEMS DESIGN:**

Overview of Basics of Fluid Mechanics in Macro and Meso scales, 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, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a Micro pressure Sensor.

**UNIT V:**

**MATERIALS FOR MEMS & MICROSYSTEMS AND THEIR FABRICATION:**

Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, 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



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**TEXT BOOKS:**

1. MEMs & Microsystems: Design & Manufacture/ Tai-Ran Hsu/Tata Mc-Graw Hill., ed./2002
2. An Introduction to Micro electro mechanical Systems Engineering/ Maluf, M./ Artech House, Boston, 2000

**REFERENCES:**

- 1 Micro robots and Micromechanical Systems/ Trimmer, W.S.N/ Sensors & Actuators, vol19, no.1989.
- 2 Applied Partial Differential Equations/ Trim, D.W/ PWS-Kent Publishing/ Boston 1990.
- 3 Fundamentals of Microfabrication Madou, M/ CRC Press, Boca Raton, 1997.  
The Finite Element Method in Thermomechanics/ Hsu, T.R / Alien & Unwin, London

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I Year II Semester	PRODUCTION AND OPERATIONS MANAGEMENT (PROGRAM ELECTIVE-4)	L	T	P	C
		3	0	0	3

**UNIT -I**

**OPERATION MANAGEMENT:** Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management. Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

**UNIT – II**

**VALUE ENGINEERING:** objective – types of values – function & cost – product life cycle-steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method. Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout – line balancing.

**UNIT - III**

**AGGREGATE PLANNING:** definition – Different Strategies – Various models of Aggregate Planning.

Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP –Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

**UNIT - IV**

**PROJECT MANAGEMENT:** Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature.

**UNIT – V**

**SUPPLY CHAIN MANAGEMENT:** Concepts, process of SCM, selection of channel strategy, core operations capabilities, SCM decisions, SCM models.



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**TEXT BOOKS:**

1. Operations Management/ E.S. BuffA/ John Wiley & Sons / 2007
2. Production and Operations Management/ Chary/ Mc Graw Hill/2004

**REFERENCES:**

- 1 Operations Management Theory and Problems/ Joseph G. Monks / Macmillan / McGraw Hill / 3<sup>rd</sup> Edition.
- 2 Production and Operations Management - Theory and Practice by Dipak Kumar Battacharyya, Universities Press Pvt Ltd, 2012.
- 3 Production Systems Management/ James I. Riggs / John Wiley & Sons.
- 4 Operations Management/ Richard Chase/ Mc Graw Hill/2006
5. Production and Operation Management / Panner Selvam / PHI.
6. Production and Operation Analysis/ Nahima/ Mc Graw Hill/2004

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<b>I Year II Semester</b>	<b>ADVANCED CNC TECHNOLOGIES (PROGRAM ELECTIVE-4)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**UNIT I**

Features of NC Machines Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, Features of NC Machine Tools, design consideration of NC machine tool, methods of improving machine accuracy. Systems Drives and Devices: Hydraulic motors, DC motors, stepping motors and AC motors, feedback devices, encoders, Induction tachometers.

**UNIT II**

NC Part Programming: Manual programming-Basic concepts, Point to Point contour programming, canned cycles, parametric programming. Computer-Aided Programming: General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems.

**UNIT III**

Post Processors: Introduction to post processors, necessity of post processors, general structure of a post processor, functions of a post processor. Automatic tool path generation. Interpolators: DDA integrator, hardware interpolators for linear and circular interpolator, DDA software interpolators and CNC software interpolators, the reference pulse technique, sampled data technique.

**UNIT IV**

Tooling for CNC machines: Inter changeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC SYSTEMS AND Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, grinding.



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**UNIT V:**

Micro Controllers: Introduction, Hardware components, I/O pins, ports, external memory, counters, timers and serial data I/O interrupts. Selection of Micro Controllers, Embedded Controllers, Applications and Programming of Micro Controllers. Programmable Logic Controllers (PLC's): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

**Text Books:**

1. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill Int. 1983.
2. Machining Tools Hand Book Vol 3, (Automation & Control)/ Manfred Weck / John Wiley and Sons, 1984.

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I Year II Semester	SUPPLY CHAIN MANAGEMENT (PROGRAM ELECTIVE-4)	L	T	P	C
		3	0	0	3

**UNIT-I**

Strategic Framework: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope.

**UNIT-II**

Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

**UNIT-III**

Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

**UNIT-IV**

Forecasting in SC: Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.

**UNIT-V**

Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory. Coordination in SC: Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect.

**Text Books:**

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia, 2010.
2. David Simchi-Levi, Philip Kamintriy and Edith Simchy Levy, Designing and Managing the Supply Chain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill, 2000.





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I Year II Semester	MATERIAL CHARACTERIZATION LAB	L	T	P	C
		0	0	4	2

- (1) Microscopy: Different microscopy techniques, Resolution, Magnification, Depth of field Imaging – theory and concepts.
- (2) Optical Microscopy: Grain size estimation, Phase Percentage Estimation
- (3) Micro hardness evaluation of Ferrous and Non ferrous metals.
- (4) Testing of Tensile Properties of mild steel material
- (5) Fatigue Test
- (6) Testing of Flexural Strength on Ferrous metals.
- (7) Evaluation of Tribological properties of Ferrous and Non ferrous metals through Pin on Disc Tester.

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I Year II Semester	SIMULATION OF MANUFACTURING SYSTEMS LAB	L	T	P	C
		0	0	4	2

1. Casting processes - Simulation of Solidification, temperatures, Residual stresses, metallurgical phases etc.
2. Bulk Forming processes - Simulation of cold working and hot working processes for extrusion, drawing, rolling, etc.
3. Sheet Metal Forming Processes – Simulation of blanking, bending, deep drawing, etc.
4. Welding Processes – Simulation of arc, spot, laser welding, etc
5. Machining Processes- Simulation of Turning, Milling and Shaping operations.

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<b>I Year II Semester</b>	<b>MINI PROJECT WITH SEMINAR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

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I Year II Semester	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

### UNIT I

Introduction to Personality Development The concept of personality - Dimensions of personality – Theories of Freud & Erickson-Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis.

### UNIT II

Attitude & Motivation Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to demotivation

### UNIT III

Self-esteem Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low selfesteem - Symptoms - Personality having low self esteem - Positive and negative self esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviours - Lateral thinking.

### UNIT IV

Other Aspects of Personality Development Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics –Good manners and etiquette.

### UNIT V

Employability Quotient Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.

### Text Books:

1. Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
2. Stephen P. Robbins and Timothy A. Judge(2014), Organizational Behavior 16th Edition: Prentice Hall. Reference Books:
1. Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi.Tata McGraw-Hill 1988.
2. Heller, Robert.Effective leadership. Essential Manager series. Dk Publishing, 2002
3. Hindle, Tim. Reducing Stress. Essential Manager series. Dk Publishing, 2003
4. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001
5. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
6. Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005.

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II Year I Semester	SURFACE INTEGRITY PROCESS (PROGRAM ELECTIVE-5)	L	T	P	C
		3	0	0	3

**Unit-I**

Introduction to surface integrity (surface morphology and surface metallurgy)

Surface Roughness: Measurement of surface roughness, Surface roughness measurement instruments and its working principles, surface roughness symbol and its notations, Importance of surface roughness, Bearing area curve, 2-D and 3-D Surface roughness parameters, Contact and non-contact surface roughness measurement, Surface flatness measurement, Skewness and kurtosis

Surface metallurgy: Measurement of various elements in surface, Grain size and boundaries, Defects in surface, relation between surface metallurgy and residual stress.

**Unit-II**

Conventional surface engineering practice: Surface engineering by material removal: like etching, grinding, polishing, etc. Surface engineering by material addition: like hot dipping, Electro- plating, carburizing, Cyaniding, etc

Surface morphology and surface metallurgy in texturing processes : Sand blasting, laser texturing etc

**Unit-III**

Advanced surface engineering practices: Surface engineering by energy beams: Laser assisted microstructural modification like surface melting, hardening, shocking etc., Laser assisted compositional modification like surface alloying, surface cladding, composite surfacing etc

**Unit-IV**

Ion beam assisted microstructure and compositional modification, Surface engineering by spray techniques like Flame spray, cold spray etc., Sputter deposition of thin films & coatings, PVD coating processes, Chemical vapour deposition and PECVD

**Unit-V**

Characterization of coatings and surfaces: Measurement of coatings thickness, porosity & adhesion of surface coatings, Measurement of residual stress & stability, Surface microscopy, topography and Spectroscopic analysis of modified surfaces. Tribology of coating and its surface characterization

**References:**

1. Introduction to Surface Engineering by P. A. Dearnley,
2. Surface Engineering for Corrosion and Wear Resistance by J.R. Davis
3. Laser surface modification of alloys for corrosion and wear resistance by Chi Tat Kwok
4. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs, 1988.
5. Tadeusz Burakowski Tadeusz Wierzchon: "Surface Engineering of Metals: Principles, Equipment, Technologies", CRC, 1998
6. ASM Hand book – Surface Engineering



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II Year I Semester	SIGNAL ANALYSIS AND CONDITION MONITORING (PROGRAM ELECTIVE-5)	L	T	P	C
		3	0	0	3

### UNIT-I

Introduction, Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.

**Signal analysis:** Filter response time. Detectors. Recorders. Analog analyzer types.

### UNIT-II

**PRACTICAL ANALYSIS OF STATIONARY SIGNALS:** Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

### UNIT-III

**PRACTICAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS:**

Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

### UNIT-IV

**PRACTICAL ANALYSIS OF TRANSIENTS:** Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

### UNIT-V

**CONDITION MONITORING IN REAL SYSTEMS:** Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations, active, passive hybrid methods of condition monitoring

### TEST BOOK:

1. Condition Monitoring of Mechanical Systems / Kolacat.

### REFERENCES:

1. Frequency Analysis /R.B.Randall.
2. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
3. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP



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II Year I Semester	INDUSTRIAL ROBOTICS (PROGRAM ELECTIVE-5)	L	T	P	C
		3	0	0	3

#### UNIT - I

**INTRODUCTION:** Automation and Robotics, Robot anatomy, robot configuration, motions joint notation scheme, work volume, robot drive systems, control systems and dynamic performance, precision of movement.

**CONTROL SYSTEM AND COMPONENTS:** basic concepts and motion controllers, control system analysis, robot actuation and feedback components.

**SENSORS:** Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators, power transmission systems

#### UNIT - II

**MOTION ANALYSIS AND CONTROL:** Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller. Robot joint control design.

#### UNIT - III

**END EFFECTORS:** Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

**MACHINE VISION:** Functions, Sensing and Digitizing-imaging devices, Lighting techniques, Analog to digital single conversion, image storage: Image processing and Analysis-image data reduction, Segmentation, feature extraction, Object recognition. Training the vision system, Robotic application.

#### UNIT - IV

**ROBOT PROGRAMMING:** Lead through programming, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching, capabilities and Limitations of lead through methods.

**ROBOT LANGUAGES:** Textual robot Languages, Generations of robot programming languages, Robot language structures, Elements and function.

#### UNIT - V

**ROBOT CELL DESIGN AND CONTROL:** Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work cell controller.

**ROBOT APPLICATION:** Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.



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**TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.

**REFERENCES:**

- 1 Robotics / Fu K S/ McGraw Hill.
- 2 Robotic Engineering / Richard D. Klafter, Prentice Hall
- 3 Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
- 4 Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley
- 5 Introduction to Robotics by SK Saha, The McGrah Hill Company, 6<sup>th</sup>, 2012
- 6 Robotics and Control / Mittal R K & Nagrath I J / TMH

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA - 533 003, Andhra Pradesh, India**

II Year I Semester	NANO TECHNOLOGY (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

**UNIT-I**

Introduction, Size and shape dependence of material properties at the nanoscale, scaling relations, can nanorobots walk and nanoplanes fly, Nanoscale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nanomachines, Nanofluidics, filtration, sorting, Molecular motors, Application of Nano Technology.

**UNIT-II**

Nano material Synthesis Techniques: Top-down and bottom-up nanofabrication, Synthesis of nano composites, The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, nano coatings and nano indentation, Electron beam lithography, Soft lithography: nanoimprinting and microcontact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

**UNIT-III**

Imaging/characterization of nanostructures General considerations for imaging, Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM.

**UNIT-IV**

Metal and semiconductor nanoparticles Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nanoparticles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

**UNIT-V**

Carbon nano tubes: Structure and synthesis, Electronic, vibrational, and mechanical properties, How can C nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement?

**TEXT BOOKS:**

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).

**REFERENCES:**

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003)
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing (2006).



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II Year I Semester	ADVANCED MATERIALS PROCESSING (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

#### UNIT-I

Advanced materials: Shape memory alloys, smart materials, piezoelectric and piezo capacitance materials, nanomaterials, composites materials. Advantages and disadvantages of each type of material and their typical applications.

#### UNIT-II

Rapid prototyping and tooling: Geometrical modeling, Reverse engineering, Virtual / Augmented reality, DFX, RP Methods, Stereo lithography, Fused-deposition modeling, Selective laser sintering, Laminated-object manufacturing, Ballistic particle Manufacturing, Solid-base curing and Direct manufacturing and rapid tooling

#### UNIT-III

Fabrication of Micro-Devices Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication

#### UNIT-IV

Nano Materials: Introduction to Nano phase Materials, effect of reduced size and dimension of materials, properties of nano structured materials, Processing of nano materials - Sol-gel, electro-deposition, plasma assisted deposition, Molecular beam epitaxy etc. Applications of Nanostructured Materials

#### UNIT-V

Processing Of Ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics.

Processing Of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

#### Reference Books:

1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, M P Groover Wiley India.
2. Manufacturing Engineering and Technology, 4/e, Serope Kalpakjian, Steven R Schmid, Pearson Education.
3. Manufacturing Processes for Engineering Materials, 5/e, Serope Kalpakjian Pearson Education
4. Fundamentals of Microfabrication Mark Madou CRC Press
5. Modern Ceramic Engineering by D.W.Richardson, Marcel Dekker Inc.



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II Year I Semester	INTELLIGENT MANUFACTURING SYSTEMS (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

**UNIT I:**

**COMPUTER INTEGRATED MANUFACTURING SYSTEMS:** structure and functional areas of cim system- CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems - MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

**UNIT II:**

**COMPONENTS OF KNOWLEDGE BASED SYSTEMS** - Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Inference Engine, Knowledge Acquisition.

**UNIT III:**

**MACHINE LEARNING** - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

**UNIT IV:**

**AUTOMATED PROCESS PLANNING** - Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KBSES.

**UNIT V:**

**GROUP TECHNOLOGY:** Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation - Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBSCIT) — Data Base, Knowledge Base, Clustering Algorithm.

**TEXT BOOKS:**

1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007



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II Year I Semester	PROJECT/DISSERTATION PHASE-I	L	P	P	C
		0	0	20	10

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II Year II Semester	PROJECT/DISSERTATION PHASE-II	L	T	P	C
		0	0	32	16

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