DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS M.Tech ME for ADVANCED MANUFACTURING SYSTEMS PROGRAMME

(Applicable for batches admitted from 2025-2026)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

M. Tech - ADVANCED MANUFACTURING SYSTEMS

I SEMESTER

S.No	Course Title		L	T	P	C
1	Automation in Manufacturing		3	1	0	4
2	Advanced Manufacturing Processes		3	1	0	4
	AI&ML for Mechanical Engineering		3	1	0	4
3	AMS 1041	Design for Manufacturing & Assembly	3	0	0	3
	AMS 1042	Quality Engineering in Manufacturing				
	AMS 1043	Industrial Robotics				
	AMS 1044	Introduction to Quantum Technologies				
4	AMS 1051	Optimization & Reliability	3	0	0	3
	AMS 1052	Nano Technology				
	AMS 1053	Precision Engineering				
	AMS 1054	Additive Manufacturing				
5	Advanced CAD Lab		0	0	4	2
6	Advanced Manufacturing Lab		0	0	4	2
7	Seminar I		0	0	2	1
	Total		**15**	**5**	**6**	**23**

II SEMESTER

S. No	Course Title		L	T	P	C
1	Advanced Finite Element Methods		3	1	0	4
2	Computer Integrated Manufacturing		3	1	0	4
	Advanced CNC Technologies		3	1	0	4
3	AMS 2041	Smart Materials	3	0	0	3
	AMS 2042	Production and Operation Management				
	AMS 2043	MEMS: Design and Manufacturing				
	AMS 2044	Total Quality Management				
4	AMS 2051	Mechatronics	3	0	0	3
	AMS 2052	Theory of Plasticity				
	AMS 2053	Design and Analysis of Experiments				
	AMS 2054	Green Manufacturing				
5	Material Characterization Lab		0	1	2	2
6	Finite Element Simulation of Manufacturing Processes Lab		0	1	2	2
7	Seminar II		0	0	2	1
	Total		**15**	**5**	**6**	**23**

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III- SEMESTER

S. No	Course Title	L	T	P	C
1	Research Methodology and IPR/Swayam 12 Week MOOC Course RM&IPR	3	0	0	3
2	Summer Internship/Industrial Training (8-10 Weeks)	-	-	-	3
3	Comprehensive Viva	-	-	-	2
4	Dissertation Part - A	-	-	20	10
	TOTAL	3	-	20	18

IV –SEMESTER

S. No	Course Title	L	T	P	C
1	Dissertation Part - B	-	-	32	16
	TOTAL	-	-	32	16

I SEMESTER

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	AUTOMATION IN MANUFACTURING (Programme Core 1)	L	T	P	C
		3	1	0	4

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 noncontact, 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. Subrahamanyarn 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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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	ADVANCED MANUFACTURING PROCESSES (Programme Core 2)	L	T	P	C
		3	1	0	4

UNIT-I

SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT- II

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.

UNIT- III

FABRICATION OF MICROELECTRONIC DEVICES:

Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

UNIT - IV

ADVANCED MACHINING PROCESSES: EDM-, Wire EDM, ECM,

– Principle, working, mechanics of material removal, limitations and applications.

UNIT -V

ADVANCED MACHINING PROCESSES: LBM, EBM, AJM, WJM

– Principle, working, mechanics of material removal, limitations and applications.

TEXT BOOKS:

1. Manufacturing Engineering and Technology *I* Kalpakijian / Adisson Wesley, 1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.

REFERENCES:

1 Microelectronic packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostrand Renihold,
2 MEMS & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH
3 Advanced Machining Processes / V.K.Jain / Allied Publications.
4 Introduction to Manufacturing Processes / John A Schey *I* Mc Graw Hill.

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	AI & ML FOR MECHANICAL ENGINEERING (PROGRAMME CORE 3)	L	T	P	C
		3	1	0	4

Course objectives:

1) To impart the basic concepts of artificial intelligence and the principles of knowledge representation and reasoning.
2) To introduce the machine learning concepts and supervised learning methods
3) To enable the students gain knowledge in unsupervised learning method and Bayesian algorithms.
4) To make the students learn about neural networks and genetic algorithms.
5) To understand the machine learning analytics and applications of deep learning techniques to mechanical engineering.

UNIT– I:

Introduction: Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and Environments; Good Behaviour - concept of rationality, the nature of environments, structure of agents.

Introduction to Machine Learning (ML): Definition, Evolution, Need, applications of ML in industry and real-world, regression and classification problems, performance metrics, differences between supervised and unsupervised learning paradigms, bias, variance, overfitting and under fitting.

Supervised Learning: Linear regression, logistic regression, Distance-based methods, Nearest-Neighbours, Decision Trees, Support Vector Machines, Nonlinearity and Kernel Methods.

UNIT– II:

Unsupervised Learning: Clustering**,** K-means, Dimensionality Reduction, PCA and Kernel.

Bayesian and Computational Learning: Bayes theorem, concept learning, maximum likelihood of normal, binomial, exponential, and Poisson distributions, minimum description length principle, Naïve Bayes Classifier, Instance-based Learning- K-Nearest neighbour learning.

UNIT– III:

Neural Networks and Genetic Algorithms: Neural network representation, problems, perceptron, multilayer networks and backpropagation, steepest descent method, Convolutional neural networks and their applications, Local vs Global optima, Introduction to Genetic algorithms.

UNIT– IV:

Deep Learning: Recurrent Neural Networks and their applications, LSTM, Deep generative models, Deep auto-encoders, Applications of Deep Networks.

Machine Learning Algorithm Analytics: Evaluating Machine Learning algorithms, Model, Selection, Ensemble Methods - Boosting, Bagging, and Random Forests.

UNIT– V

Overview of Applications to Mechanical Engineering: Introduction to Machine learning packages, preparation of dataset for machine learning (cleansing and featuring)
Design of1D mechanical structures, Crack detection, fatigue life and creep estimation, Defect detection in casting and welding, Tool wear and Surface roughness prediction in CNC machining, Heat exchanger design optimization, fault classification.

TEXT BOOKS:

1) Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2) Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3) EthemAlpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.

REFERENCE BOOKS:

1) Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2) Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2012.

ONLINE RESOURCES:

https://www.tpointtech.com/artificial-intelligence-ai
https://www.geeksforgeeks.org/

Course outcomes: At the end of the course, student will be able to

CO1: Explain the basic concepts of artificial intelligence
CO2: Learn about the principles of supervised learning methods
CO3: Gain knowledge in unsupervised learning method and Bayesian algorithms
CO4: Get knowledge about neural networks and genetic algorithms.
CO5: Understand the machine learning analytics and apply deep learning techniques to mechanical engineering applications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	DESIGN FOR MANUFACTURING & ASSEMBLY (Program Elective – I)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the manufacturing constraints that influences the design of parts and part systems.
- To introduce the Design for Manufacturability (DFM) methodology.
- To understand infeasible or impractical designs.
- To know automatic assembly transfer system.
- To understand design of manual assembly.

COURSE OUTCOMES:

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

	Course Outcome	*BTL (K#)*
CO1	Explain the basic concepts of DFMA & their applications. Apply design rules to manual assembly.	K2
CO2	Apply design rules for ease of machining and understand the design recommendations for machined parts	K3
CO3	Enlist the selection, simulation, and design rules of casting processes. Also, to explain the design considerations for extruded sections and various forming processes.	K2
CO4	Explain the design considerations and effect of thermal stresses in welded joints and the design factors for forging.	K2
CO5	Describe the design considerations for automatic assembly and do quantitative analysis of assembly systems.	K1

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

Unit Description	*Contact Hrs.*
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.	**[10]**
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.	**[10]**
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 guidelines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking	**[10]**
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 joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.	**[10]**
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.	**[09]**

TEXTBOOKS:

1. Product Design for Manufacture and Assembly, Geoffrey Boothroyd , Peter Dewhurst, Winston A. Knight, CRC Press, Third Edition,2010.

2. Design for Manufacturability Handbook, James G. Bralla, The McGraw-Hill Companies, Inc. 2nd edition, 1999.
3. Assembly Automation and Product Design/ Geoffrey Boothroyd/ Marcel Dekker Inc., NY, 1992.
4. Engineering Design - Material & Processing Approach/ George E. Deiter/McGraw Hill Intl. 2nd Ed. 2000.
5. Hand Book of Product Design/ Geoffrey Boothroyd/ Marcel and Dekken, N.Y. 1990.

REFERENCE BOOKS:

1. ASM Hand book, ASM International, 1997.
2. A Text Book of PRODUCTION TECHNOLOGY (Manufacturing Processes), P. C. Sharma, S. Chand Publishing, 2007.

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	**QUALITY ENGINEERING IN MANUFACTURING (Program Elective – I)**	**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 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:

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

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 *I* Prentice Hall Pvt. Ltd., New Delhi

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	INDUSTRIAL ROBOTICS (Program Elective – I)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce Robotics and Automation including robot classification, design and selection, analysis and applications in industry.
- To provide information on various types of end effectors, their design, interfacing and selection.
- To provide the details of operations for a variety of sensory devices that are used on robot , the meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.
- To familiarize the basic concepts of transformations performed by robot, to perform kinematics to and to gain knowledge on programming of robots.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Figure out, demonstrate the terminologies related to robotics technology, hardware components and apply logic for selection of robotic sub systems and systems.	K2 &K3
CO2	Apply the spatial transformations to evaluate forward Kinematics, inverse kinematics and Jacobian for serial and parallel robots.	K3& K5
CO3	Demonstrate knowledge of end effectors, design considerations and the interpretation of data from data acquisition systems.	K2
CO4	Apply the fundamental knowledge of robot programming methods to write small programs for desired application.	K3
CO5	Apply and design robot cell layouts and analyse their applications in various fields.	K3 & K6

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***

K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

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Unit Description	*Contact Hrs.*
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	**[10]**
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.	**[10]**
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.	**[12]**
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.	**[09]**
UNIT – V: **Robot Cell Design and Control**: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Interlocks, Error detection, Work cell controller. **Robot Applications**: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.	**[07]**

Introduction to Drone Technologies and It's Applications.

TEXTBOOKS:

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

REFERENCE BOOKS:

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, TheMcGrah Hill Company, 6th, 2012.
6. Robotics and Control / Mittal R K &Nagrath I J / TMH.

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

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		L	T	P	C
I semester	**INTRODUCTION TO QUANTUM TECHNOLOGIES (Program Elective – I)**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
- To explore quantum computing and communication principles and technologies.
- To understand the physical implementation and limitations of quantum systems.
- To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
- To familiarize students with the emerging trends in quantum technologies.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Explain core principles of quantum mechanics and their technological implications.	K2
CO2	Analyze quantum phenomena like superposition and entanglement.	K4
CO3	Apply mathematical tools to model and solve quantum systems.	K3
CO4	Demonstrate understanding of quantum algorithms and quantum circuits.	K2 & K3
CO5	Evaluate potential applications and challenges in quantum communication and sensing.	K5

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description *Contact Hrs.*

UNIT – I:

Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrodinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions. **[10]**

UNIT – II:

Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; **[10]**

CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

UNIT – III:

Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, Introduction to quantum programming: Qiskit(overview) **[12]**

UNIT – IV:

Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise) **[09]**

UNIT – V:

Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era. **[07]**

TEXTBOOKS:

1. "Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang
2. "Quantum Mechanics: Concepts and Applications" by Nouredine Zettili

WEB REFERENCES:

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	OPTIMIZATION & RELIABILITY (Program Elective – II)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge on Micro-manufacturing and Scaling Laws.
- To train the students to gain the skill in Mechanical micromachining, Advanced micromachining processes and associated computer/laboratory work.
- To create the awareness on Metrology, Micro-machine tool system, machining essentials including part registration and micro-manufacturing case studies.

COURSE OUTCOMES:

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

	Course Outcome	*BTL (K#)*
CO1	Apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.	K3 & K4
CO2	Apply numerous numerical methods to solve the engineering problems for optimization.	K3
CO3	Apply GA and GP optimization methods to solve the differential equations and analyse the differences between GA and GP.	K3 & K4
CO4	Apply optimization techniques to design and manufacturing systems for the optimization of process parameters.	K3
CO5	Understand and apply major concepts of reliability in engineering design for analysing the statistical experiments leading to reliability modeling.	K3 & K4

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description *Contact Hrs.*

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 technique. **[10]**

UNIT – II: **[10]**

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. **[12]**

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. **[09]**

UNIT – V:

Reliability: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, and hazard analysis. **[07]**

TEXTBOOKS:

1. Optimization for Engineering Design – Kalyan Moy 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 Kalyan Moy Deb, PHI Publishers

REFERENCE BOOKS:

1. Genetic algorithms in Search, Optimization, and Machine learning – D. E. Goldberg, Addison-Wesley Publishers.
2. Multi objective Genetic algorithms - Kalyan Moy 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

WEB REFERENCES:

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ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	NANO TECHNOLOGY (Program Elective – II)	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, Nano scale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nanoelectromechanical systems, nano machines, Nano fluidics, 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 micro-contact 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 nano particles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

UNIT-V :

Carbon nanotubes 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).

	PRECESION ENGINEERING	L	T	P	C

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	**(Program Elective – II)**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- Understand accuracy and precision and learn how to test and improve machine tool alignment and part accuracy.
- Learn different precision manufacturing methods and surface finishing techniques.
- Understand various measurement tools and techniques used to check dimensions and surface quality.
- Learn the basics of nanotechnology and its applications in manufacturing tiny parts and materials.
- Understand how to use fits, tolerances, and geometric dimensioning to design and assemble parts correctly.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Evaluate the part and machine tool accuracies.	K5
CO2	Understand principles of ultra-precision machining, micro-manufacturing methods, and additive manufacturing	K2
CO3	Understand advanced metrology tools and techniques to measure and analyze components with high precision.	K2
CO4	Understand the principles and techniques of nanotechnology to develop and analyze nanoscale materials and devices for various applications	K2
CO5	Design and apply fits and tolerances using principles of dimensional chains for individual features for parts and assemblies according to ISO standards.	K3 & K6

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1:	***Remember***	**K2:**	***Understand***	**K3:**	***Apply***
K4:	***Analyse***	**K5:**	***Evaluate***	**K6:**	***Create***

Unit Description *Contact Hrs.*

UNIT – I:

Accuracy and Precision: Introduction - Accuracy and precision – Need – Application of precision machining- Alignment testing of machine tools, Accuracy of numerical control system, Accuracy specification of parts and assemblies. **[10]**

UNIT – II:

Precision Manufacturing: Micro machining processes-Diamond machining - Micro engraving - Micro replication techniques-Forming, Casting, Injection molding - Micro embossing. Methods of obtaining high quality surfaces, Lapping, Honing, Super finishing and Burnishing processes **[10]**

UNIT – III:

Precision Metrology- In situ measurement- In process measurement of position of processing Point-Post process and online measurement of dimensional features-Mechanical measuring systems- Optical Measuring Systems- Optical Interferometry, Laser Scanning, White Light Interferometry Confocal Microscopy, Electron beam measuring Systems-Scanning Tunnelling-Atomic Force Microscope and XRay Computed Tomography. Surface Metrology-Surface Roughness and Measurement. **[12]**

UNIT – IV:

Quality assurance Nano precision technology: Fundamentals of nanotechnology, Nano physical processing of atomic-bitunits Nano chemical and electrochemical atomic-bit processing. –Nano-Grating systems –Nano lithography, Electron beam lithography –Mirror grinding of ceramics, Focused Ion Beam (FIB) Milling, Atomic Layer Deposition (ALD), Nano processing of materials for super high-density ICs-Nano-mechanical parts, Nano machines-NEMS, Applications- Nanoelectronics, Nanocomposites and nano coatings **[09]**

UNIT – V:

Geometric Dimensioning and Tolerancing: Tolerance and fits, Hole and shaft basis system, Types of fits- Types of assemblies-probability of clearance and interference fits in transitional fits, Concept of dimensional chain or tolerance stack. Dimensioning of stepped shaft and holes assigning tolerances on the constituent dimensions. Tolerance zone conversions-surfaces, Datum - Datum feature of representation-form controls, Logical approach to tolerancing-datum systems, Geometrical tolerances. **[07]**

TEXTBOOKS:

1. Precision Engineering in Manufacturing, R.L.Murty, New Age International Publishers, 1996.
2. V.K. Jain, Advanced Machining Processes, 12th reprint, Allied Publishers Ltd, 2010.
3. James, D. and Meadow, S., “Geometric Dimensioning and Tolerancing”, Marcel Dekker Inc.,1995.

REFERENCE BOOKS:

1. V.Kovan, "Fundamentals of Process Engineering", Foreign Languages Publishing House, Moscow, 1975
2. J.L.Gadjala, "Dimensional control in Precision Manufacturing", McGraw Hill Publishers.
3. Norio Tanigichi “Nano Technology”, oxford university press, 2003.
4. Venkatesh, V.C. and Sudin, I., “Precision Engineering”, Tata McGraw Hill Co., NewDelhi, 2007.
5. Liangchi Zhang, “Precision Machining of Advanced Materials”, Trans Tech Publications Ltd., Switzerland, 1st Edition, 2001.
6. X. Jane Jiang, Paul J. Scott, “Advanced Metrology: Freeform Surfaces”, Academic Press Inc, April 2020.

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester	ADDITIVE MANUFACTURING (Program Elective – II)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide comprehensive knowledge of the wide range of additive manufacturing processes, capabilities and materials.
- To understand the software tools and techniques used for additive manufacturing.
- To create physical objects that facilitates product development/prototyping requirements

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Demonstrate a basic technical understanding of the physical principles, materials, and operation of the types of AM processes such as VAT Photo polymerization.	K2
CO2	Explain the working principles and analyse the process parameters of jetting and extrusion-based additive manufacturing processes.	K2& K4
CO3	Describe the laminated sheet based and powder based additive manufacturing processes and analyse the characteristic feature of the developed AM components.	K2 & K4
CO4	Identify appropriate sold-state additive manufacturing process for the desired application to generate metal AM components.	K3
CO5	Apply the key concepts of material science, and well-designed guidelines to analyse the effect of post processing operations of different AM processes.	K3 &K4

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description	*Contact Hrs.*

UNIT – I:

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM.

VAT Photo polymerization AM Processes: Stereo lithography (SL), Materials, Process Modelling, SL resin curing process, SL scan patterns, Micro-stereo lithography, Mask Projection Processes, Two-Photon vat photo polymerization, Process Benefits and Drawbacks, Applications of Vat Photo polymerization, case studies.

[10]

UNIT – II:

Material Jetting AM Processes: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes.

Binder Jetting AM Processes: Materials, Process Benefits and Drawbacks, Research achievements in printing deposition, technical challenges in printing, Applications of Binder Jetting Processes. **[10]**

Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes, case studies.

UNIT – III:

Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOMand UC applications, case studies.

Powder Bed Fusion AM Processes: Selective laser Sintering(SLS),Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, **[12]**

Electron Beam melting (EBM): Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes, case studies.

UNIT – IV:

Directed Energy Deposition AM Processes: Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. **[09]**

Friction stir additive manufacturing: process, parameters, advantages, limitations and applications, Additive friction stir deposition process: principle, parameters, applications, functionally graded additive manufacturing components, Case studies.

Wire Arc Additive Manufacturing: Process, parameters, applications, advantages and disadvantages, case studies.

UNIT – V:

Materials science for AM - Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, micro structural studies, Structure property relationship, case studies. **[07]**

Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for

use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques, case studies.

Guidelines for Process Selection: Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.

TEXTBOOKS:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.
2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua CheeKai, Leong Kah Fai, World Scientific, 2015, 4th Edition.

REFERENCE BOOKS:

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. VenuVinod and Weiyin Ma, Springer, 2004.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.
3. Rapid Prototyping: Principles and Applications in Manufacturing, RafiqNoorani, John Wiley & Sons, 2006.
4. Additive Manufacturing, Second Edition, Amit BandyopadhyaySusmita Bose, CRC Press Taylor & Francis Group, 2020.
5. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A. N. Junoop, McGraw Hill, 2021.

WEB REFERENCES:

- Phttps://www.nist.gov/additive-manufacturing
- https://www.metal-am.com/
- http://additivemanufacturing.com/basics/
- https://www.3dprintingindustry.com/
- https://www.thingiverse.com/
- https://reprap.org/wiki/RepRap

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

Students shall carry out the modeling of the following:

1. Product Modelling- Surface Modelling and Solid modelling
2. Assembly of different mechanical components
3. Disassembly of different mechanical components
4. Dimensional and Form Tolerances
5. Assembly tolerances
6. FE Analysis of 1Dstructural components
7. FE Analysis of 2D structural components
8. FE Analysis of 3D structural components

	ADVANCED MANUFACTURING LAB	L	T	P	C

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

I Semester		**0**	**0**	**4**	**2**

Students shall carry out the experiments on the following:

1. Fabrication of component through any metal Casting processes
2. Fabrication of component through any Forging processes
3. Fabrication of component through any Forming Processes –blanking, bending and deep drawing
4. Fabrication of a Weldment – arc, gas or spot-welding processes
5. Fabrication of component through Powder metallurgy- Calculation of Green Density and sintering density
6. Fabrication of component through Additive Manufacturing –simple parts in 3D printing
7. Metal removal using a Machining process - 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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

		L	T	P	C
I Semester	**SEMINAR - 1**	**0**	**0**	**2**	**1**

II SEMESTER

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	**ADVANCED FINITE ELEMENT METHODS (Programme Core 1)**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

- The course's goal is to familiarise students with the fundamentals of the Finite Element Technique, a numerical method for solving various practical and the method's fundamentals will eventually be covered before moving on to various areas of implementation.
- To present analytical approaches for structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Apply several kinds of computational methods to develop and evaluate the governing equations for various engineering problem	K3& K5
CO2	Develop, solve, and analyse problems involving one-dimensional axially loaded bars, trusses, and beam elements	K3 &K4
CO3	Apply the numerical methods of FEM to derive element matrices. Solve and analyse two dimensional CST, axi-symmetric problems subjected to various boundary conditions	K3 & K4
CO4	Apply and develop the solutions for the numerous engineering problems using the concepts of iso-parametric formulation and convergence techniques	K3
CO5	Evaluate various engineering problems subjected to dynamic and thermal conditions for optimum solutions	K5

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

	Unit Description	*Contact Hrs.*
UNIT – I:		**[10]**

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 Problems: Bar, trusses, beams and frames, displacements, stresses and temperature effects. **[09]**

UNIT – III:

Two Dimensional Problems: CST, Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. **[09]**

UNIT – IV:

Iso-Parametric Formulation: Concepts, sub-parametric, super parametric elements, numerical integration, LST, four-nodded and eight-nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. **Convergence**: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle, Patch test **[10]**

UNIT – V:

Dynamic Problems: Analysis, Eigen value problems, and their solution methods. **[10]**

Heat Transfer problems: Conduction and convection, examples: - One & two-dimensional fin. Introduction to non linear problems.

TEXTBOOKS:

1. Finite element methods by Chandrupatla&Belegundu.
2. Finite Element Analysis by P. Seshu, PHI learning private limited, New Delhi.

REFERENCE BOOKS:

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press,1994
2. Zienckiwicz O.C. and R. L. Taylor, Finite Element Method, McGraw-Hill,1983
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996
4. Concepts and applications of finite element analysis, R.D.Cook et al. Wiley

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	COMPUTER INTEGRATED MANUFACTURING (Programme Core 2)	L	T	P	C
		3	1	0	4

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

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	ADVANCED CNC TECHNOLOGIES (Programme Core 3)	L	T	P	C
		3	1	0	4

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, sample 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

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	SMART MATERIALS (Programme Elective III)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Knowing the behavior of Piezoelectric and magnetostrictive materials and their suitability as sensors in smart structures.
- Understanding the behavior of IPMC, Shape memory alloys and Rhelogical fluids and applied as Biometric sensors, as actuators in medical devices, aerospace and automotive industry, and as insulating membrane in bearings respectively.
- Studying about different sensors and their role in health monitoring systems.
- Develop different actuators for vibration control.
- Designing the smart systems using self sensing and self healing systems.

COURSE OUTCOMES:

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

	Course Outcome	*BTL (K#)*
CO1	Knowing the behavior of Piezoelectric and magnetostrictive materials and their suitability as sensors in smart structures.	K2
CO2	Understanding the behavior of IPMC, Shape memory alloys and Rhelogical fluids and applied as Biometric sensors, as actuators in medical devices, aerospace and automotive industry, and as insulating membrane in bearings respectively.	K2
CO3	Studying about different sensors and their role in health monitoring systems.	K2 & K4
CO4	Develop different actuators for vibration control.	K3 & K6
CO5	Designing the smart systems using self sensing and self healing systems	K6

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description *Contact Hrs.*

UNIT – I: **[10]**

Introduction: Introduction to Smart Materials, Principles of Piezoelectricty, PerovskytePiezoceramic Materials, Single Crystals vs Polycrystalline

Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto-resistance Effect.

UNIT – II:

Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids. **[10]**

UNIT – III:

Piezeoelctric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magnetostrictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors. **[12]**

UNIT – IV:

Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magnetovolume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control. **[09]**

UNIT – V:

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design. **[07]**

TEXTBOOKS:

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000
2. Functional and Smart materials by Z L Wang and Z C Kang, Plenium Press
3. Gauenzi, P., Smart Structures, Wiley, 2009

REFERENCE BOOKS:

1. Cady, W. G., Piezoelectricity, Dover Publication
2. Smart materials: Integrated design, Engineering approaches and potential applications,
3. AncaFilimon, Apple Academic Press

WEB REFERENCES:

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	PRODUCTION AND OPERATION MANAGEMENT (Programme Elective III)	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. MEMS

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 / 3rd 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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	MEMS: DESIGN AND MANUFACTURING (Programme Elective III)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- To design, analysis, fabrication and testing the MEMS based components.
- To find various opportunities in the emerging field of MEMS. about the application and utility of Mechatronics used in various sectors and fields.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Synthesize and characterize nanomaterials for engineering applications	K3 & K4
CO2	Design and analyze methods and tools for micro and nano manufacturing.	K2& K3
CO3	Improve the quality of MEMS by analyzing the variables of the underlying micro and nano manufacturing method.	K2
CO4	Apply the concepts of thermo fluid engineering.	K2 &K3
CO5	Select appropriate industrially-viable process, equipment and tools for a specific product.	K2

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description *Contact Hrs.*

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 **[10]**

UNIT – II:

Engineering Science for Microsystems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and **[10]**

Intermolecular Forces, 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, Thermomechanics, Fracture Mechanics, Thin-Film Mechanics, Overview of Finite Element Stress Analysis. **[12]**

UNIT – IV:

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

Materials for MEMS: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers and Applications **[09]**

UNIT – V:

Microsystems and their fabrication: Introduction to Micro systems Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process and Applications. **[07]**

TEXTBOOKS:

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

REFERENCE BOOKS:

1. An Introduction to Micro electro mechanical Systems Engineering by Maluf M., Artech House, Boston 2000
2. Micro robots and Micromechanical Systems by Trimmer, W.S.N., Sensors & Actuators, Vol 19, 1989.
3. Applied Partial Differential Equations by Trim, D.W., PWS-Kent Publishing, Boston, 1990.

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	TOTAL QUALITY MANAGEMENT (Programme Elective III)	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-Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system. (Add Latest cerfication process)

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	MECHATRONICS (Programme Elective IV)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the basic knowledge and importance on Mechatronics in Engineering Fields among the students.
- To create the awareness on Mechatronics in Research and Application area.
- To impart the knowledge about the application and utility of Mechatronics used in various sectors and fields.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Identification and demonstration of key elements of mechatronics system and its representation in terms of block diagram.	K2
CO2	Describe the use of solid-state electronic devices, diodes, amplifiers, etc. in designing the mechatronics systems and MEMS.	K2
CO3	Illustrate the applications of various hydraulic, pneumatic, mechanical, electrical actuating systems and valves in designing the mechatronic systems.	K3
CO4	Develop the PLC ladder programming for the creation of real-time mechatronic system.	K6
CO5	Develop dynamic models using system interfacing and data acquisition methods to design mechatronics systems for future applications.	K6

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description	*Contact Hrs.*
UNIT – I:	
Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.	**[10]**
UNIT – II:	

Solid state electronic devices, P-N junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications. **[10]**

UNIT – III:

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems, Mechanical actuating systems and electrical actuating systems. **[12]**

UNIT – IV:

Digital electronics and systems, digital logic control, microprocessors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control. **[09]**

UNIT – V:

System and interfacing and data acquisition, DAQS, SCADA, Analogue to Digital and Digital to Analogue conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends. **[07]**
Modeling and analysis of mechatronics systems (case studies)

TEXTBOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK VijayaRaghavan/WILEY India Edition/2008.
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

REFERENCE BOOKS:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3. Mechatronics System Design / Devdasshetty / Richard / Thomson.
4. Mechatronics / M.D. Singh / J.G. Joshi/PHI.
5. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton.
6. Mechatronics – Principles and Application Godfrey C. Onwubolu, Wlsevier, 2006 Indian print.

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	**THEORY OF PLASTICITY (Programme Elective IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Describe the elastic and plastic behaviour from stress-strain curves for materials;	
CO2	Recognize typical plastic yield criteria established in constitutive modelling	
CO3	Understand the physical interpretation of material constants in mathematical formulation of constitutive relationship	
CO4	solve analytically the simple boundary value problems with elasto-plastic properties	
CO5	Develop constitutive models based on experimental results on material behaviour	

UNIT	CONTENTS	**Contact Hours**
UNIT – 1	**Introduction:** Modeling Uniaxial behavior in plasticity. Index notation, Cartesian tensors. Yield and failure criteria Stress, stress deviator tensors. Invariants, principal, mean stresses, Elastic strain energy, Mohr's representation of stress in 2 & 3 dimensions, Haigh-Westergaard stress space, Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria. **Strain at point:** Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations	
UNIT – 2	**Principle of virtual work and its rate forms:** Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations. **Criteria for loading and unloading:** Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic–plastic materials. Expansion of a thick walled cylinder.	
UNIT – 3	**Incremental stress strain relationships:** Prandtl-Reuss material model. J_2 deformation theory, Drucker-Prager material, General Isotropic materials. **Deformation theory of plasticity:** Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.	

UNIT – 4	**Finite element formulation for an elastic plastic matrix:** Numerical algorithms for solving non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations	
UNIT – 5	**Bounding surface theory:** Uniaxial and multiaxial loading anisotropic material behavior **Theroms of limit analysis**: Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorems, examples and problems.	
	Total	

*Note:

TEXT BOOK:

1. Theory of Elasticity by S.P. Timoshenko & J.K Goodier, MGH

REFERENCES:

1. Plasticity for structural engineering W.F.Chen s and D.J.Han, Springer verlag-1987.
2. Mechanics of Materials –II, Victor E. Saouma.
3. Theory of plasticity, Sadhu Singh

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	DESIGN AND ANALYSIS OF EXPERIMENTS (Programme Elective IV)	L	T	P	C
		3	0	0	3

I. Learning Outcomes

After successful completion of the course students will be able to:

1. To acquaint with the role of statistics in different fields with special reference to agriculture.
2. Learn to apply the one of the design of experiment to agricultural fields.
3. Learn to apply the randomization to the blocks of various fields in agriculture.
4. To get the familiarity about applications of three principles.
5. Learn to deal the agricultural fields with different factors and levels.
6. To use appropriate experimental designs to analyze the experimental data.

II. Syllabus

Unit – 1: Analysis of variance (ANOVA)

Concept, Definition and assumptions. ANOVA one way classification – mathematical model, analysis – with equal and unequal classification. ANOVA two way classification – mathematical model, analysis and problems.

Unit – 2: Completely Randomised Design (CRD)

Definition, terminology, Principles of design of experiments, CRD – Concept, advantages and disadvantages, applications, Layout, Statistical analysis. Critical Differences when hypothesis is significant.

Unit – 3: Randomised Block Design (RBD)

Concept, advantages and disadvantages, applications, Layout, Statistical analysis and Critical Differences. Efficiency of RBD relative to CRD. RBD with one missing value and its analysis, problems.

Unit – 4: Latin Square Design

Concept, advantages and disadvantages, applications, Layout, Statistical analysis and Critical Differences. Efficiency of LSD over RBD and CRD. Estimation of one missing value in LSD and its analysis, problems.

Unit – 5: Factorial experiments

Main effects and interaction effects of 2^2 and 2^3 factorial experiments and their Statistical analysis. Yates procedure to find factorial effect totals.

Practical Syllabus

1. ANOVA - one - way classification with equal number of observations.

2. ANOVA - one - way classification with unequal number of observations.
3. ANOVA Two-way classification.
4. Analysis of CRD and critical differences.
5. Analysis of RBD and critical differences. Relative efficiency of CRD with RBD.
6. Estimation of single missing observation in RBD and its analysis.
7. Analysis of LSD and efficiency of LSD over CRD and RBD.
8. Estimation of single missing observation in LSD and its analysis.
9. Analysis of 2^2 with RBD layout.
10. Analysis of 2^3 with RBD layout.

Note: Training shall be on establishing formulae in Excel cells and derive the results. The excel output shall be exported to MS word for writing inference.

V. References

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand &Sons, New Delhi.
2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.
3. M. R. Saluja: Indian Official Statistics. ISI publications.

VI. Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	GREEN MANUFACTURING (Programme Elective IV)	L	T	P	C
		3	0	0	3

Unit – 1:

Introduction to Green Manufacturing

Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing. The Social, Business, and Policy Environment for Green Manufacturing: Introduction, The Social Environment—Present Atmosphere and Challenges for Green Manufacturing, The Business Environment: Present Atmosphere and Challenges, The Policy Environment—Present Atmosphere and Challenges for Green Manufacturing.

Unit – 2:

Metrics for Green Manufacturing

Introduction, Overview of Currently Used Metrics, Overview of LCA Methodologies, Metrics Development Methodologies, Outlook and Research Needs. Green Supply Chain: Motivation and Introduction, Definition, Issues in Green Supply Chains (GSC),Techniques/Methods of Green Supply Chain, Future of Green Supply Chain. Principles of Green Manufacturing: Introduction, Background, and Technology Wedge Principles Mapping Five Principles to Other Methods and Solutions.

Unit – 3:

Closed-Loop Production Systems

Life Cycle of Production Systems, Economic and Ecological Benefits of Closed Loop Systems, Machine Tools and Energy Consumption, LCA of Machine Tools, Process Parameter Optimization, Dry Machining and Minimum Quantity Lubrication, Remanufacturing, Reuse, Approaches for Sustainable Factory Design.

Unit – 4:

Environmental Implications of Nano-manufacturing

Introduction, Nano-manufacturing Technologies, Conventional Environmental Impact of Nano-manufacturing, Unconventional Environmental Impacts of Nano-manufacturing, Life Cycle Assessment (LCA) of Nanotechnologies. Green Manufacturing Through Clean Energy Supply: Introduction, Clean Energy Technologies, Application Potential of Clean Energy Supplying Green Manufacturing

Unit – 5:

Packaging and the Supply Chain

A Look at Transportation, Introduction, Background, Recommended Method to Determine Opportunities for Improved Pallet Utilization, Discussion.

Text Book:

1. David Dornfeld “Green Manufacturing Fundamentals and Applications”, Springer, 2013

Reference:

1. J. Paulo Davim “Green Manufacturing Processes and Systems” Springer-Verlag Berlin Heidelberg, 2013

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	MATERIAL CHARACTERIZATION LAB	L	T	P	C
		0	1	2	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. Testing of Compression Properties
6. Testing of Flexural Strength on Ferrous metals.
7. Die penetrant test
8. Magnetic particle Inspection
9. Evaluation of Tribological properties of Ferrous and Non ferrous metals through Pin on Disc Tester.
10. Study of XRD Analysis
11. Study of FESEM Images
12. Study of digital scanning calorimetry images

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	FINITE ELEMENT SIMULATION OF MANUFACTURING PROCESSES LAB	L	T	P	C
		0	0	4	2

Students shall carry out the modeling and FE analysis of the following:

1. Casting processes - Study of Solidification, temperatures, Residual stresses, metallurgical phases, defects, etc.
2. Forging processes - Study of cold working and hot working processes for extrusion, drawing, rolling, defects, etc.
3. Forming Processes – Study of blanking, bending, deep drawing, defects, etc.
4. Welding Processes – Study of arc, spot, laser welding, defects, etc.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

II Semester	SEMINAR - II	L	T	P	C
		0	0	2	1

SEMESTER – III

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

III Semester	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the knowledge on basics of research and its types.
- To impart the concept of Literature Review, Technical Reading, Attributions and Citations.
- To know the Ethics in Engineering Research.
- To know the concepts of Intellectual Property Rights in Engineering.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Explain the meaning of engineering research and apply to develop an appropriate framework for research studies.	K2& K3
CO2	Identify the procedure of Literature Review, Technical Reading, etc. and apply to develop a research design during their project work.	K2 & K3
CO3	Explain and apply the fundamentals of patent laws and drafting procedure in their research works.	K2& K3
CO4	Demonstrate the copyright laws, subject matters of copyrights, designs etc. to apply in patent filing.	K2 & K3
CO5	Identify the new developments in IPR and employ the applications of computer software in writing/filing patents in future.	K2 & K3

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description *Contact Hrs.*

UNIT – I: **[10]**

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: **[10]**

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: **[10]**

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: **[10]**

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

UNIT – V: **[09]**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.

TEXTBOOKS:

1. C.R. Kothari , 2nd Edition, “Research Methodology: Methods and Techniques”.
2. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step-by-Step Guide for beginners”

REFERENCE BOOKS:

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. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
4. Mayall, “Industrial Design”, McGraw Hill, 1992.
5. Niebel, “Product Design”, McGraw Hill, 1974.
6. Asimov, “Introduction to Design”, Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
8. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

III Semester	SUMMER INTERNSHIP	L	T	P	C
		0	0	0	3

COURSE OBJECTIVES:

- Internships provide students with an opportunity to put into practice skills they have learned while in college.
- In addition, students should have an opportunity to enhance those skills, obtain the perspective of a work environment and benefit from a mentor or supervisor's experience and advice.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Integrate theory and practice to assess interests and abilities in their field of study.	K3 & K4
CO2	Develop work habits, attitudes necessary to appreciate work and its function in the economy.	K3
CO3	Develop communication, interpersonal and other critical skills to build a record of work experience.	K3

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***

K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

III Semester	**COMPREHENSIVE VIVA**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**2**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

III Semester	DISSERTATION PART A	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- To impart fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
- To familiarise how to incorporate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
- Expose to the critical aspects like identifying, analysing and solving problems creatively through sustained critical investigation using effective oral, written and visual communications.
- To inculcate the key aspects like awareness and application of appropriate personal, societal and professional ethical standards to excellence needed to engage in lifelong learning.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Carryout a critical review of literature on a chosen topic of research and identify gaps in the literature to define a problem for research work.	K3 & K4
CO2	Formulate/adapt a clear methodology using multi-disciplinary approach and modern tools.	K3& K6

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***

K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

SEMESTER – IV

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

R25 M.TECH MECHANICAL ENGINEERING

ADVANCED MANUFACTURING SYSTEMS SYLLABUS

IV Semester	DISSERTATION PART B	L	T	P	C
		0	0	32	16

COURSE OBJECTIVES:

- To impart fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
- To familiarise how to incorporate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
- Expose to the critical aspects like identifying, analysing and solving problems creatively through sustained critical investigation using effective oral, written and visual communications.
- To inculcate the key aspects like awareness and application of appropriate personal, societal and professional ethical standardsto excellence needed to engage in lifelong learning.

COURSE OUTCOMES:

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

	Course Outcome	***BTL (K#)***
CO1	Carryout design/analysis of a product/system or devise experiments to study and develop a system/process/product.	K3 & K4
CO2	Interpret & validate results of analysis/experiments conducted to study behaviour of a product /system/ process considered for the research leading to valid conclusions that add value to the body of knowledge.	K3 & K5
CO3	Write and present a technical report of the project work.	K6

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***