Vision of the Institution

To ignite the minds of the students through academic excellence so as to bring about social transformation and prosperity.

Mission of the Institution

- To expand the frontiers of knowledge through Quality Education.
- To provide valued added Research and Development.
- To embody a spirit of excellence in Teaching, Creativity, Scholarship and Outreach.
- To provide a platform for synergy of Academy, Industry and Community.
- To inculcate high standards of Ethical and Professional Behavior.

Vision of Mechanical Engineering Department

To foster prosperity through technological development by means of education, innovation and collaborative research.

Mission of Mechanical Engineering Department

- To produce effective and responsible graduate and post-graduate engineers for global requirements by imparting quality education.
- To improve the Department's infrastructure to facilitate research productivity and success.
- To integrate teaching and research for preservation and effective application of knowledge and skills.
- To strengthen and expand collaboration and partnerships with industry and other organizations.
- To provide consultancy to the neighborhood and inculcate a spirit of entrepreneurship.
- To serve society through innovation and excellence in teaching and research.

Program Educational Objectives(PEOs)

PEO1: Graduates apply a deep working knowledge of technical fundamentals in areas such as Design, Thermal, Production, Industrial and related fields to address needs of the customer and society.

PEO2: Graduates pursue advanced education, Research and Development in Engineering, Technology and other professional careers.

PEO3: Perform themselves in a responsible, professional and ethical manner.

PEO4: Graduates participate as leaders in their fields of specialization and in activities that contribute to service and overall economic development of society.

Program Outcomes(POs) of Mechanical Engineering Department

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's):

PSO1: Able to apply the knowledge learned as a part of the curriculum to provide solutions for problems related to Mechanical Engineering.

PS**O**2: Think innovatively, design and develop products with modern CAD/CAM tools and with optimized manufacturing processes.

VISHNU INSTITUTE OF TECHNOLOGY::BHIMAVARAM
(AUTONOMOUS)

Department of Mechanical Engineering

Course Structure

M.Tech (Advanced Manufacturing Systems)

I Semester

S.No.	Subject	L	P	C
1	Automation in Manufacturing	3	--	3
2	Special Manufacturing Processes	3	--	3
3	**ProgrammeElective I** IndustrialRobotics Intelligent Manufacturing Systems Total QualityManagement	3	--	3
4	**ProgrammeElective II** AdvancedCAD Mechatronics PrecisionEngineering	3	--	3
5	Research Methodology	2	--	2
6	Advanced CAD/CAM Lab	--	4	2
7	Robotics Lab	--	4	2
8	English for Research Paper Writing	2	--	0
	Total	16	8	**18**

II Semester

S.No.	Subject	L	P	C
1	Modeling and Simulation of Manufacturing Systems	3	--	3
2	ProductDesign	3	--	3
3	**ProgrammeElective III** Finite Element Methods Concurrent Engineering Design and Manufacturing of MEMS and Microsystems	3	--	3
4	**ProgrammeElective IV** Production and Operations Management Materials Technology Computational Fluid Dynamics	3	--	3
5	Manufacturing Simulation and Precision Engg. Lab	--	4	2
6	Product Design Lab	--	4	2
7	Pedagogy Studies	2	--	0
8	Mini Project	--	4	2
	Total	14	12	**18**

III Semester

S.No.	Subject	L	P	C
1	**Programme Elective V** Advances in CNC Technologies Design for Manufacturing and Assembly Advanced Materials	3	--	3
2	**Open Elective** Quality Engineering in Manufacturing ReliabilityEngineering Design of Experiments	3	--	3
3	Dissertation Phase – I	--	20	10
	Total	6	20	**16**

IV Semester

S.No.	Subject	L	P	C
1	Dissertation Phase – II	--	32	16
	Total	--	32	**16**

I Semester

	AUTOMATION IN MANUFACTURING	L	P	C
		3	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.PGroover/PHI/3rd edition/2012,

REFERENCES:

1. CAD/CAM/CIM/ P. Radha Krishnan & S. Subrahamanian 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/WillcoxPublishers

I Semester

	SPECIAL MANUFACTURINGPROCESSES	L	P	C
		3	0	3

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: Characteristics of Ceramics, classification, Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, finishing of ceramics, Applications.

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 microelectronics, surface mount technology, Integrated circuit economics.

UNIT - IV

ADVANCED MACHINING PROCESSES: AJM, EBM, ECM, EDM, Wire EDM, LBM, USM, WJM – Working Principle, Equipment, Material Removal Rate, Process Parameters, Advantages, Limitations and Applications.

UNIT -V

RAPID PROTOTYPING: Introduction, Methods - Stereo Lithography, Selective Laser Sintering, Fused Deposition Method, Laminated Object Manufacturing - Working Principles, Applications, Advantages and Limitations

TEXT BOOKS:

1. Manufacturing Engineering and Technology *I* Kalpakijian / Adisson Wesley,1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI1990.

REFERENCES:

1. Microelectronic packaging handbook / Rao. R. Thummala and Eugene,J. Rymaszewski / Van NostrandRenihold.
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*McGrawHill.

I Semester

	INDUSTRIAL ROBOTICS (PROGRAMME ELECTIVE – I)	L	P	C
		3	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, Positions sensors, velocity sensors, actuators, power transmission systems, robot joint control design.

UNIT – II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations. Trajectory Planning: Joint interpolation, task space interpolation, executing user specified tasks.

END EFFECTORS: Grippers-types, operation, mechanism, force analysis for various basic gripper systems including Mechanical, Hydraulic and Pneumatic systems.

UNIT – III

SENSORS: Sensor devices, Types of sensors - contact, position and displacement sensors, force and torque sensors - Proximity and range sensors - acoustic sensors.

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.

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: DESGIN 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.

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

I Semester

	INTELLIGENT MANUFACTURING SYSTEMS (PROGRAMME ELECTIVE – I)	L	P	C
		3	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, Interference 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, Modelling the Manufacturing Equipment Selection Problem, Problem Solving approaches in KBSES, Structure of the KRSES.

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/ YagnaNarayana/PHI/2006
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007

I Semester

	TOTAL QUALITY MANAGEMENT (PROGRAMME ELECTIVE – I)	L	P	C
		3	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 thesystem.

TEXT BOOKS:

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

REFERENCES:

1 Beyond TQM / RobertL.Flood
2 Statistical Quality Control / E.L. Grant / McGrawHill.
3 Total Quality Management- A Practical Approach/H. Lal
4 Quality Management/KanishkaBedi/Oxford UniversityPress/2011
5 Total Engineering Quality Management/SunilSharma/Macmillan

I Semester

	ADVANCED CAD (PROGRAMME ELECTIVE – II)	L	P	C
		3	0	3

UNIT- I:
PRINCIPLES OF COMPUTER GRAPHICS : Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of characters.

UNIT- II:
CAD TOOLS: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.
GEOMETRICMODELLING: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves.

UNIT- III:
SURFACE MODELING: Mathematical representation surfaces, Surface model, Surface entities surface representation, parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

UNIT- IV:
PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES: HermiteBicubic surface, **Bezier** surface, **B-** Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation — Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D)

UNIT-V:
GEOMETRICMODELLING-3D: Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG). **CAD/CAM Exchange**: Evaluation of data - exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.
Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems.

TEXT BOOKS:
1. Mastering CAD/CAM / IbrhimZeid / McGraw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition

REFERENCES:
1. CAD/CAM /Groover M.P./ Pearson education
2. CAD/CAM Concepts and Applications/ Alavala/ PHI
3. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
4. Principles of Computer Aided Design and Manufacturing/ FaridAmirouche/ Pearson

I Semester

	MECHATRONICS (PROGRAMME ELECTIVE – II)	L	P	C
		3	0	3

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 lightsensors.

UNIT-II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC.Analog signal conditioning, amplifiers, filtering.Introduction to MEMS & typical applications.

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.

UNIT-IV

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

TEXT BOOKS:

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

REFERENCES:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / AnuradhaAgenciesPublishers.
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

I Semester

	PRECISION ENGINEERING (PROGRAMME ELECTIVE – II)	L	P	C
		3	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:

GEOMETIC DEIMENSIONING 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

I Semester

	RESEARCH METHODOLOGY	L	P	C
		2	0	2

UNIT-I: RESEARCH FOUNDATION: Motivation and objectives – Research methods, Methodology. Types of research, Defining and formulating the research problem, Hypothesis – Qualities of a good Hypothesis, Hypothesis Testing – Logic & Importance

UNIT-II: LITERATURE REVIEW: primary and secondary sources, Effective literature studies approaches, analysis, identifying gap areas from literature and research database.

UNIT III: DATA COLLECTION AND ANALYSIS: Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT IV: RESEARCH ETHICS: Plagiarism, Research ethics, IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, reproducibility and accountability.

UNIT V: INTERPRETATION AND REPORT WRITING: Significance of Report Writing, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal,Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

REFERENCES:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
2. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing.
3. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
4. Stuart Melville and Wayne Goddard, 1996. Research methodology: an introduction for science & engineering students, Kenwyn, South Africa : Juta& Co. Ltd.,
5. T. Ramappa, 2008, Intellectual Property Rights Under WTO, S. Chand.

ADDITIONAL READING:

1. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Wayne Goddard and Stuart Melville, ‒Research Methodology: An Introduction‖
6. Ranjit Kumar, 2 nd Edition, ‒Research Methodology: A Step by Step Guide for beginners‖

I Semester

	ADVANCED CAD/CAM LAB	L	P	C
		0	4	2

1. Features and selection of CNC turning and millingcenters.
2. Practice in part programming and operation of CNC turning machines, subroutine techniques and use ofcycles
3. Practice in part programming and operating a machining center, tool panning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming.
4. Practice in Robot programming and its languages.
5. Robotic simulation using software.
6. Robo path control, preparation of various reports and route sheets,Simulation of manufacturing system using CAM software, controller operating systemcommands.

I Semester

	ROBOTICS LAB	L	P	C
		0	4	2

1. Introduction to robot programming
2. Determination of maximum and minimum position of links.
3. Verification of transformation (position and orientation) with respect to gripper and world coordinate system
4. Robot programming and simulation for pick and placing the object using manual mode
5. Pick and placing the object programming mode
6. Pick and placing objects using sub routines
7. Robot programming and simulation for machining
8. Introduction to robot studio
9. Creating paths using virtual flex pendant in robot studio
10. Pick and place objects in manual mode in robot studio

I Semester

	ENGLISH FOR RESEARCH PAPER WRITING	L	P	C
		2	0	0

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability

2. Learn about what to write in each section

3. Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission

UNI-I: Planning and Preparation, Word Order, Breaking up longsentences, Structuring Paragraphs and Sentences, Being Conciseand Removing Redundancy, Avoiding Ambiguity and Vagueness

UNI-II: Clarifying Who Did What, Highlighting Your Findings, Hedgingand Criticising, Paraphrasing and Plagiarism, Sections of a Paper,Abstracts. Introduction

UNI-III: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNI-IV: 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,

UNI-V: 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

UNI-VI: 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