JIS College of Engineering

Department: Mechanical Engineering
Specialization: M. Tech. in Mechanical Engineering

Semester - I							
Sl. No	**Course Type**	**Course Code**	**Course Name**	**Teaching Scheme**			**Credits**
				L	**T**	**P**	
1	Core- I	MME101	Design of Machine Tools & Metal Cutting	3	-	-	3
2	Core- I	MME102	Generative Manufacturing Process	3	-	-	3
3	PE-I	MME103	1. Advanced Engineering Mathematics 2. Engineering Management 3. Total Quality Management	3	-	-	3
4	PE-II	MME104	1. Advanced Material Science 2. Reliability Engineering & Failure Statistics 3. Industrial Safety	3	-	-	3
5	Core	MME191	Advanced Machining lab	-	-	4	2
6	Core	MME192	Generative Manufacturing Lab	-	-	4	2
7	MLC*	MLC101	Research Methodology and IPR	2	-	-	2
8	Audit	MC101	Audit course – 1 1. **MC101A**- Stress Management by Yoga 2. **MC101B**-Pedagogy Studies 3. **MC101C**-Constitution of India 4. **MC101D**-Personality Development through Life Enlightenment Skills	2	-	-	0
			Total	**16**	**-**	**8**	**18**

*MLC – Mandatory Learning Course

Semester - II							
Sl. No	**Course Type**	**Course Code**	**Course Name**	**Teaching Scheme**			**Credits**
				L	**T**	**P**	
1	Core-III	MME201	Advanced Manufacturing Systems	3	-	-	3
2	Core-IV	MME202	Concurrent/Simultaneous Engineering	3	-	-	3
3	PE-III	MME203	A. Advanced Mechatronics Systems B. Mechanical Vibrations C. Finite Element Method and its Applications	3	-	-	3
4	PE-IV	MME204	a. Robotics & Automation b. Operations Research c. Manufacturing Support Systems	3	-	-	3
5	Core	MME291	Advanced manufacturing lab-I	-	-	4	2
6	Core	MME292	Advanced Control lab-II	-	-	4	2
7	Core	MME281	Mini Project and Seminar	-	-	4	2

8	Audit	MC201	Audit course – 2 1. **MC201A**-English for Research Paper Writing 2. **MC201B**- Disaster Management 3. **MC201C**-Sanskrit for Technical Knowledge 4. **MC201D**-Value Education	2	-	-	0
			Total	**14**	**-**	**12**	**18**

Semester - III							
Sl. No	**Course Type**	**Course Code**	**Course Name**	**Teaching Scheme**			**Credits**
				L	**T**	**P**	
1	PE- V	MME301	1. Reverse Engineering 2. Supply Chain Management 3. Project management	3	-	-	3
2	OE	MME302	1. Tribology and Terrotechnology 2. Cryogenic Engineering 3. NanoTechnology and Nano-Materials	3	-	-	3
3	Dissertation	MME381	Dissertation Phase - I	-	-	20	10
			Total	**6**	**-**	**20**	**16**

Semester - IV							
Sl. No	**Course Type**	**Course Code**	**Course Name**	**Teaching Scheme**			**Credits**
				L	**T**	**P**	
1	Dissertation	MME 481	Dissertation Phase - II	-	-	32	16
			Total	**-**	**-**	**32**	**16**

Total Credits for the Program = 18 + 18 +16 +16 = 68

Audit course Sem-1
1. **MC101A**- Stress Management by Yoga
2. **MC101B**-Pedagogy Studies
3. **MC101C**-Constitution of India
4. **MC101D**-Personality Development through Life Enlightenment Skills

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Audit course Sem-2
1. **MC201A**-English for Research Paper Writing
2. **MC201B**- Disaster Management
3. **MC201C**-Sanskrit for Technical Knowledge
4. **MC201D**-Value Education

M. Tech. in Mechanical Engineering
DETAILED SYLLABUS

Semester – I

Course Name: Design of Machine Tools & Metal Cutting
Course code: MME 101
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand the concepts of tool life, machinability, wear, influence of heat.
CO2. Design the jigs and fixtures required for machine tools.
CO3. Analyze Speed, feed, depth of cut and their influence on surface roughness,
CO4. Crate a numerical model of Metal removal rate, tool wear rate, machining time, energy, work done and heat distribution.

Course Contents:

Design of Machine Tools:	
Strength & Rigidity of Machine Tools Structures.	4L
Analysis of Bearings, Slides & Guides.	3L
Machine Tools Vibration.	4L
Control Systems of Advanced (non-traditional) Machine Tools.	3L

Theory of Metal Cutting:
Deformation of Metals, Mechanism of Chip formation,
Interrelationships of Tool Angles including concept of 'Master Line' Mechanism of Metal Cutting, Mechanics of Metal Cutting, Tool Failures, Newer Tool Materials, Surface Integrity, Economics of Machining, Fundamental aspects of Cutting Tool Design 16L

Text books:
1. Principles of Machine Tools by A. Bhattacharya and G. Sen, Central Book Agency, Kolkata.
2. Machine Tool, Vol - I, II, III, IV by Acharkan, Mir Publishers.
3. M/C Tool & Metal Cutting is Dr. Amitabha Bhattacharyya's Book & Dr. A.B. Chattopadhyay's

Reference Books:
1. Fundamentals of Metal Cutting Machine Tools by G.Boothroyd, TMH.
2. Production Technology, HMT Publication, TMH.
3. Metal Cutting Theory & Practice by A.Bhattacharya, Central Book Publisher, Calcutta
4. Manufacturing Science by A.Ghosh and A.K.Mallik, Wiley Eastern.
5. Manufacturing Process by Maslov, Mir Publishers.
6.Principal of Machine Tool by G. Sen & A. B. Chattopadhyaty, New Central Book Agency

Course Name: Generative Manufacturing Process
Course code: MME 102
Credit: 3-0-0 (3 credits)
Course outcomes: After completing the course, students will be able to:
CO1. Understand and posses the knowledge of different advanced manufacturing technique
CO2. Identify different micro-machining processes and devices used for AMT
CO3. Understand about powder metallurgy and surface coating
CO4. Identify rapid prototyping and types of generative manufacturing processes

Course Contents:
Concept of Present GMP (Generative Manufacturing Process). 2L
Comparative study on Additive & Subtractive Manufacturing Process, transformation from primary to advanced Manufacturing Process, Three Categories of Processing like Shaping, solidification processes, particulate processing, deformation and material removal. 8L
Property Enhancing and Surface Processing Operations (shot peening & Sand blasting, diffusion & ion implantation) 4L
Powder Metallurgy: process, different methods of producing powders, different techniques to form the shape viz. pressing, extruding, sintering, and hot pressing, advantages, disadvantages. 4L
Surface coating & thin film deposition by Electroplating, Anodizing, Physical Vapour Deposition (PVD) & Chemical Vapour Deposition (CVD). 6L
Rapid Tooling: Techniques and procedures; Economics of Rapid Prototype and Rapid Tooling. 3L
Future GMP and Ultimate GMP. 3L

Text Books:
1. Text Book for GMP (Generative Manufacturing Process) by M.P. Groover

Reference Books:
1. Rapid Prototyping - A Brief Introduction by Amitabha Ghosh, East West Publishers

Course Name: Advanced Engineering Mathematics
Course code: MME 103A
Credit: 3-0-0 (3 credits)
Course outcomes: After completing the course, students will be able to:
CO1. Understand the basic notions of Graph Theory and Fuzzy Set.
CO2. Identify the operations for eigenvalues and eigenvectors and their interpretations.
CO3. Apply the algorithms for finding out shortest path, spanning tree of a graph.
CO4. Analyze the results derived by applying linear transformations.

Course contents:
1. Graph Theory: Graph, directed graphs, walk, path, circuits, connected graphs, components, operation on graphs, isomorphism of graphs, trees, some important properties of trees, binary trees, spanning trees, cut set, cut vertices, fundamental cut set, fundamental circuits, matrix representation of graphs, shortest path algorithm, spanning tree algorithm. 14L

2. Linear Algebra: Matrices, elementary operations, rank, eigenvalues and eigenvectors, solution of linear equations, vector space, subspace, linear dependence and independence, basis and dimension, linear mapping , linear operator, applications. 14L

3. Fuzzy Theory: Introduction to Fuzzy set theory, Fuzzy relation and Fuzzy graph with simple applications. 8L

Text Books:

1.Hoffman K and Kunze R – Linear Algebra, PHI
2. Golub G H and Van Loan C F – Matrix Computations, North Oxford Academic
3. Narsing Deo-Graph Theory, PHI
4. John Yen and Reza Langari-Fuzzy Logic: Intelligence, Control and Information, Pearson.
5. George J Klin and Bo Yuan-Fuzzy Sets and Fuzzy Logic (Theory and Applications), PHI.

Course Name: Engineering Management
Course code: MME 103B
Credit: 3-0-0 (3 credits)
Course outcomes: After completing the course, students will be able to:
CO1. Demonstrate an understanding of, and apply, the fundamentals of project planning and project management.
CO2. Critically evaluate professional practice principles and their application to an engineering environment.
CO3. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
CO4. Make them capable to analyze, strength and weakness of an organization to identify its internal external opportunities and threats.

Course contents:

Introduction: Concept, process and significance of management; Managerial roles; An overview of functional areas of management; Development of management thought; Classical and neo-classical systems; Contingency approaches. 6L

Planning: Concept, process and types. Decision making – concept and process; Management by objectives; Corporate planning; Environment analysis; Strategy formulation. 4L

Organizing: Concept, nature, process and significance; Authority and responsibility relationships; Centralization and decentralization; Organization structure – forms and contingency factors. 4L

Directing: Motivation – Concept & Theories – (Maslow, Alderfer, Herzberg, MClelland, Porter & Lawler, Vroom); Financial and non-financial incentatives of Motivation, Leadership – Leadership Theories, Leadership styles. Communication – Type, process and barriers. 6L

Controlling: Concept and process; Effective control system; Techniques of control. 3L

Values – Importance, Sources of Value Systems, Types, Values, Loyalty and Ethical Behaviour, Values across Cultures. 4L

Business Ethics – Nature, Characteristics and Needs, Ethical Practices in Management. 3L

Text Books:

1. Weihrich and Koontz, et al : Essentials of Management; Tata McGraw Hill
2. Stoner J and Freeman RE : Management; Prentice-Hall

Reference Books

1. Daft, RL : Management, Thomson
2. V.S.P Rao & Hari Krishna : Management-Text & Cases,Excel Books
3. ramaswami T; Principles of Mgmt., Himalaya Publishing
4. Chandan, JS : Management – Concepts and Strategies, Vikas Publishing
5. Robbins, SP : Management, Prentice Hall

6. S. K. Chakraborty : Values and Ethics in Organisation, OUP
7. A. N. Tripathi : Human Values, New Age International

Course Name: Total Quality Management
Course code: MME103C
Credit: 3-0-0 (3 credits)
Course Outcomes After completing the course, students will be able to:
CO1. Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2.To realize the importance of significance of quality
CO3. Manage quality improvement teams
CO4. Identify requirements of quality improvement programs

Course Contents:
Basic concepts, definitions and history of quality control. Quality function and concept of quality cycle. Quality policy and objectives. 4L

Economics of quality and measurement of the cost of quality. Quality considerations in design. 3L

Process control: Machine and process capability analysis. Use of control charts and process engineering techniques for implementing the Quality plan. 6L

Acceptance Sampling: single, double and multiple sampling, lot quality protection, features and types of acceptance sampling tables, Acceptance sampling of variables and statistical tolerance analysis. Quality education, principles of participation and participative approaches to quality commitment. 11L

Emerging concepts of quality management: Taguchi's concept of off-line quality control and Ishikawa's cause and effect diagram. 6L

Text Books:
1. Industrial Engineering Management by O.P. Khanna

Reference Books
1. Total Quality Management – An Introductory Text by Paul James, Prentice Hall
2. Quality Control and Applications by Housen & Ghose

Course Name: Advanced Material Science
Course code: MME 104A
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Explain the differences in the mechanical behavior of engineering materials based upon bond type, structure, composition, and processing.
CO2. Describe the basic structures and repeat units for common thermoplastics and relate the distribution of molecular weights, degree of polymerization, percent crystallinity.
CO3. Apply binary phase diagrams to predict microstructures and also to understand precipitation hardening
CO4. Understand thermal treatments affect the microstructure and, thus, properties of materials.

Course contents:

Introduction, Structure – Properties – Performance of Different Types of Materials, Atomic Bonding and coordination, Polymers, Three dimensional Bonding, Inter-atomic distances, 6L

Crystals, crystalline Phases, Cubic & non Cubic Structures, Polymorphism, Unit Cell Geometry, Crystal directions, Crystal planes, Imperfection of crystalline solids, Solid Solutions in Ceramic, polymers and material compounds. 6L

Phase Equilibrium: Qualitative Phase Diagram, Quantities of Phases in Equilibrium Mixtures, Invariant Reactions, Selected Phase Diagrams, Reaction Rates, Deferred Reactions, Nucleation, And Atomic Diffusion 6L

Microstructures: Single Phase Materials, Phase Distribution (Eutectoid Decomposition, Microstructures and Polymer) 2L
Heat treatment processes - general classifications, various heat treatment of steels, properties and applications of alloy steels, tool steels, stainless steels and cast iron, different heat treatment furnaces. 6L

Hot and cold working of metals, recovery, recrystallisation and grain growth. Fracture, fatigue and creep phenomenon in metallic materials. 4L
Non-ferrous materials - Copper and Aluminium based alloys. 2L
Mechanical, Magnetic, Electrical and Electronic properties of metals, alloys, ceramics, semiconductors and composites. 4L

Text Books:
1. Material Science and Engineering by V.Raghavan, Prentice Hall.
2. Introduction to Engineering Materials by B.K.Agarwal, TMH.

Reference Books:
3. Mechanical Metallurgy by G.E.Dieter, McGrawhill.
4. Physical Metallurgy Principles by R.E.Reedhill, East-West Publishers.
5. Principles of Materials Science by W.F.Smith, 3rd ed., McGrawhill.
6. Steel and its Heat Treatment by K.E.Theling, Butterworth.
7. Material Science by J. C. Anderson, K. D. Leaver, R. D. Rawlings and J. M. Alexander, Chapman Hall, 4th Ed., 1992.

Course Name: Reliability Engineering & Failure Statistics
Course code: MME 104B
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO 1. Explain the basic concepts of Reliability Engineering and its Understand measures.
CO 2. Predict the Reliability at system level using various models.
CO 3. Predict and estimate the reliability from failure data.
CO 4. Understand the concepts of maintainability.

Course Contents:
Reliability: Definition and basic concepts; Failure data, failure modes, and reliability in terms of hazard rate and failure density function. 6L

Hazard models and bath tub curve; applicability of Weibull distribution. Reliability calculations for series, parallel and parallel-series 4L

Systems; Reliability calculations for maintained and stand-by systems. 2L

Maintenance - its role and scope in total organizational context. Objectives and characteristics of maintenance; basic guidelines for design of Organization structure for maintenance; Centralized vs. decentralized maintenance; Types of maintenance - corrective, planned, preventive And predictive maintenance; Factors affecting maintenance; opportunistic maintenance; Measurement of maintenance work; rating and Allowances. Maintenance cost budgets. 12L

Maintenance planning and scheduling; MIS in maintenance; Measurement of maintenance, Effectiveness and maintenance audit. 6L

Text Books:
1. Introduction to Reliability Engineering by Dhilan & Singh

Reference Books:
1. Mechanical Reliability Engineering by ADS Carter, Macmilan
2. Reliability Evaluation of Engineering Systems by Roy Billington and R.N. Allen, Pitman
3. Reliabilities for the Technologies by L.A.Doty, Industrial Press Inc.
4. Management of Industrial Maintenance by . Kelly & Harris- Newnes- Butterworths Management Library,London

Course Name: Industrial Safety
Course code: MME 104C
Credit: 3-0-0 (3 credits)

Course Outcomes: After completing the course, students will be able to:
CO 1. Understand the industrial laws, regulations and source models.
CO 2. Understand the methods of hazard identification and preventive measures
CO 3. Apply the methods of prevention of fire and explosions.
CO 4. Understand the methods of safety in finishing, inspection and testing.

Course Contents:
CONCEPTS
Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. 2L

TECHNIQUES
Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit. 4L

SAFETY EDUCATION AND TRAINING
Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.
8L

PHYSICAL HAZARDS
Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program 6L

CHEMICAL HAZARDS
Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, 3L

SAFETY IN METAL WORKING MACHINERY

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines 3L

PRINCIPLES OF MACHINE GUARDING
Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. 4L

SAFETY IN WELDING AND GAS CUTTING
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders. 3L

SAFETY IN FINISHING, INSPECTION AND TESTING
Safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. 2L

Text Books:
1. Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.

Reference Books:
1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.
3. "Safety in Industry" N.V. Krishnan JaicoPublishery House, 1996.

Course Name: Advanced machining Lab
Course code: MME191
Credit: 0-0-4 (2 credits)

Course Contents:
1. To determine Chip reduction coefficient during turning in metal cutting process
2. Measurement and analysis of cutting forces by using tool force dynamometer.
3. Study and Analysis of Microstructure during Grinding Process
4. Effect of Tool Geometry on Surface and Sub-surface quality of the Product.
5. CNC modeling, Programming & simulation (CNC Lathe, & CNC Milling Machines).

Course Name: Generative Manufacturing Lab
Course code: MME192
Credit: 0-0-4 (2 credits)

Course Contents:

1. Prepare a design model through CAD and GMP software
2. A solid model by layer-by-layer techniques through Rapid Prototyping.
3. Surface coating & thin film deposition by Electroplating on a simple model,
4. Anodizing, Physical Vapour Deposition (PVD) & Chemical Vapour Deposition (CVD) on metal plate.

Course Name: Research Methodology and IPR
Course code: MLC101
Credit: 0-0-4 (2 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand research problem formulation.
CO2. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO3.Understand that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO4.Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations 6L

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics, 2L

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee 4L

Unit 4: 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. 8L

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. 5L

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. 5L

Text Books:
1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

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

Course Name: Audit course
Course code: MME106
Credit: 0-0-4 (2 credits)

Audit course 1 & 2
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Semester – II

Course Name: Advanced Manufacturing System
Course code: MME201
Credit: 0-0-4 (2 credits)

Course Outcomes: After completing the course, students will be able to:
CO1. Model the material removal in various modern manufacturing processes
CO2. Analyze the processes and evaluate the role of each process parameter during machining
CO3. Select the best process out of the available various advanced manufacturing processes of different material
CO4. Understand requirements to achieve maximum material removal rate and best quality of machined Surface

Course Contents:

Classifications of Non-conventional Manufacturing Processes .	1L
Construction and working principal of Non-conventional machining processes such as Mechanical (AJM, WJM, AWJM, USM, AFM, MAF)	10L
Thermoelectric (EDM, PAM, IBM, EBM, LBM)	6L
Electrochemical & Chemical (BM, ECM, CHM)	4L
Hybrid Processes (ECG, ECAM, ECSM, EDAG)	5L
Deep Edge Lithography & Micro machining	2L

Textbooks:
1. Non-Conventional Machining by P.K.Mishra, Narosa Publishers.
2. Manufacturing Engineering & Technology, K. Jain, Pearson Education]

Course Name: Concurrent/ Simultaneous Engineering
Course code: MME 202
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand the need of concurrent engineering and strategic approaches for product design.
CO2. Apply concurrent design principles to product design.
CO3. Design assembly workstation using concepts of simultaneous engineering.
CO4. Design automated fabricated systems – Case studies.

Course Contents:

UNIT - I: Introduction: Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box collaborative product development Use Of Information Technology: IT support - Solid modeling - Product data management - Collaborative product commerce - Artificial Intelligence - Expert systems - Software hardware co-design. 8L
UNIT - II: Computer Aided Process Planning (CAPP), Concurrent Engineering. & Design for Manufacturing (Product Development, Design Engineering & Manufacturing Engineering as a TEAM to develop a new marketable product with in a very short time), Facilities Planning & Design (Plant Layout). 7L
UNIT - III: Advanced Manufacturing Planning, Contribution of Rapid Prototyping, Rapid Tooling & Reverse Engineering.) In the development of Concurrent Engineering, Rapid Response Manufacturing for advanced & Cost Effective Products. 8L
UNIT - IV: JIT system - low inventory - modular - Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing. Project Management: Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost. 8L

Text book:
1. Concurrent Engineering: Automation Tools and Technology / Andrew Kusaik/ Wiley John and Sons Inc., 1992.
Reference Books:
1. Automation, Production Systems and Computer Integrated Manufacturing by Groover, Prentice Hall.
2. CAD/CAM by M. P. Groover and E. W. Zimmers, Prentice Hall of India.
3. Manufacturing Technology, Radhakrishnan, Scitech

Course Name: Advanced Mechatronics System
Course code: MME203A
Credit: 0-0-3 (3credits)

Course Outcomes: After completing the course, students will be able to:
CO1: Outline appropriate sensors and actuators for an engineering application
CO2: Write simple microcontroller programs
CO3: Explain linearization of nonlinear systems and elements of data acquisition
CO4: Explain various applications of design of mechatronic systems

Course Contents:
Introduction to Mechatronics. Control Systems: Open- & Closed-loop Controls; PI and PID Controllers. Fundamentals of Electronics & Digital Circuits: Logic Gates & Circuits, Signal Conditioning, Data Acquisition & Conversion. Analog Signal Processing using Op-amps; Digital Signal Processing & Conversion, DAC & ADC.

Transducers & Sensors: Transducer Characteristics, Sensors for Measurement of Position, Displacement, Velocity, Force, Temperature, Fluid Pressure, etc.
Electrical Actuators: Relays, Drive Systems, Servo Motor & Servo-mechanism, and Stepper Motor.
Pneumatic & Hydraulic Actuators: Directional Control & Pressure Control Valves, Solenoid operated Valves.
Microprocessor, Micro-controller & PLC, Assembly Language Programming with Intel 8085 Microprocessor, Interfacing.
System Response: System modeling, Dynamic Responses of Systems, First-order & Second-order Systems.
Mechatronic System Design & Applications: Design Strategy, Traditional and Mechatronic Approach, Case Studies of Mechatronic Systems.

Text Books:
"Mechatronics" by W. Bolton, Pearson Education
"Mechatronics – Principles, Concepts & Applications" by N.P. Mahalik, TMH Publication

Reference Books:
"Introductio to Mechatronics & Measurement Systems" by D. G. Alciatore & M. B. Histand, TMH Publication
"A Text Book of Mechatronics" by R. K. Rajput, S Chand & Co.
"Mechatronics" by HMT Ltd, TMH Publication

Course Name: Mechanical vibration
Course code: MME 203B
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Formulate mathematical models of problems in vibrations using Newton's second law or energy principles,
CO2. Determine a complete solution to the modeled mechanical vibration problems.
CO3. Correlate results from the mathematical model to physical characteristics of the actual system.
CO4. Design of a mechanical system using fundamental principles developed in the class.

Course Contents:
Elements of vibration, Energy method, Rayleigh's method, equilibrium method.
Undamped free vibrations, Newton's method, Energy method, Rayleigh's method.
Torsional vibrations, Transverse vibrations of beams, Free damped vibration, viscous damping, Coulomb damping, Structural damping, Critical damping constant and damping ratio.
Forced Vibration, Forced vibrations with Coulomb damping, Forced vibration with Hysteris or structural damping, Forced vibrations with Coulomb and viscous damping, Total response, characteristic curves. variation of frequency ratio, two degrees of freedom system, several degree of freedom system, transient vibration, non-linear vibrations.

Text Books:
1. Mechanical Vibration-by J.Thompson
2. Mechanical Vibration by Sato Shaum Series.
3 Mechanical Vibration- V.P. Singh, Dhanpat Rai

Course Name: Finite Element Method and its Applications
Course code: MME 203CB
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1.Understand different mathematical Techniques used in FEM analysis
CO2. Understand use of FEA in Structural and thermal problem
CO3. Understand the application of FEA in heat transfer problem
CO4. Learn finite element modeling techniques.
Course Contents:
Introduction: basic concept of the finite element method, comparison with finite difference method; Variation methods: calculus of Variation, the Rayleigh-Ritz and Galerkin methods; Finite Element analysis of 1-D problems: formulation by different approaches (direct, Potential energy and Galerkin); Derivation of elemental equations and their assembly, solution and its post processing. 12L
Applications in heat Transfer, fluid mechanics and solid mechanics. 4L
Bending of beams, analysis of truss and frame. Finite element analysis of 2-D problems: finite Element modeling of single variable problems, triangular and rectangular elements 6L
Numerical considerations: numerical integration, error analysis, mesh refinement. Plane stress and plane strain problems 4L
Bending of plates; Eigen value and time dependent problems; Discussion about preprocessors, post processors and finite element packages. 4L

Text Books:
1. An Introduction to the Finite Element Method by J.N.Reddy, McGrawHill, NewYork.
Reference Books:
1. Concepts and Applications of Finite Element Analysis by R.D.Cook, D.S.Malkus and M.E.Plesha, 3rd ed., John Wiley, New York.
2. The Finite Element Method by O.C.Zienkiewicz and R.L.Taylor, 3rd ed. McGraw-Hill.
3. The Finite Element Method by T.J.T Hughes, PrenticeHall, Englewood Cliffs, NJ.

Course Name: Robotics and Automation
Course code: MME 204A
Credit: 0-0-3 (3 credits)

Course Outcomes: After completing the course, students will be able to:
CO1. Ability to identify the electrical, electronic and mechanical components and use of them design or machine elements and transmission system.
CO2. Ability to understand the electronic control system in metal machining and other manufacturing process.
CO3. Ability to understand the features and operation of automation products.
CO4. Ability to apply knowledge of mathematics, sciences and engineering

Course Contents:

Robot definition: Robotic systems - Its role in automated manufacturing; robot anatomy; robot classifications and specifications.
Robot kinematics, forward and reverse transformations, homogeneous transformation.

Robot Dynamics: Introduction to Force Analysis, Trajectory generation. Robot actuators and control;

Robot end-effectors- mechanical, magnetic and vacuum grippers, gripping forces, RCC and design features of grippers. Robot sensors- contact and non-contact sensors, Robot vision and their interfaces.

Robot languages and programming techniques. Applications of robots in materials handling, machine loading/unloading, inspection, welding, spray painting and finish coating, and assembly, etc. Economic performance and evaluation strategies, Robot installation and planning. Safety features

Analysis of Industrial Robots, Accuracy & Repeatability, System Architecture & AGV, Artificial Intelligence & Expert Systems, Factory/ Process Automation, Factories of Future.

Text Book :
1."Robotic Technology & Flexible Automation" by S.R. Deb, Tata Mcgraw-hill

Reference Book:
1."Automation, Production Systems and CIM" by M.P. Groover, Prentice Hall of India.
"Introduction to Robotics"- J.J. Craig, Addison-Wesley.
2. "Fundamentals of Robotics Analysis and Control"- R.J. Schilling, Prentice Hall of India.
3. "Analytical Robotics and Mechatronics", W. Stadler, McGraw Hill Book Co.
4. "Foundations of Robotics Analysis and Control"- T. Yoshikawa, Prentice Hall of India.
5.. "Robotics for Engineers"- Y. Koren, McGraw-Hill Book Company, New York.
6. "Industrial Robots and Computer Integrated Manufacturing"- S. Kumar, Oxford & IBH Publishing Co. Ltd.
7. "Automation, Production Systems, and Computer-Integrated Manufacturing" - M.P. Groover, Prentice Hall of India.

Course Name: Operation Research
Course code: MME 204B
Credit: 0-0-3 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
CO2. Students should able to apply the concept of non-linear programming
CO3. Students should able to carry out sensitivity analysis
CO4. Student should able to model the real world problem and simulate it.
Course contents
Unit-I Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
Unit-II Formulation of a LPP - Graphical solution revised simplex method duality theory dual simplex method - sensitivity analysis - parametric programming
Unit-III Nonlinear programming problem -Kuhn-Tucker conditions min cost flow problem max flow problem CPM/PERT
Unit-IV Scheduling and sequencing single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming
Unit-V Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Text Books:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

Reference Books:
1. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3. Pannerselvam, Operations Research: Prentice Hall of India 2010
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Name: Manufacturing Support Systems
Course code: MME 204C
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand basic foundation in computer aided design / manufacturing
CO2. Assessment of degree and level of automation
CO3. Understand concept of Group Technology, FMS and CIM
CO4. Knowledge about various components of automation like sensors, actuators, PLC and advanced industrial automation

Course Contents:
Product Design, CAD, CAM, CIM, Quality Function Deployment (QFD),
Process Planning & Concurrent/Simultaneous Engineering.
Production Planning & Control Systems (PPC, JIT, MRP)

Text Books:
1. Automation, Production Systems and CIM" by M.P. Groover, Prentice Hall of India.
2 CAD / CAM by P. N.Rao, TMH

Course Name: Advanced manufacturing Lab-I
Course code: MME 291
Credit : 0-0-4 (2 credits)
Course Contents:
Design of components of machine tools, cutting tool, other tooling, metal working processes, etc.

Stress analysis of components of machine tools, cutting tool, other toolings, metal working processes, etc. under different types of loading conditions using standard software such as ANSYS, etc.

Designing for New Product Development.

Course Name: Advanced Control Lab-II
Course code: MME 292
Credit: 0-0-4 (2 credits)

Course Contents:
1. Study of hydraulic, pneumatic and electro-pneumatic circuits.
2. Study the control behavior of five axis Robot using software.
3. Study the numerical simulation on CNC machining using MTAB software.
4. Study of PLC and its applications.
5. Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using software
6. Study of various types of transducers

Course Name: Mini Project
Course code: MME293
Credit: 0-0-4 (2 credits)
Course Contents:
Mini Project would be to do some preliminary works that would lead to the detailed project work spanning over Semester III and IV. Related to the same, the Seminar would be based on literature review on some emerging areas related to this course and the preliminary works done on the mini project.

Seminar presentation would be made by an individual student, and a report would have to be submitted by each student separately.

Course Name: Audit course
Course code: MME206
Credit: 0-0-4 (2 credits)

Audit course 1 & 2
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Semester - III

Course Name: Reverse Engineering
Course code: MME 301A
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand basic concept of Re-Engineering & Robust Engineering
CO2. Quality Assessment of Robust Design, Safety, Green Engineering.
CO3. Apply the Knowledge Recycling materials, reducing the energy consumption and packaging in final product

Course Contents:
Reverse Engineering, Re-Engineering & Robust Engineering and comparison with Forward Engineering.
TAGUCHI's CONCEPT OF QUALITY, Signal to Noise Ratio (S/N ratio) in Robust Design, Safety.
Green Engineering, Reducing the toxicity of raw materials used in production, reducing energy consumption during the manufacturing process.
Recycling materials and scrap, reducing the amount of packaging in final product.
"LEED" (Leadership in Energy & Environment Design)

Text Books:
1. Automation, Production Systems and CIM by M.P. Groover, Prentice Hall of India.
2. Reverse Engineering, By Raja, Vinesh Fernandes.
3. Reversing- Secrets of Reverse Engineering by Elad Eilam.

Course Name: Supply Chain Management
Course code: MME 301B
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand fundamental supply chain management concepts.
CO2. Apply knowledge to evaluate and manage an effective supply chain.
CO3. Understand the foundational role of logistics as it relates to transportation and warehousing.
CO4. Analyze and improve supply chain processes.

Course Contents:

INTRODUCTION:

Role of Logistics and Supply chain Management: Scope and ImportanceEvolution of Supply Chain Decision Phases in Supply Chain - Competitive and Supply chain Strategies Drivers of Supply Chain Performance and Obstacles.

SUPPLY CHAIN NETWORK DESIGN:

Role of Distribution in Supply Chain, Factors influencing Distribution network design, Design options for Distribution Network Distribution Network in PracticeRole of network Design in Supply Chain, Framework for network Decisions.

LOGISTICS IN SUPPLY CHAIN:

Role of transportation in supply chain, factors affecting transportations decision, Design option for transportation network, tailored transportation, Routing and scheduling in transportation.

SOURCING AND COORDINATION IN SUPPLY CHAIN:

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain. SUPPLY

CHAIN AND INFORMATION TECHNOLOGY:

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

Books:

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education
2. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury
3. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI,
4. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics" PHI
5. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press

Course Name: Project management
Course code: MME 301C
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:

CO1. Understand project characteristics and various stages of a project.
CO2. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
CO3. Understand the Project Procurement, and productivity.
CO1. Apply Decision making theories under certainty, risk, uncertainty and competitive situations

Course Contents:

Project Definition: Venture analysis, Project management Features;

Project organization design; Operation planning and resource allocation; Plant location analysis models; Project scheduling; Gantt charts;

Analysis of project networks - PERT and CPM. Scheduling under Resources constraint, Cash scheduling to multi-projects situation Project

Monitoring and control aspects; Decision making theories in Management under certainty, risk, uncertainty and competitive situations;

Applications of the methodologies and formulations in such project decision making problem solutions; Project capital, cost estimation;

Breakeven Analysis, Cost Benefit Analysis; Profitability Analysis, Commercial and notional profitability.

Project Engineering, procurement, storage and construction functions and other related management problems; Project wind up and
Technological obsolescence; Computer aided Project Management.

Text book:
1. Project Management by R.Panneerselvam and P.Senthil kumar

References book:
1. Operations Research – An Introduction by Taha
2. Principles of Operations Research with Applications to Managerial Decision by Wagner.

Course Name: Tribology and Terotechnology
Course code: MME 302A
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:
CO1. Understand of friction, lubrication, and wear processes.
CO2. Analyze tribological processes.
CO3. Knowledge in Maintenance management systems and Terotechnology.
CO4.Apply various Replacement and Inspection decision models for maximizing profit and minimizing downtime.

Course Contents:
Friction, wear & Lubrication as a system
Terotechnology aspects affecting Tribo Characteristics
Tribo-analysis at different hostile & hazardous environment
Theories of Friction, Wear & Lubrication
Control of Tribo-aspects using different interfacial separators

Text books:
A Text Book of Tribology & Terotechnology by Dr. D.K. Biswas & Dr. U. Bandyopadhyay, Tech International, 2010

Reference Books:
1. Introduction to Tribology of Bearings by B. C. Majumder, AHW
2. Tribology by J. Halling, Bowden & Tabor

Course Name: Cryogenic Engineering
Course code: MME 302B
Credit: 3-0-0 (3 credits)

Course Outcome: After completing the course, students will be able to:
CO1. Understand the principles cryogenics systems
CO2. Remember the applications of cryogenic systems
CO3. Analyze performance of cryogenics gas liquefaction system
CO4. Evaluate material properties at cryogenic temperature

Course Contents:
Development Techniques of Cryo-Tribo –Vacuum Chamber For Mechanical Treatment of Materials at Hazardous Environment, Material Behaviuor at High Pressure and cryogenic temperature, Design & Fabrication of tribotesting chamber at hostile environment for Spatial requirements.

Text books:

1. Cryogenic Engineering by Russel B Scott
2. Cryogenic Engineering by Joseph H Bell
3. Cryogenic Engineering by Thomas H Flynn..
4. Cryogenic Heat Transfer by Randall F. Barron
5. Cryogenic systems by Randall F. Barron.
6. Fundamental of Process Engineering by V. Kovan

Course Name: Nano-Technology and Nano-Materials
Course code: MME 302C
Credit: 3-0-0 (3 credits)
Course Outcomes: After completing the course, students will be able to:

CO1. Explain methods of fabricating nanostructures.
CO2. Relate the unique properties of nano-materials to the reduce dimensionality of the material.
CO3. Describe tools for properties of nanostructures.
CO4. Discuss applications of nano-materials and implication of health and safety related to nano-materials.

Course Contents:

Unit – I

Introduction, Properties of materials & nanomaterials, role of dimensions in nanomaterials. Quantum Confinement, Size Quantization, three Dimensional System (Bulk), Two Dimensional System (Nanostructured Plane), One Dimensional System (Quantum Wire), Zero Dimensional System (Quantum Dots), Varieties of Quantum Dots. 6L

Unit – II

Fabrication of Nanomaterials by Physical Methods: -Inert gas condensation, Arc discharge, RFplasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Molecular beam epitaxy, Chemical vapour deposition method and Electro deposition.
Chemical Routes for Synthesis of Nanomaterials: Chemical precipitation and co-precipitation; Metal nanocrystals by reduction, Sol-gel synthesis; Microemulsions or reverse micelles, myle formation; Solvothermal synthesis; Thermolysis routes, Microwave heating synthesis; Sonochemical synthesis; Electrochemical synthesis; ,Photochemical synthesis, Synthesis in supercritical fluids 8L

Unit – III

Nanocomposites: An Introduction: Types of Nanocomposite (i.e. metal oxide, ceramic, glass and polymer based); Core-Shell structured nanocomposites Superhard Nanocomposite: Synthesis, applications and milestones. 4L

Unit–IV

Nanopolymers: Preparation and characterization of diblock Copolymer based nanocomposites, Nanoparticles polymer ensembles; Assembly of polymer-Nanoparticles composite material; Fabrication of polymer-mediated organized Nanoparticles assemblies; Applications of Nanopolymers in Catalysis. 6L

Unit–V

Metal Nanoparticles: Size control of metal Nanoparticles and their characterization; Study of their properties: Optical, electronic, magnetic; Surface plasmon band and its application; Role in catalysis, Alloy Nanoparticles, Stabilization in Sol, Glass, and other media, Change of bandgap, Blueshift, Colour change in sol, glass, and composites, Plasmon Resonance. 6L

Text books:

1. Microfabrication and Nanomanufacturing- Mark James Jackson

References Book:

1. Encyclopedia of Nanotechnology- Hari Singh Nalwa
2. Fabrication of fine pitch gratings by holography, electron beam lithography and nano-imprint Lithography (Proceedings Paper), Darren Goodchild; Alexei Bogdanov; Simon Wingar; Bill Benyon; Nak Kim;
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830831 Cambridge University Press.
4. Processing & properties of structural Nanomaterials - Leon L. Shaw (editor)
5. Springer Handbook of Nanotechnology - Bharat Bhusan.

Course Name: Dissertation Phase - I
Course code: MME 303
Credit: 0-0-20 (10 credits)
Submission of Dissertation and Comprehensive Viva Voce

Semester – IV

Course Name: Dissertation Phase - II
Course code: MME401
Credit: 0-0-20 (10 credits)
Submission of Dissertation and Comprehensive Viva Voce