Curriculum Structure and Syllabus

for

M.Tech.

in

Mechanical Engineering

Specialization with

Manufacturing Engineering

A.Y 2020-21

Department of Mechanical Engineering
National Institute of Technology Andhra Pradesh
Tadepalligudem, West Godavari Dist., 534 101
Andhra Pradesh (INDIA)

Curriculum Structure and Syllabus
for M.Tech. in Mechanical Engineering
Specialization: Manufacturing Engineering

For the Academic Year 2020-21 Admitted Batch

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Course Structure

Distribution of Total Credits:

Semester	Core Subjects	Dept. Elective	Open * Elective	Labs.	Seminar	Comp. viva	Dissertation-Part A	Dissertation-Part B	Total
I	3 (3*4=12)	1 (1*3=3)	1* (1*3=3)	2 (2*2=4)	-	-	-	-	**22**
II	3 (3*4=12)	1 (3*1=3)	1 (1*3=3)	1 (1*2=2)	1 (1*2=2)	-	-	-	**22**
III	-	2 (2*2=4) Mandatory Elective from Course era /NPTEL/SWAYAM /MIT…		-	-	2	8 (equivalent to 2 core subjects)	-	**14**
IV	-	-	-	-	-	-	-	16 (equivalent to 4 core subjects)	**16**
Total									**74**

I -Semester:

Code No.	Subject Name	L-T-P	Cr.
19PME101	Metal Forming Technology	4-0-0	4
19PME102	Casting and Welding Technology	4-0-0	4
19PME103	Computer Aided Manufacturing	4-0-0	4
19PMEXXX	Department Elective – I	3-0-0	3
19PMEXXX	Open Elective – I	3-0-0	3
19PME104	Manufacturing Technology Laboratory	0-0-3	2
19PME105	CAD/CAM/CAE Laboratory	0-0-3	2
Total			**22**

II -Semester:

Code No.	Subject Name	L-T-P	Cr.
19PME126	Subtractive Manufacturing	4-0-0	4
19PME127	Additive Manufacturing	4-0-0	4
19PME128	Mechatronics and Robotics	3-0-0	4
19PMEXXX	Department Elective – II	3-0-0	3
19PMEXXX	Open Elective – II	3-0-0	3
19PME129	Seminar	0-3-2	2
19PME130	Mechatronics and Robotics Laboratory	0-0-3	2
Total			**22**

III -Semester:

Code No.	Subject Name	L-T-P	Cr.
19PME151	Mandatory Elective from Course era /NPTEL/SWAYAM/MIT…	2-0-0	2
19PME152	Mandatory Elective from Course era /NPTEL/SWAYAM/MIT…	2-0-0	2
19PME153	Comprehensive viva		2
19PME154	Dissertation-Part A	0-0-20	8
Total			**14**

IV -Semester:

Code No.	Subject Name	L-T-P	Cr.
19PME176	Dissertation-Part B	0-0-36	16
Total			**16**

Department Elective - I:

Code No.	Subject Name	L-T-P	Cr.
19PME106	Geometric Dimensioning and Tolerancing	3-0-0	3
19PME107	Composite Science and Technology	3-0-0	3
19PME108	Design for Manufacture & Assembly	3-0-0	3
19PME109	Industrial Tribology	3-0-0	3
19PME110	Optimization Techniques in Manufacturing	3-0-0	3
19PME111	Geometric Modeling	3-0-0	3
19PME112	Characterization of Materials	3-0-0	3

Department Elective - II:

Code No.	Subject Name	L-T-P	Cr.
19PME131	Product Design and Development	3-0-0	3
19PME132	Reverse Engineering	3-0-0	3
19PME133	Design of Experiments	3-0-0	3
19PME134	Tool Design Engineering	3-0-0	3
19PME135	Processing and Design of Materials	3-0-0	3
19PME136	Laser Processing of Materials	3-0-0	3
19PME137	Manufacturing Planning and Control	3-0-0	3

Open Elective - I:

Code No.	Subject Name	L-T-P	Cr.
19PME113	Financial Management	3-0-0	3
19PME114	Quality Engineering & Management	3-0-0	3
19PME115	Industrial Machine Vision	3-0-0	3
19PME116	Nanoscience and Technology	3-0-0	3
19PME117	Lean manufacturing and Six sigma	3-0-0	3

Open Elective - II:

Code No.	Subject Name	L-T-P	Cr.
19PME138	Research Methodology and IPR	3-0-0	3
19PME139	Micro-Electro-Mechanical-Systems (MEMS)	3-0-0	3
19PME140	Automation and Control	3-0-0	3
19PME141	Industrial Safety and Risk Assessment	3-0-0	3
19PME142	Entrepreneurship and Startups	3-0-0	3

M. Tech. (Manufacturing Engineering), Semester – I	L	T	P	Credits
	4	0	0	4

Metal Forming Technology

Syllabus

Engineering Materials: Classification of materials, Phase diagrams of metals, Heat Treatment.

Essentials of Metal Forming: Classifications and mechanism of metal forming, effect of temperature of metal working, hot working, cold working. Tribology in metal forming and other phenomena (friction and lubricants), Analysis of forming – Lower and Upper bound Analysis, slip line field methods.

FORGING: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging.

Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations.

Extrusion & Drawing: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes. Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing.

Sheet Metal forming: Conventional processes, Forces in circular cup drawing, Redrawing, drawing of tubes from annular sheet dies, forming limit diagram, forming with hydrostatic pressure, Explosive forming, electrohydraulic forming, magnetic pulse forming, Forming limit criteria, defect in formed parts, principles and process parameters- Advantages -Limitations and Applications.

Press Tool, Jigs and Fixture Design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies. Principles of location, six-point location principle, clamping elements and methods.

Advanced Metal Forming Processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment, computer applications in metal forming.

Powder metallurgy: Introduction and feature of powder metallurgy processes. Advanced solidification techniques: directional solidification, single crystal growth and levitation melting.

Text Book(s):

1. Fundamentals of Metal Forming Processes / B.L. Juneja / New Age International Publishers
2. U.S. Dixit (editor) and R. Ganesh Narayanan (editor) (2013), Metal Forming: Technology and Process Modelling, McGraw-Hill Education, Noida
3. Mechanical Metallurgy – Dieter (Mc Graw Hill)

Reference Book(s)

1. ASM Metal Forming Hand Book.
2. An Introduction to Principles of Metal Working – G.W.Rowe
3. Metal Forming: Processes and Analysis – Avitzur (TMH)
4. Principles of Metal Working / Sunder Kumar

M. Tech. (Manufacturing Engineering), Semester – I	L	T	P	Credits
Casting and Welding Technology	4	0	0	4

Syllabus*:*

Principles of Metal Casting: Pattern Making, Mould and Core Materials, Moulding, Core Making, Gating System and Risers, Metal Melting and Pouring, Shakeout and Cleaning of Castings, Foundry Mechanization and Management, Shell Mould Casting, Investment Casting, Pressure Die Casting, Centrifugal Casting, Continuous Casting, Miscellaneous Special Casting Processes. Solidification and Cooling of Castings, Casting Defects, Principles of Casting Design.

Principles of Metal Joining: Classification, structure and characteristics of welding arc, arc blow, methods of arc initiation and maintenance, arc stability, arc welding power sources, duty cycle, metal transfer.

Different Welding Processes: Shielded Metal Arc Welding (SMAW), Submerged Arc Welding (SAW), Gas Tungsten Arc Welding (GTAW/TIG), Gas Metal Arc Welding (GMAW), Electro-slag and Electro-gas welding, Resistance welding, Solid-state welding processes, Ultrasonic, Electron beam welding, Laser welding, Plasma arc welding, Thermit welding, Weld defects. Brazing and soldering, adhesive bonding.

Welding Metallurgy: Heat flow in welding, Metallurgical transformation in and around weldment, Implication of cooling rates, Heat affected zone (HAZ), Weldability of plain carbon steels, Stainless steels, Cast iron, Aluminium and its alloys.

Design of weldments, Joint design, Residual stresses and distortion, Testing of welded joints, Destructive Tests and Non-destructive tests (NDT).

Text Books:

1. K. C. John, Metal Casting and Joining, PHI Learning Pvt. Ltd., 2015.
2. P. L. Jain, Principles of Foundry Technology, 5th edition, TMH Publications, 2009.
3. R. S. Parmar, Welding Processes and Technology, 3rd Edition, Khanna Publishers, New Delhi, 2011.

References:

1. Richard Heine, Carl Loper, Philip Rosenthal, Principles of Metal Casting, TMH Publications, 2004.
2. A. Ghosh and A. K. Mallik, Manufacturing Science, East west press, New Delhi, 2006,
3. H.S. Bawa, Manufacturing Technology-I, TMH Publications, New Delhi, 2007.
4. S.V. Nadkarni, Modern Arc Welding Technology, Oxford and IBH Publishing Co. Pvt. Ltd., 2010.
5. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, 4th edition, Pearson Education, 2007.

M. Tech. (Manufacturing Engineering), Semester - I	L	T	P	Credits
Computer Aided Manufacturing	4	0	0	4

Syllabus*:*

Computer Aided Manufacturing: Manufacturing Processes, Removing, Forming, Deforming and joining Integration equipments. Integrating CAD, NC and CAM Machine Tools Point to point and continuous path machining, NC, CNC and DNC NC Programming, Basics, Languages, G Code, M Code, APT Tool path generation and verification CAD/CAM NC Programming Production Control Cellular Manufacturing.

Computer Aided Process Planning: Role of process planning in CAD/CAM Integration Computer Aided Process Planning, Development, Benefits, Model and Architecture, CAPP Approaches Variant, Generative and Hybrid Process and Planning systems CAM-I, D-CLASS and CMPP Criteria in selecting a CAPP System.

Computer Aided Inspection: Engineering Tolerances, need for Tolerances, Conventional Tolerances, FITS and LIMITS, Tolerance Accumulation and Surface quality, Geometric Tolerances, Tolerances Practices in design, Drafting and manufacturing, Tolerance Analysis, Tolerance synthesis, Computer Aided Quality control, Contact Inspection Methods, Non-Contact Inspection Methods, Non optical.

Reverse Engineering: Scope and tasks of Reverse Engineering, Domain Analysis, Process Duplicating, Tools for RE, Developing Technical data, Digitizing techniques, Construction of surface model, Solid part model, Characteristic evaluation, Software's and its application, CMM and its feature capturing, surface and solid modeling.

Data Management: Strategies for Reverse Engineering Data management, Software application, Finding renewable software components, Recycling real time embedded software, Design experiments to evaluate a RE tools, Rule based detection for RE user interface, RE of assembly programs.

Text Books:

1. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", Revised First special Indian Edition, Tata Mc Graw Hill Publication, 2007
2. Ibrahim Zeid, "Mastering CAD/CAM", special Indian Edition, Tata McGraw Hill Publication, 2007

References:

1. Linda Wills, "Reverse Engineering" Kluwer Academic Press, 1996
2. Catherine A. Ingle, "Reverse Engineering", Tata Mc Graw Hill Publication, 1994
3. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, "Computer Integrated Design and manufacturing", Mc Graw Hill International series, 1991
4. Donald R. Honra, "Co-ordinate measurement and reverse Engineering, American Gear Manufacturers Association.

M. Tech. (Manufacturing Engineering), Semester - 2	L	T	P	Credits
Subtractive Manufacturing	4	0	0	4

Syllabus:

Mechanics of metal cutting; Tool signature and its effect on the performances, strain and strain rate in orthogonal cutting, stress distribution along rake face, theories of Merchant's, Lee and Shaffer's, Oxley's, etc.

Inserts-chip groove geometries; Nomenclature, selection and applications in turning, milling, drilling, design concepts; Carbide grade design, carbide coatings, ceramic, super hard grade design, effect of cutting variables on forces, tool failure analysis, theories of tool wear, measurement of tool wear, tool life, process optimization.

Thermal aspects in machining; Heat and temperature distribution, modeling of chip formation in metal cutting, modeling of machining characteristics in turning, milling, drilling, grinding, etc., measurement of cutting forces and cutting temperatures.

CNC machining; Introduction to hardware and software, economic aspects.

Non-traditional Machining processes, EDM, ECM, LBM, WJM, USM, AJM etc.

Micro machining and super-finishing; micro-turning, micro-milling, micro-drilling, micro EDM, micro-WEDM, micro ECM, etc., ultra-precision machining, electrolytic in-process dressing and grinding, high speed machining, nano surface generation, ductile cutting of silicon wafers, mechanism of ductile cutting, nanometric cutting, chip formation, recent developments.

Text Books:

1. E. J. A. Armarego, R. H. Brown, "The Machining of Metals", Prentice Hall Inc.
2. Kronenberg, "Machining Science and Applications", Pergamon Press.
3. Geoffrey Boothroyd and W. A. Knight, "Fundamentals of Machining and Machine Tools", Marcel Dekkel Inc.
4. J. A. McGeough, "Advanced Methods of Machining", Chapman and Hall.
5. P. L. B. Oxley, "The Mechanics of Machining", Ellis Horwood Ltd.

References:

1. Nontraditional machining, by P K Mishra Narosa Publishing House (19 July 2007)
2. Advanced machining process By V K Jain, Allied Publishers Pvt. Ltd.; 1 edition (2007)
3. Gary F. Benedict, "Nontraditional Manufacturing Processes", Marcel Dekker Inc.
4. Amitabha Battacharyya, "Metal Cutting, Theory and Practice", New Central Book Agency
5. Amitabh Ghosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East West Press Pvt. Ltd.
6. B. L. Juneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age, International (P) Ltd.
7. V. C. Vekatesh and H. Chandrasekharan, "Experimental Techniques in Metal cutting", Practice Hall of India Pvt. Ltd.
8. M. C. Shaw, "Metal Cutting Principles", CBs Publishers.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Additive Manufacturing	4	0	0	4

Syllabus:

Additive Manufacturing Process: Basic Principles of the Additive Manufacturing Process, Generation of Layer Information, Physical Principles for Layer Generation. Elements for Generating the Physical Layer, Classification of Additive Manufacturing Processes, Evaluation of the Theoretical Potentials of Rapid Prototyping Processes.

Machines for Additive Manufacturing: Overview of Polymerization: Stereo-lithography (SL), Sintering/Selective Sintering: Melting in the Powder Bed, Layer Laminate Manufacturing (LLM) and Three-Dimensional Printing (3DP).

Rapid Prototyping: Classification and Definition, Strategic Aspects for the Use of Prototypes, Applications of Rapid Prototyping in Industrial Product Development. Rapid Tooling: Classification and Definition of Terms, Properties of Additive Manufactured Tools, Indirect Rapid Tooling Processes: Molding Processes and Follow-up Processes, Indirect Methods for the Manufacture of Tools for Plastic Components, Indirect Methods for the Manufacture of Metal Components.

Rapid Tooling: Prototype Tooling: Tools Based on Plastic Rapid Prototyping Models and Methods, Metal Tools Based on Multilevel AM Processes, Direct Tooling: Tools Based on Metal Rapid Prototype Processes.

Rapid Manufacturing: Feasibility, Cost estimation, Breakeven analysis, sustainability aspects.

Text Books:

1. Andreas Gebhardt Jan-Steffen Hötter, Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser Publications, 6915 Valley Avenue, Cincinnati, Ohio.
2. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Second Edition, Springer New York Heidelberg Dordrecht London.

References:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid
3. Tooling: Technologies and Industrial Applications", CRC press, 2000.

M. Tech. (Manufacturing Engineering), Semester - 2	L	T	P	Credits
Mechatronics and Robotics	4	0	0	4

Syllabus:

Introduction: History of Mechatronics, Scope and Significance of Mechatronics systems, elements of mechatronic systems, needs and benefits of mechatronics in manufacturing.

Sensors: Classification of sensors, Position, Displacement, Velocity and Acceleration Sensors. Thermal Sensors, Force and Torque Sensors, Smart Sensors.

Actuators: Electrical Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors. Hydraulic & Pneumatic devices, Design of Hydraulic & Pneumatic circuits. Piezoelectric actuators, Shape memory alloy based actuators.

Digital Electronics and Signal Conditioning: Number systems, Boolean algebra, Design of circuits. Operational amplifiers, Multiplexer, Analog to digital convertors, digital to analog convertors, Data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.

Robotics: Introduction to Robotics, Robot anatomy physical configurations, Manipulator, Kinematics, Technical features. Programming of Mobile robot, robot programming language, end effecters.

Modelling of Mechatronic and Robotic Systems: Modelling for one and two degrees of freedom systems, Block diagram representations for these systems. Transfer function, Modelling Dynamic systems, first order systems, second order systems.

Controllers for Robots: Classification of control systems, Feedback, closed loop and open loop systems, Continuous and discrete processes, control modes, Two step Proportional, Derivative, Integral, PID controllers.

PLC Programming for Robots: PLC Principles of operation PLC sizes PLC hardware components I/O section Analog I/O section Analog I/O modules, digital I/O modules CPU Processor memory module Programming. Ladder Programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems.

Text Books:

1. W. Bolton, "Mechatronics", 5th edition, Addison Wesley Longman Ltd, 2010.
2. Devdas Shetty & Richard Kolk "Mechatronics System Design", 3rd edition. PWS Publishing, 2009.

References:

1. Alciatore David G & Histand Michael B, "Introduction to Mechatronics and Measurement systems", 4th edition, Tata McGraw Hill, 2006.
2. Saeed B Niku, "Introduction to Robotics: Analysis, Systems, Applications", 2nd edition, Pearson Education India, PHI, 2003.

M. Tech. (Manufacturing Engineering), Semester – 1	L	T	P	Credits
Geometric Dimensioning and Tolerancing	3	0	0	3

Syllabus:

Introduction: Geometric Dimensioning and Tolerancing, Maximum Material Condition, and Regardless of Feature Size. How to read a Feature Control Frame? Size Control Form: Rules, concepts, Characteristics, and un-tolerance Dimensions. Datum's, The Maximum Material Condition symbol and its Ramifications, Relationship between Individual Feature's; Virtual Condition and Resultant Condition Boundaries. Datum Feature of Size Representation; Form Controls; Orientation Controls; Profile; Run out; Location. A Logical Approach to part Tolerancing, Dimensioning and Tolerancing Schemes, Steps for the Development of a Dimensional Inspection Plan. Paper Gauging. Functional Gauging.

Text Books:

1. James D Meadows, "Geometric Dimensioning and Tolerancing", Marcel Dekker, Inc.
2. James D Meadows, "Measurement of Geometric Tolerancces in Manufacturing", Marcel Dekker, Inc.

References:

1. Bruce A. Wilson, "GD&T: Application and Interpretation", Goodheart-Willcox.
2. P S Gill, "Geometric Dimensioning and Tolerancing", S.K. Kataria & Sons; 2013.

M. Tech. (Manufacturing Engineering), Semester – 1	L	T	P	Credits
Composite Science and Technology	3	0	0	3

Syllabus:

Introduction to Composite Materials, Classification, reinforcement; Polymer matrix composites, Thermoplastic and thermosetting resins, Common matrix reinforcement system; Concept of A stage, B stage and C stage resins; Particulate and fibre filled composites, Short fibre composites, Theories of stress transfer; Continuous fibre composites, Failure mechanism and strength, Halpin-Tsai equations, Prediction of Poisson's ratio, Various failure modes; Specialty composites, Composites for satellites and advanced launch vehicles, Design considerations, PMC- for structural composites, MMC- design, Silicon carbide composites; Carbon-Carbon composites, Matrix precursors, Manufacturing considerations; Nanocomposites, Nano particle dispersion in polymer matrix, Polymer-nanoclay and carbon nanotubes composites; Design and analysis of composite structures macro mechanics, Micro mechanics, Laminate analysis, FE model and analysis, Manufacturing techniques- hand lay-up, filament winding, pultrusion, resin transfer molding, processing science of reactive polymer composites; Testing of composites, Raw material testing, NDT techniques.

Text Books:

1. T. G. Gutowski, (Ed.) Advanced Composites Manufacturing, John Wiley & Sons, New York 1997.
2. R.M. Jones, Mechanics of Composites, 2nd ed., Taylor & Francis, 1999.
3. E. Fitzer, L.M. Manocha, Carbon Reinforcement and Carbon/Carbon Composites, SpringerVerlag, Heidelberg, New York, 1998.
4. P.M. Ajayan, L. Schadler, P.V. Braun Nano Composite Science and Technology, Wiley VCH, 2003.

References:

1. N. Chawla, K.K. Chawla, Metal Matrix Composites, Springer-Verlag, 2006.
2. K.K. Chawla, Ceramic Matrix Composites, Kluwer Academic Publishers, 2003.
3. J.C. Seferis, L. Nicolais, (Eds.) The Role of the Polymeric Matrix in the Processing and Structural Properties of Composite Materials, Plenum Press, New York 1983.

M. Tech. (Manufacturing Engineering), Semester – 1	L	T	P	Credits
Design for Manufacturing and Assembly	3	0	0	3

Syllabus:

Introduction: Design for Manufacture and Assembly, History, Implementation of Design for Assembly, Design for Manufacture, Producibility Guidelines, Advantages of Applying DFMA during Product Design.

Selection of Materials and Processes: General Requirements for Early Materials and Process, Selection, Selection of Manufacturing Processes, Process Capabilities, Selection of Materials, Primary Process/Material Selection, Systematic Selection of Processes and Materials, Problems.

Design for Machining: Machining Using Single-Point Cutting Tools, Machining Using Multipoint Tools, Machining Using Abrasive Wheels, Standardization, Choice of Work Material, Shape of Work Material, Machining Basic Component Shapes, Assembly of Components, Accuracy and Surface Finish, Summary of Design Guidelines, Cost Estimating for Machined Components.

Design for Sheet Metalworking: Dedicated Dies and Press working, Press Selection, Turret Press working, Press Brake Operations, Design Rules.

Design for Die Casting: Die Casting Alloys, The Die Casting Cycle, Die Casting Machines
Die Casting Dies, Finishing, Auxiliary Equipment for Automation, Determination of the Optimum Number of Cavities, Determination of Appropriate Machine Size, Die Casting Cycle Time Estimation, Die Cost Estimation, Assembly Techniques, Design Principles.

Design for Hot Forging: Characteristics of the Forging Process, The Role of Flash in Forging, Forging Allowances, Preforming During Forging, Flash Removal, Classification of Forgings, Forging Equipment, Classification of Materials, Forging Costs, Forging Die Costs, Die Life and Tool Replacement Costs, Costs of Flash Removal, Other Forging Costs.

Text Books:

1. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight, Product Design for Manufacture and Assembly, 3rd Edition, CRC Press, 2010.
2. Kalpakjian, S., Schmid, S.R., "Manufacturing Processes for Engineering Materials", 4th ed., Prendice-Hall, N.J., 2003.
3. Beck, Ronald D., "Plastic Product Design", 2nd ed., Van Nostrand Reinhold, New York.

References:

1. Landers, Thomas L., "Electronics Manufacturing Processes", Prentice Hall International Editions, Englewood Cliff, N.J.
2. Trucks, H.E., "Design for Economical Production", 2nd ed., Mich., Dearborn, SME 1987.
3. Bralla, James G., "Handbook of Products Design for Manufacturing: A Practical Guide to Low-cost Production", McGraw Hill, New York, 1986.
4. Farag, Mahmoud M., "Selection of Manufacturing Processes for Engineering Design", Prentice-Hall, London, 1989.
5. Linberg, Roy A., "Processes & Materials of Manufacture", 4th ed., Allyn & Bacon, Boston, U.S.A., 1990.
6. Lotter, B., "Manufacturing Assembly Handbook", Butterworth, London, 1989.

M. Tech. (Manufacturing Engineering), Semester – I	L	T	P	Credits
Industrial Tribology	3	0	0	3

Syllabus:

Surface topography: Characteristics of surface layers, Roughness parameters, Multi scale characterization of surface topography, Surface roughness measurement, Advanced techniques for surface topography evaluation, Contact of ideally smooth surfaces, contact of rough surfaces.

Types of wear and their mechanisms: Adhesive wear, Abrasive wear, Wear due to surface fatigue, wear due to chemical reactions, sliding contact between surface asperities, the probability of surface asperity contact, Wear in lubricated contacts, Rheological lubrication regime, Functional lubrication regime, Fractional film defect, Load sharing in lubricated contacts, Adhesive wear equation, Fatigue wear equation.

Lubrication and roughness: Introduction, Lubricants, Regimes of lubrication, Reynolds' equation, Applications of hydrodynamic lubrication theory, Hydrodynamic lubrication of roughened surfaces.

Tribology in manufacturing: Friction in manufacturing, Lubrication to control friction in manufacturing, solid lubrication, Tribology of rolling, drawing, extrusion and forging.

Sliding element bearings: Derivation of the Reynolds equation, Hydrostatic bearings, Squeeze-film lubrication bearings, thrust bearings, Journal bearings, air lubricated bearings.

Text Books:

1. Paulo Davim, Tribology for Engineers: A practical guide, Woodhead publishing, 2011.
2. Kragelski, Friction, Wear and Lubrication, Vol. I, II, III, MIR Publishers, 1983

References:

1. Basu, Sen Gupta and Ahuja, Fundamentals of Tribolgy, PHI, 2000.
2. M. M. Khonsari & E. R. Booser, "Applied Tribology", John Willey &Sons, New York, 2001.
3. E. P. Bowden and Tabor.D., "Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
4. Cameron, "Basic Lubrication theory", Longman, U.K.., 1981.
5. M. J. Neale (Editor), "Tribology Handbook", Newnes. Butterworth-Heinemann, U.K., 1995.

M. Tech. (Manufacturing Engineering), Semester – I	L	T	P	Credits
Optimization Techniques in Manufacturing	3	0	0	3

Syllabus:

Problem Solving Methods and Tools: Problem Space, Problem solving, State space, Algorithm's performance and complexity, Search Algorithms, Depth first search method, Breadth first search methods their comparison, A*, AO*, Branch and Bound search techniques, p type, Np complete and Np Hard problems.

Evolutionary Computing Methods: Principles of Evolutionary Processes and genetics, A history of Evolutionary computation and introduction to evolutionary algorithms, Genetic algorithms, Evolutionary strategy, Evolutionary programming, Genetic programming.

Genetic Algorithm and Genetic Programming: Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

Swarm Optimization: Introduction to Swarm intelligence, Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial Bee colony algorithm (ABC), Other variants of swarm intelligence algorithms.

Advances in Soft Computing Tools: Fuzzy Logic, Theory and applications, Fuzzy Neural networks, Pattern Recognition, Differential Evolution, Data Mining Concepts, Applications of above algorithms in manufacturing engineering problems.

Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Back propagation algorithm, factors affecting back propagation training, applications.

Application of Soft Computing to Mechanical Engineering/Production Engineering Problems: Application to Inventory control, Scheduling problems, Production Distribution, Routing, Transportation, Assignment problems.

Text Books:

1. Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001.
2. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, John Wiley and Sons, 2001.

References:

1. Elaine Rich, Artificial Intelligence, McGraw Hill, 2/e, 1990.
2. R. Panneerselvam, Operations Research‖, Prentice Hall of India Private Limited, New Delhi 2005
3. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
4. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
5. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994
6. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Geometric Modeling	3	0	0	3

Syllabus:

Fundamentals, Interpolation, and Curve Modeling: Introduction, Bezier Curves, Lagrange and Hermite Interpolation, Subdivision curves, B-splines, Matrix Forms, Rational Polynomial Curves, NURBs.

Surface Modeling, Subdivision, and Volumes: Surface topology, Curvature, Bezier Surfaces, B-spline Surfaces, B-spline Subdivision Schemes, Doo-Sabin and Catmull-Clark Subdivision, Triangulation and Loop Subdivision, Surface Interrogation, B-rep and Boolean Ops, Elements of CAD: Extrusion, Rotation, Lofting, Sweeping, CSG Representations and Euler Ops.

Applications and Advanced Research Topics: Voronoi Diagrams and Delaunay Triangulations, Curve and Surface Reconstruction, Registration, Simplification and Decimation, Smoothing, Discrete Deferential Geometry, Parameterization, Remeshing, Shape Analysis, Deformation, Segmentation, Spectral Methods.

Software Tools for Geometric Modeling.

Text Books:

1. Karl T Ulrich, Steven D Eppinger, "Product Design & Development" Tata McGrawhill New Delhi 2003.
2. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992, N J M Roozenberg, J Ekels, N F M Roozenberg, "Product Design Fundamentals and Methods" John Willey & Sons 1995.
3. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1/e 2004, Pearson Education New Delhi.

References:

1. Hollins B & Pugh S "Successful Product Design." Butter worths London.
2. Baldwin E N & Neibel B W "Designing for Production." Edwin Homewood Illinois
3. Jones J C "Design Methods." Seeds of Human Futures. John Willey New York.
4. Bralla J G "Handbook of Product Design for Manufacture, McGrawhill NewYork.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Characterization of Materials	3	0	0	3

Syllabus:

Introduction to materials and Techniques, Structure analysis tools: X-ray diffraction: phase identification, indexing and lattice parameter determination, Analytical line profile fitting using various models, Neutron diffraction, Reflection High Energy Electron Diffraction, and Low Energy Electron Diffraction; Microscopy techniques: Optical microscopy, transmission electron microscopy (TEM), energy dispersive X-ray microanalysis (EDS), scanning electron microscopy (SEM), Rutherford backscattering spectrometry (RBS), atomic force microscopy (AFM) and scanning probe microscopy (SPM); Thermal analysis technique: Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermo-gravimetric analysis (TGA); Electrical characterization techniques: Electrical resistivity, Hall effect, Magnetoresistance; Magnetic characterization techniques: Introduction to Magnetism, Measurement Methods, Measuring Magnetization by Force, Measuring Magnetization by Induction method, Types of measurements using magnetometers: M-H loop, temperature dependent magnetization, time dependent magnetization, Measurements using AC susceptibility, Magneto-optical Kerr effect, Nuclear Magnetic Resonance, Electron Spin Resonance; Optical and electronic characterization techniques: UV-VIS spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy.

Text Books:

1. Characterization of Materials (Materials Science and Technology:A Comprehensive Treatment, Vol 2A & 2B, VCH (1992).
2. Semiconductor Material and Device Characterization, 3rd Edition, D. K. Schroder, Wiley-IEEE Press (2006).
3. Materials Characterization Techniques, S Zhang, L. Li and shok Kumar, CRC Press (2008).

References:

1. Physical methods for Materials Characterization, P. E. J. Flewitt and R K Wild, IOP Publishing (2003).
2. Characterization of Nanophase materials, Ed. Z L Wang, Willet-VCH (2000).

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
	3	0	0	3

Product Design and Development

Syllabus:

Introduction: Classification/ Specifications of Products, Product life cycle. Product mix, Introduction to product design, Modern product development process, Innovative thinking. Morphology of design. Conceptual Design: Generation, selection & embodiment of concept. Product architecture, Industrial design: process, need

Robust Design: Taguchi Designs & DOE, Design Optimization. Design for Manufacturing & Assembly: Methods of designing for Manufacturing and assembly, Designs for Maintainability, Designs for Environment, Product costing, Legal factors and social issues, Engineering ethics and issues of society related to design of products.

Value Engineering / Value Analysis: Definition. Methodology, Case studies, Economic analysis, Qualitative & Quantitative. Ergonomics / Aesthetics, Gross human autonomy, Anthropometry, Man-Machine interaction, Concepts of size and texture, colour. Comfort criteria, Psychological & Physiological considerations,

Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design. Concurrent Engineering, Rapid prototyping, Tools for product design Drafting / Modeling software, CAM Interface, Patents & IP Acts. Overview, Disclosure preparation.

Text Books:

1. Karl T Ulrich, Steven D Eppinger, "Product Design & Development" Tata McGrawhill New Delhi 2003.
2. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992 N J M Roozenberg, J Ekel, N F M Roozenberg "Product Design Fundamentals and Methods" John Willey & Sons 1995.
3. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004, Pearson Education New Delhi.

References:

1. L D Miles "Value Engineering."
2. Hollins B & Pugh S "Successful Product Design." Butter worths London.
3. Baldwin E N & Neibel B W "Designing for Production." Edwin Homewood Illinois
4. Jones J C "Design Methods." Seeds of Human Futures. John Willey New York.
5. Bralla J G "Handbook of Product Design for Manufacture, McGrawhill NewYork

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Reverse Engineering	3	0	0	3

Syllabus:

Introduction: Historical Background, Industrial Evolution, Reinvention of Engineering, Marvels from Nature, Reverse Engineering in Modern Industries, Reverse, Engineering vs. Machine Design, Motivation and Challenge, Analysis and Verification, Accreditation, Part Criticality, Applications of Reverse Engineering.

Geometrical Form: Surface and Solid Model Reconstruction, Scanning Instruments and Technology, Principles of Imaging, Cross-Sectional Scanning, Digital Data, Computational Graphics and Modeling, Data Refinement and Exchangeability, Dimensional Measurement, Case Studies, Part Tolerance, Prototyping, Additive Prototyping Technologies, Subtractive Prototyping Processes, Rapid Injection. Molding, Steps of Geometric Modeling.

Material Characteristics and Analysis: Alloy Structure Equivalency, Phase Formation and Identification, Mechanical Strength, Hardness, Part Durability and Life Limitation, Part Failure Analysis, Fatigue, Creep and Stress Rupture, Environmentally, Induced Failure.

Material Identification and Process Verification: Material Specification, Composition Determination, Microstructure Analysis, Manufacturing Process Verification.

Data Process and Analysis: Statistical Analysis, Data Analysis, Reliability and the Theory of Interference, Weibull Analysis, Data Conformity and Acceptance, Data Report

Part Performance and System Compatibility Performance Criteria, Methodology of Performance Evaluation, System Compatibility.

Acceptance and Legality: Legality of Reverse Engineering, Legal Definition of Reverse Engineering, Legal Precedents on Reverse Engineering, Patent, Copyrights, Copyright Codes, Legal Precedents on Copyrights, Trade Secret, Case Study of Reverse Engineering a Trade Secret, Third-Party Materials.

Text Books:

1. Wego Wang, "Reverse Engineering: Technology of Reinvention", ISBN-13: 978-1439806302, CRC Press.
2. Kevin Otto, "Product Design: Techniques in Reverse Engineering and New Product Development", ISBN-13: 9788177588217, Dorling Kindersley

References:

1. Robert Messler, "Reverse Engineering: Mechanisms, Structures, Systems & Materials", McGraw Hill Education, ISBN: 9780071825160
2. Raja, Vinesh, Fernandes, Kiran J, "Reverse Engineering an Industrial Perspective" ISBN 978-1-84628-856-2, Springer.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Design of Experiments	3	0	0	3

Syllabus:

Graphical Data analysis tools - Stem and leaf plot, Dot plot, Box plot, Distribution of sample data Normal distribution, t-distribution, Normal Probability Plotting on ordinary graph paper, Interpretation, testing a new method for improvement - Variability known from past, Variability estimated from the experiment, comparing two methods - Randomised samples, Paired samples, Comparing more than two methods simultaneously- ANOVA.

Experimental strategies - Deficiencies of one factor at a time experiments, Problems in analysis of past data, Necessity for randomization, Basics of Experimental Design - Terminology, two level factorials, Estimation of effects and interactions, Yates algorithm, Un-replicated experiments - judging significance, Testing for significance in replicated experiments. Developing mathematical model equations, calculating residuals, checking whether experiment has been conducted satisfactorily.

Handling non-normal response, Transformations, Choosing the number of experiments, testing whether linear model is satisfactory, how to handle uncontrollable factors, how to deal with difficult to randomize factors. Dealing with large number of factors, Fractional Factorial experiments and Plackett Burman Designs, how to minimize possible confusion, Design Resolution, Sequential experimentation strategies, Folding over. Determining optimum conditions experimentally - Central Composite Designs, D-Optimal Designs, Response Surface methods, Mixture experiments. Experiments to determine variability and minimize it. Training in Design Expert, software for DoE. Individual Design Project, presentation and discussion. Applications / Case Studies in Research, Quality Improvement, Product Development.

Text Books:

1. Quality Engineering Using Robust Design, by Madhav S. Phadke , Prentice Hall (12 May 1989)
2. M. J. Anderson, and P. J. Whitcomb, DoE Simplified: Practical Tools for Effective Experimentation, 3rd ed., Productivity Press, USA, 2015.

References:

3. J. Lawson, and J. Erjavec, Modern Statistics for Engineering and Quality Improvement, Thomson Duxbury, Indian EPZ edition, 2000.
4. G. E. P. Box, W. G. Hunter, and S. J. Hunter, Statistics for Experimenters", 2nd ed., John Wiley & Sons Inc., 2005.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Tool Design Engineering	3	0	0	3

Syllabus:

Cutting tool design: Different tool materials: cemented carbides, coated carbides, cermets, ceramics and polycrystalline tool materials - compositions - properties of tool materials - Selection and treatments - Plastics as tooling materials - New tooling materials Design of single point turning and threading tools - Selection of tool holders and inserts for turning - Chip breakers - Design of twist drill and reamers.

Press tool design: Press working terminology - Presses and press accessories - Computation of capacities and tonnage requirements - Strip layout - Types of dies - Design and development of various types of cutting, forming, bending and drawing dies - Progressive dies, Combination dies and compound dies - Blank development for cylindrical and non-cylindrical shells, Simple problems.

Design of jigs: Principles of jigs and fixtures - Locating elements - Drill bushes - Different types of jigs - Plate, latch, channel, post, angle plate, turn over, and pot jigs - Automatic drill jigs, Design and development of jigs for given components.

Design of fixtures: Design principles of fixtures - Design of fixtures for milling, boring. Design of fixture for assembly, inspection and welding. Design and development of fixtures for given components.

Case study: Case study in Jigs, fixture and press tools.

Text Books:

1. Sadasivan T.A, and Sarathy D, "Cutting tools for Productive machining", 1st edition, Widia (India) Ltd, Bangalore, 1999.
2. Donaldson.C, Lecain.G.H and Goold.V.C, "Tool Design", Tata McGraw Hill publishing company limited, New Delhi, 2002.
3. Edward G. Hoffman, "Jigs and Fixture design", 2nd edition, Galgotia publication Pvt. Ltd., New Delhi, 1987.

References:

1. Hiram E. Grant, "Jigs and Fixtures - Nonstandard clamping device", Tata McGraw Hill, New Delhi, 1971.
2. Prakash H. Joshi, "Press tool design and construction", 1st edition, Wheeler Publishing, New Delhi, 2000.
3. Kempster.M.H.A, "An Introduction to Jig and tool design", 3rd edition, ELBS, 1987.
4. Prakash H. Joshi, "Cutting tools", 1st edition, Wheeler Publishing, New Delhi, 1997.
5. Prakash H. Joshi, "Tooling Data", 1st edition, Wheeler Publishing, New Delhi, 2000.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Processing and Design of Materials	3	0	0	3

Syllabus:

Introduction of advanced materials and its manufacturing processes for engineering applications. Piezoelectric materials (PZT): Dynamic behavior of PZT transducers, piezoelectric materials and manufacturing techniques (stability, poling and depolarization).

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Temperature assisted shape memory effect, Visco-elastic behavior, magnetic shape memory effect. Various shape memory alloys. Manufacturing technology of SMAs.

Electro rheological (ER) and magneto-rheological (MR) materials: Characteristics of ER and EM fluids. ER and EM materials. Composite materials: Design and manufacturing of polymer matrix, metal matrix and ceramic matrix composites. Various forms and type of reinforcements, fillers and additives. Design of composites for structural, wear resistance and high temperature applications.

MEMS systems. Introduction, characteristics of silicon wafers and other materials for MEMS applications. Various manufacturing techniques of MEMS components Materials for high temperature applications: Ni-Cr alloys, ODS materials, Ni base and Co based super alloys, carbon-carbon composites. Diffusion bond coating of high temperature materials.

NEMS systems: Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects, fabrication and applications.

Smart Materials: Smart materials: Concepts, crystal structure, phase transformation mechanism and characteristics, properties, classification, applications.

Text Books:

1. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman and Hall, 1992.
2. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P, 1998.
3. T W Duerig, K N Melton, D Stockel, and CW Wayman, "Engineering Aspects of Shape Memory Alloys", Butterworth Heinemann, 1990.
4. Fahrner W.R.,Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.

References:

1. Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub., 1985.
2. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing and Design.
3. Marcel Dekker Inc, New York, 1993. J. Jackson, "Micro Fabrication and Nano machining", Taylor and Francis, 2006.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Laser Processing of Materials	3	0	0	3

Syllabus:

Principles of industrial lasers: Principle of Laser Generation, Optical Resonators, Laser Modes, Mode Selection, Line- Broadening Mechanisms, Laser Beam Modifications and Types of Industrials Lasers.

Thermal process- heat and fluid flow: Heat Flow in The Work Piece: Thick Plate with Point Heat Source, Thin Plate with Line Heat Source, Peak Temperature and Cooling Rates Fluid Flow in Molten Pool: Continuity Equation, Navier-Stokes Equation and Surface Tension Effects.

Laser metallurgy: Process Microstructure- Fusion Zone, Zone of Partial Melting, Haz, Discontinuities- Porosity, Cracking, Lack of Fusion, Incomplete Penetration and Undercut.

Laser welding and surface modifications: Process Mechanisms (Key Hole and Plasmas), Operating Characteristics, Process Variations, Imperfections-Industrial Applications, Recent Developments Laser Surface Heat Treatment, Laser Surface Melting- Glazing, Laser Direct Metal Deposition, Laser Surface Alloying, Laser Surface Cladding and Hard Coatings, Laser Physical Vapour Deposition and Laser Shock Peening.

Laser Machining: Laser Instrumentation for Cutting and Drilling, Cut Quality and Process Characteristics, Methods of Cutting, Practical Performance, Process Variations, Industrial Applications of Laser Cutting and Drilling.

Laser Forming: Mechanisms of Laser Forming, Laser Origami, Laser assisted forming.

Text Books:

1. Elijah Kannatey-Asibu, Jr., "Principles of Laser Materials Processing ", John Wiley & Sons, 2009
2. Jacques Perrière, Eric Millon, Eric Fogarassy, "Recent Advances in Laser Processing of Materials" Elsevier, 2006.

References:

1. John C. Ion, "Laser Processing of Engineering Materials", Elsevier Butter Worth- Heinemann, Burlington, 2005.
2. Steen W. M, "Laser Materials Processing", 3rd Edition, Springer Verlag, U.K., 2003.
3. Ykalin, Ugloo A, Kokona A.,"Laser And Electron Beam Material Processing", Hand Book, MIR Publishers, 1987.
4. Narendra B. Dahotre, Sandip P. Harimkar, "Laser Fabrication and Machining of Materials" Springer, 2008.
5. Duley W. W," Laser Processing AndAnalysis Of Materials"; Plenum Press, New York, 1983

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Manufacturing Planning and Control

Syllabus:

Overview of manufacturing systems and various issues of interest: Assembly Line, Repetitive batch manufacturing, Cellular manufacturing, FMS, JIT, CIM.

Preplanning: Forecasting, Economic analysis, Aggregate planning, Capacity planning, Inventory planning.

Decision making in design of manufacturing systems: Group Technology, Line balancing, Plant layout.

Operations planning: MRP, MRP II, Hierarchical planning systems, JIT systems, FMS

Operation and control: Lot sizing decisions, production scheduling, line of balance, quality planning and control, cost planning and control, productivity planning and control and applications of theory of constraints.

Simulation: Simulation analysis of manufacturing systems.

Road map to World Class Manufacturing Systems: Ideal Manufacturing, Intelligent Manufacturing and Agile Manufacturing Systems.

Applications of recent developments in IT including ERP, e-Business, Enterprise Applications Integration (EAI) and Virtual Manufacturing: Concepts, Justification and Status of development and implementation.

Case Studies.

Text Books:

1. D. D. Bedworth and J. E. Bailey (1983), Integrated Production Control System-Management, Analysis and Design, John Wiley.
2. E. A. Elsayed and T. O. Boucher (1985), Analysis and Control of Production Systems, Prentice Hall.
3. J. R. King (1975), Production Planning and Control, Pergamon Press Oxford.

   P. F. Bestwick and K. Lockyer (1982), Quantitative Production Management, Pitman Publications.

References:

1. A. C. Hax and D. Candea (1984), Production and Inventory Management, Prentice Hall.
2. L. A. Johnson and D. C. Montgomery (1974), O.R. in Production Planning, Scheduling and Inventory Control, John Wiley and Sons.

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Financial Management

Syllabus:

Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Characteristics and Classification of Financial Instruments. Financial Marketing strategies: Capital Market, Money Market and Foreign Currency Market Financial Institutions: Commercial Banks, Investment-Merchant Banks and Stock Exchanges. Initial Public Offers

Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.

Overview of Corporate Finance: Objectives, Industrialization and corporate planning Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.

Capital Budgeting: Inputs for Capital Budgeting Decisions; Investment Appraisal Criteria Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.

Sources of Finance: Long Term and Short Term Finance.

Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches.

Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, Modigliani-Miller Approach, effect of Tax structure, Goods and Services Tax.

Text Books:

1. Fundamentals of Financial Management, 13 th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10 th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.

References:

1. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
2. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Quality Engineering and Management

Syllabus:

Introduction Quality Management: Indian Companies Monopolize the Deming Awards in 2003, Quality Management- A conceptual frame work, Strategic Quality Management, Benchmarking

Quality Standards and business excellence models: Quality system Standards, Bureau of Indian Standards, Agmark Grading and standardization, Quality council of India, International Organization for Standardization, Conformance to Specifications, Quality Assurance, Quality Circles, Quality audits, ISO 14000, Customer Operations Performance Centre 2000

Total Quality Management, W. Edwards Deming's Contribution to TQM, Juran's Contribution to TQM, Crosby's contribution to TQM, Ishikawa's contribution to TQM, Comparing the Quality Gurus, Total Productive Maintenance.

Service quality management and Cost of Quality: Measuring Service Quality, Prevention costs, Appraisal Costs, Internal and External failure costs, Cost of quality models, India's Quality Journey so far, Quality management in India, Quality related priorities of Indian companies, Case studies

Six sigma and Experimental design: Meaning of Six sigma, The seven magnificent Quality tools, Introduction of experimental design, Taguchi Method in Experimental Design, Concept, Application of QFD, Case Study

Statistical Quality Control: Quality control-its introduction and benefits, Variation in processes: factors, process capability & Its analysis, control charts for variables and attributes, Establishing & interpreting control charts, Concept of Acceptance Sampling, sampling by attributes, single and double sampling plans, inspections by samples, AQL, LTPD, consumers and producer's risk, construction and use of operating characteristic curves, use of standard sampling tables and related IS, sampling by variables, Continuous sampling plan, vendor ratings.

Intellectual Properties System: Definition of intellectual property, importance of IPR; TRIPS and its implications, patent, copyright, industrial design and trademark

Text Books:

1. Quality Management, by Kanishka Bedi
2. Intellectual Property Rights, Prbuddha Ganguli, TMH Publisher
3. Probability and Reliability with Statistics, by Trivedi,PHI

References:

1. Statistical Quality Control, by M. Mahajan
2. TQM in Service Sector, by R.P.Mohanty and R.R.Lakhe
3. Total Quality Management, by Arora, Kataria
4. Total Quality Management, by Subburaj, TMH

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Industrial Machine Vision

Syllabus:

Introduction: Types of inspection tasks, Structure of image processing systems, examples
Image Preprocessing: Gray Scale transformations, Image arithmetic, Linear Filters, Other Filters
Positioning: Positioning of individual object, Orientation of individual object, Robot positioning
Segmentation: Regions of interest, Thresholding, Contour Tracing, Edge based methods, Template matching
Mark Identification: Bar code identification, Character identification, identifying pin marked digits on metal, Print quality inspection Classification: As function approximation, Instance based classifiers, Function based classifiers, Neural network classifiers Dimension checking: Simple Gauging, Shape checking on punched parts, injection molded parts, High accuracy gauging of threads, Calibration.
Image acquisition and illumination: Solid state sensors, Standard video cameras, other cameras, Transmission to computer, Optics, Lighting
Presence Verification: Simple presence verification, simple gauging for assembly verification, presence verification using classifiers Object Features: Basic Features, Shape Descriptors, Gray Level Features.

Text Books:

1. Demant, Industrial Image Processing – Visual Quality Control in Manufacturing, 2nd ed., Springer, 2013.
2. Gonzalez, Digital Image Processing Using MATLAB, 2nd ed., Pearson Education, 2010.

References:

1. Gonzalez, and Woods, Digital Image Processing, 3rd ed., Pearson Education, 2008.
2. Batchelor, and Whelan, Intelligent Vision Systems for Industry, Springer Verlag, 1997.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Nanoscience and Technology	3	0	0	3

Syllabus:

Over View 0f Nanotechnology: Definition, historical development, properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials, ordered oxides, Nano arrays, potential health effects

Nanodefects, Nano Partiles and Nanolayers: Nanodefects in crystals, applications, Nuclear Track nano defects. Fabrication of nano particles, Epitaxy and ion implantation, formation of Silicon oxide- chemical composition, doping properties, optical properties

Nanostructuring: Nanophotolithography, techniques, optical, electron beam, ion beam, X-ray and Synchrotron, nanolithography for microelectronic industry, nanopolishign of Diamond, Etching of Nano structures, Nano imprinting technology, Focused ion beams, LASER interference Lithography nanoarrays, Near-Field Optics - case studies and Trends

Science and Synthesis of Nano Materials: Classification of nano structures – Effects of nano scale dimensions on various properties, structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics, Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon Nanotubes Solid carbon source based production techniques, Gaseous carbon source based production techniques, Diamond like carbon coating. Top down and bottom up processes.

Characterization of Nano Materials: Nano-processing systems, Nano measuring systems, characterization, analytical imaging techniques, microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques, spectroscopy techniques, Raman spectroscopy, 3D surface analysis, Mechanical, Magnetic and thermal properties, Nano positioning systems.

Text Books:

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Fahrner W.R.,Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
5. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006.
6. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013.
7. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004.

References:

1. Cao G., Nanostructures and Nanomaterials Synthesis, Properties, and Applications, Imperial College Press, 2004.
2. Wang, Z. L., (Ed.), Characterization of nanophase materials, Wiley-VCH Verlag, GmbH, 2000.
3. Goddard III W.A., Handbook of Nanoscience, Engineering, and Technology, Taylor & Francis Group, 2007.
4. B.P.S. Chauhan (Ed), Hybrid Nanomaterials: Synthesis, Characterization, and Applications,Wiley-VCH Verlag GmbH, 2011.
5. J. Lei andF.Lin, Bioinspired Intelligent Nanostructured Interfacial Materials, World Scientific Publishing Company, 2010.

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Lean manufacturing and Six sigma	3	0	0	3

Syllabus:

Introduction to Lean- Definition, Purpose, features of Lean; top seven wastes, Need for Lean, Elements of Lean Manufacturing, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept, Critical success factors for six sigma.

Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma, Features of lean six sigma, The laws of lean six sigma, Benefits of lean six sigma, Introduction to DMAIC tools.

Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event, Launch preparation.

Resource and project selection, Selection of Black belts, Selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Balanced score card for project identification, project suitable for lean six sigma.

Predicting and improving team performance, nine team roles, Team leadership, DMAIC process, Institutionalizing lean six sigma, Design for lean six sigma, Case study presentations.

Nine sigma: Basic Concepts and principles, comparison with six sigma etc

Text Books:

1. Michael L. George, Lean Six Sigma, McGraw-Hill, 2002.
2. James P. Womack, Daniel T. Jones, Lean Thinking, Free press business, 2003.
3. Forrest W. Breyfogle III, Implementing Six Sigma: Smarter solutions Using Statistical Methods, 1999.

References:

1. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, John Wiley & Sons, 2003.
2. Rother M. and hook J., Learning to See: Value Stream Mapping to add value and Eliminate Muda, Lean Enterprise Institute, Brookline, MA.

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Research Methodology and IPR

Syllabus:

Introduction: Meaning of Research, Objectives, Motivation, Types of Research, Research approaches, Significance of Research Method versus Methodology, Research and Scientific Method Importance of Knowing how research is done, Research Process, Criteria of Good Research, Problems encountered by Researchers in India. What is a Research Problem, Selecting the problem Necessity of defining the problem, Technique involved in defining a problem.

Research Design: Meaning, Need, features of Good Design, Important concepts of Research Design Different Research designs, Basic Principles of Experimental Designs, Developing a Research Plan.

Sampling Design: Census and Sample survey, Implications of a Sample Design, Steps and Criteria for selecting a Sampling Procedure, Characteristics and Types of a Good Sample Designs, Random Sample, Random Sample from an indicate universe, Complex Random Sampling Designs.

Processing and Analysis of Data: Processing operation, problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression Partial Correlation, Association in case of Attributes, Other Measures, Summary chart concerning Analysis of Data.

Interpretation, Report Writing: Interpretation, need, Technique, Precaution in interpretation, Significance of Report writing, Steps in report writing, Layout of the Research report, Types and Mechanics of writing Research Reports, Computer & Computer Technology, Oral presentation.

Intellectual Property Rights: Basic concept of Intellectual Property, Characteristics and Nature of Intellectual Property right, Justifications for protection of IP Co, IPR and Economic Development, Major International Instruments relating to the protection of IP - Berne Convention, Paris Convention and TRIPS. Copyright, Patents

Text Books:

1. R. Panner Selvam, ―Research Methodology‖, Prentice Hall of India, New Delhi, 2004.
2. Research Methodology – C.R. Kothari, Wishwa Prakashan Publishers, India, 2001.
3. Murray R. Spigel, Theory and problem of Statistics‖, Schaum Publishing Co., New York. 2000.
4. Lionel Bently & Brad Sherman, Intellectual Property Law, Oxford.
5. P. Narayanan, Intellectual Property Law, Eastern Law House

References:

1. The Copyright Act, 1957
2. The Patent Act, 1970
3. The Trade Marks Act, 1999
4. The Designs Act, 2000
5. The Geographical Indication of Goods Act, 1999
6. The Protection of Plant Varieties and Farmers' Rights Act, 2001.

L T P Credits

M. Tech. (Manufacturing Engineering), Semester – 2

Micro Electro Mechanical Systems (MEMS) 3 0 0 3

Syllabus:

Over View of Mems and Microsystems: Definition, properties, design and fabrication micro-system, microelectronics, working principle, applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers.

Fabrication Processes and Micro System Packaging: Photolithography, photo resist applications, light sources, ion implantation, diffusion, Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy, etching bulk and surface machining, LIGA process, LASER, Electron beam, Ion beam processes, Mask less lithography. Micro system packaging, packaging design, levels of micro system packaging -die level, device level and system level, interfaces in packaging, packaging technologies- Assembly of Microsystems.

Micro Devices: Sensors, classification, signal conversion ideal characterization of sensors micro actuators, mechanical sensors, measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer, chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators, applications.

Science and Synthesis of Nano Materials: Classification of nano structures, Effects of nano scale dimensions on various properties, structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics, Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes, Solid carbon source based production techniques, Gaseous carbon source based production techniques, Diamond like carbon coating. Top down and bottom up processes.

Characterization of Nano Materials: Nano-processing systems, Nano measuring systems, characterization, analytical imaging techniques, microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques, spectroscopy techniques, Raman spectroscopy, 3D surface analysis, Mechanical, Magnetic and thermal properties, Nano positioning systems.

Text Books:

1. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004.
2. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
3. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
4. Tai – Ran Hsu, MEMS & Microsystems Design & Manufacture, Tata-McGraw Hill, New Delhi, 2002.
5. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8.

References:

1. C. Liu, Foundations of MEMS
2. N. Maluf, An Introduction to Microelectromechanical Systems Engineering
3. J. Pelesko & D. Bernstein, Modeling MEMS and NEMS

M. Tech. (Manufacturing Engineering), Semester – 2	L	T	P	Credits
Automation and Control	3	0	0	3

Syllabus:

Introduction: Structure & components Industrial Automation systems. Architectural levels of Industrial controls.

Actuators & sensors: Servomotors, Stepper motors, Process I/O systems. Local & remote I/O systems.

Controllers: Different types of controllers, Single loop and Multiloop controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning, Direct Digital Controllers, Software implementation of Multiloop Controllers. Distributed Control Systems.

Sequence Control: Programmable Logic Controllers, Relay Ladder Logic, Programming.

Supervisory Controllers: Functionally of Supervisory Control Level, Process Optimization, Recipe Management Material. Tracking. Man-machine interfaces.

Process Operation Management Systems: Overview of process operation management systems, order, inventory management, process scheduling, quality management.

Industrial Communication Systems: Characteristic features of industrial networks. Low level networks and their features, Field bus architecture. Performance aspects of Industrial Automation Systems.

Text Books:

1. Webb J.W-Programmable controllers: Principle and Applications, PHI New Delhi
2. Parr A –Programmable Controllers: An Engineers' Guide, Newnes, Butterworth-HeinnemanLtd1993.
3. Liptak B.G (ED)-Process Control H andbook, vol-2 Chilton book Co.

References:

1. Noltinc - Handbook for Instrumentation Engineers.
2. Bollinger J.G and Duffie N.A-Computer control of machines and processes, Reading M A, Addison-Wesley, 1988.

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Industrial Safety and Risk Assessment

Syllabus:

Concepts of safety: Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards, Hazards from utilities like air, water, steam. Hazard identification, Safety Audits Checklists, What if Analysis, HAZAN, HAZOP, Vulnerability models, Event tree and Fault Tree Analysis, Past accident analysis, Flixborough, Mexico, Bhopal, Madras, Vizag accident analysis.

Hazops: Principles, Risk ranking, Guide word, Parameter, Deviation, Causes, Consequences, Recommendation, Coarse HAZOP study, Case studies, Pumping system, Reactor System, Mass transfer system.

Introduction to Consequence Analysis: Fire and Explosion models: Radiation, Tank on fire, Flame length, Risk analysis- Radiation intensity calculation and its effect to plant, people & property, UCVCE –Explosion, Deflatration, Detonation, TNT, TNO & DSM model, Over pressure. Methods for determining consequences effects: Effect of fire- Effects of explosion, Risk contour, Flash fire, Jet fire, Pool fire, BLEVE, Fire ball.

Safety in plant design and layout: Safety provisions in the factory act 1948, Indian explosive act 1884 ESI act 1948 Advantages of adopting safety laws. Safety measures in handling and storage of chemicals, Fire chemistry and its control, Personnel protection, Safety color codes of chemicals.

Risk Management & ISO14000: Overall risk analysis, Generation of Meteorological data, Ignition data, Population data. Overall risk analysis, E and FI model, Disaster management plan, Emergency planning, Onsite and offsite emergency planning, Risk management, Gas processing complex, refinery – First aids.

Text Books:

1. Blake, R.P., “Industrial Safety”, Prentice Hall, 1953.
2. Lees, F.P., “Loss Prevention in Process Industries”, 2nd Edition, Butterworth Heinemann, 1996.
3. K. V. Raghavan and A A. Khan, “Methodologies in Hazard Identification and Risk Assessment”, Manual by CLRI, 1990.
4. V. C. Marshal, “Major Chemical Hazards”, Ellis Horwood Ltd., Chichester, United Kingdom. 1987.

References:

1. Geoff Wells, “Hazard Identification and Risk Assessment”, I.ChE.,John Ridley and John Channing, “Safety at Work”, 6th Edition. Butterworth-Heinemann, 2003.
2. “A Guide to Hazard Operability Studies”, Chemical Industry Safety and Health Council, 1977.

M. Tech. (Manufacturing Engineering), Semester – 2

L	T	P	Credits
3	0	0	3

Entrepreneurship and Startups

Syllabus:

Entrepreneurship: Definition of Entrepreneur, Entrepreneurial motivation and barriers; Internal and external factors; Types of entrepreneurs; Theories of entrepreneurship; Classification of entrepreneurship. Creativity and Innovation: Creative Problems Solving, Creative Thinking, Lateral Thinking, Views of De Bono, Khandwala and others, Creative Performance in terms of motivation and skills.

Creativity and Entrepreneurial Plan: Idea Generation, Screening and Project Identification, Creative Performance, Feasibility Analysis: Economic, Marketing, Financial and Technical; Project Planning, Evaluation, Monitoring and Control, segmentation, Targeting and positioning of Product, Role of SIDBI in Project Management.

Operation problems: Incubation and Take-off, Problems encountered Structural, Financial and Managerial Problems, Types of Uncertainty. Institutional support for new ventures: Supporting organizations; Incentives and facilities; Financial Institutions and Small-scale Industries, Govt. Policies for SSIs.

Family and non-family entrepreneurs: Role of Professionals, Professionalism vs. family entrepreneurs, Role of Woman entrepreneur, Sick industries, Reasons for Sickness, Remedies for Sickness, Role of BIFR in revival, Bank Syndications.

Startups' Opportunity Assessment, Business Models, Entrepreneur talk, Clinical/ Regulatory, Sector Specific Group Briefing by Advisory Committee, Corporate Legal and Intellectual Property, Pitching, Payers and Reimbursement, Pitch practice, Investors, Mistakes I Won't Repeat, Business Development and Exits, Finance, Budgeting, Team Building,

Text Books:

1. Bridge S., et al- Understanding Enterprise: Entrepreneurship and Small Business (Palgrave, 2003).
2. Holt- Entrepreneurship: New Venture Creation (Prentice-Hall) 1998.
3. Robert D.Hisrich, Michael P.Peters, "Entrepreneurship Development, Tata McGraw Hill edition.
4. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company - Blank and Dorf.

References:

1. Marc H. Meyer and Frederick G. Crane, New Venture Creation: An Innovator's Guide to Entrepreneurship, Sage Publications, 2nd Edition.
2. Technology Ventures: From Idea to Enterprise - Byers, Dorf, Nelson.
3. Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist - Feld, Mendelson, Costolo.
4. The Founder's Dilemma, Wasserman.
5. Breakthrough Entrepreneurship, Burgstone and Murphy
6. Business Model Generation, Alexander Osterwalder.