MAHATMA GANDHI UNIVERSITY

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

MECHANICAL ENGINEERING

WITH SPECIALIZATION IN

COMPUTER INTEGRATED MANUFACTURING

(2011 ADMISSION ONWARDS)

SCHEME AND SYLLABI FORM. Tech. DEGREE PROGRAMME IN MECHANICAL ENGINEERING WITH SPECIALIZATION IN COMPUTER INTEGRATED MANUFACTURING

SEMESTER - I

Sl. No.	Course Number	Subject	Hrs/Week			Evaluation Scheme (Marks)					Credits
						Sessional Exam (internal)			ESE (Theory / Practical)	Total	
			L	T	P	TA	CT	Sub Total			
1	MMECM 101[$1]	Advanced Engineering Materials and Processing	3	1	0	25	25	50	100	150	4
2	MMECM 102	Computer Aided Process Planning and Control	3	1	0	25	25	50	100	150	4
3	MMECM 103[$2]	Computer Aided Design in Manufacturing	3	1	0	25	25	50	100	150	4
4	MMECM 104	Finite Element Analysis in Manufacturing	3	1	0	25	25	50	100	150	4
5	MMECM 105	Professional Elective – I	3	0	0	25	25	50	100	150	3
6	MMECM 106	Professional Elective – II	3	0	0	25	25	50	100	150	3
7	MMECM 107	Computer Integrated Manufacturing Laboratory - I	0	0	3	25	25	50	100	150	2
8	MMECM 108	Seminar - I	0	0	2	50	-	50	0	50	1
			18	4	5			400	700	1100	25

Elective – I (MMECM 105)		Elective – II (MMECM 106)	
MMECM 105-1	Metrology and Computer Aided Inspection	MMECM 106-1	Production Scheduling
MMECM 105-2	Principles of Robotics and Applications	MMECM 106-2	Reliability Engineering
MMECM 105-3	Rapid Prototyping	MMECM 106-3	Quality Engineering and Management
MMECM 105-4	Deign for Manufacturing and Assembly	MMECM 106-4	Lean Manufacturing

TA – Teachers Assessment (Quizzes, attendance, group discussion, tutorials, seminar, field visit etc)

CT – Class Test; Minimum two tests conducted by the institute

ESE – University End Semester Exam will be conducted by the institute through concerned affiliating University.

L - Lecture, T - Tutorial, P - Practical

$1 Common to MMEPI, MMEMP and MMECM

$2 Common to MMEPI, MMECM and MMEMD

SEMESTER – II

Sl. No.	Course Number	Subject	Hrs/Week			Evaluation Scheme (Marks)					Credits
						Sessional Exam (internal)			ESE (Theory / Practical)	Total	
			L	T	P	TA	CT	Sub Total			
1	MMECM 201	Computer Aided Manufacturing	3	1	0	25	25	50	100	150	4
2	MMECM 202	Simulation of Manufacturing Systems	3	1	0	25	25	50	100	150	4
3	MMECM 203[$3]	Flexible Manufacturing Systems	3	1	0	25	25	50	100	150	4
4	MMECM 204[$4]	Automation and Control Systems	3	1	0	25	25	50	100	150	4
5	MMECM 205	Professional Elective – III	3	0	0	25	25	50	100	150	3
6	MMECM 206	Professional Elective – IV	3	0	0	25	25	50	100	150	3
7	MMECM 207	Computer Integrated Manufacturing Laboratory - II	0	0	3	25	25	50	100	150	2
8	MMECM 208	Seminar - II	0	0	2	50	0	50	0	50	1
			18	4	5			400	700	1100	25

$3 Common to MMEPI and MMECM

$4 Common to MMEMP and MMECM

Elective – III (MMECM 205)		**Elective – IV (MMECM 206)**	
MMECM 205-1	Micromachining and Precision Engineering	MMECM 206-1	Advanced Operations Research
MMECM 205-2	Advanced Tool Engineering	MMECM 206-2	Advanced Optimisation Techniques
MMECM 205-3	Analysis and Control of Manufacturing Systems	MMECM 206-3	Research Methodology
MMECM 205-4	Artificial Intelligence	MMECM 206-4	Manufacturing Information Systems

TA – Teachers Assessment (Quizzes, attendance, group discussion, tutorials, seminar, field visit etc)

CT – Class Test; Minimum two tests conducted by the institute

ESE – University End Semester Exam will be conducted by the institute through concerned affiliating University.

L - Lecture, T - Tutorial, P - Practical

SEMESTER-III

Sl. No.	Course Number	Subject	Hrs/Week			Evaluation Scheme (Marks)					Credits
						Sessional Exam (internal)			ESE (ORAL**)	Total	
			L	T	P	TA	CT	Sub Total			
1	MMECM 301	Industrial Training	0	0	20	50*	0	50	100	150	10
2	MMECM 302	Thesis – Phase I	0	0	10	100***	0	100	0	100	5
					30			150	100	250	15

* TA - based on technical report submitted together with presentation at the end of the industrial training.

** Industrial training evaluation will be conducted at end of the third semester by a panel of examiners, with at least one external examiner, constituted by the University.

*** 50% of the marks to be awarded by the project guide and the remaining 50% to be awarded by a panel of examiners, including project guide, constituted by the department

SEMESTER-IV

Sl. No	Course Number	Subject	Hrs/Week			Evaluation Scheme (Marks)					Credits
						Sessional Exam (Internal)			ESE Thesis Evaluation and Viva****	Total	
			L	T	P	TA***	CT	Sub Total			
1	MMECM 401	Thesis – Phase II	0	0	30	100	0	100	100	200	15
2	MMECM 402	Master's Comprehensive Viva							100	100	
										300	15
Grand total marks of all four semesters										2750	Total Credits = 80

*** 50% of the marks to be awarded by the project guide and the remaining 50% to be awarded by a panel of examiners, including project guide, constituted by the department.

**** Thesis evaluation and viva-voce will be conducted at end of the fourth semester by a panel of examiners with at least one external examiner, constituted by the University.

MMECM 101 ADVANCED ENGINEERING MATERIALS AND PROCESSING

L	T	P	C
3	1	0	4

Module 1

Origin of crystal clear concept - atomic structure: correlation of atomic radius to strength, electron configurations - primary bonds: covalent and ionic bond: bond energy with strength, cohesive force, density, directional and non-directional bonding – metallic bond: conductivity, ductility, opaque, lustrous, density, non directional bonding – **Specific properties of bonding**: Deeper energy well bond and shallow energy well bond, melting temperature, modulus of elasticity, coefficient of thermal expansion and attributes of modulus of elasticity in metal cutting process - secondary bonds: classification, hydrogen bond, specific heat etc.

Crystallography: Crystal, space lattice, unit cell - BCC, FCC, HCP structures - short and long range order - effects of crystalline and amorphous structure on mechanical properties - determination of atomic packing factor of SC, BCC, FCC, HCP - coordination number - densities - Polymorphism and allotropy - miller indices: slip system, brittleness of BCC, HCP and ductility of FCC - fundamentals, crystal structure determination by X-ray diffraction and a typical case study.

Module 2

Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity - effects of grain size, grain size distribution, grain shape, grain orientation on dislocation movement/strength and creep resistance - Hall - Petch relation - significance high and low angle grain boundaries on dislocation-polishing and etching to determine the microstructure - mode of plastic deformation: Von Mises' yield criterion basic only - slip and twinning, slip system - classification of imperfections: point, line, surface and volume imperfections - role of surface defects on crack propagation - edge dislocation, screw dislocation, forest of dislocation - Burgers vector - correlation of dislocation density with strength - significance of Frank and Read source in materials deformation - diffusion in solids, Fick's laws, applications of diffusion in mechanical engineering.

Module 3

Phase diagrams: Limitations of pure metals and need of alloying - classification of alloys, solid solutions, Hume Rothery`s rule

Intermetallics: Electron (or Hume - Rothery) compounds and Laves phase.

Maraging steel: History of maraging steel development - applications - advantages and limitations of maraging steel - comparison of production sequence with high tensile steel - reaction in austenite - reaction in martensite - effects of maraging with cobalt, cobalt free, molybdenum and other alloying elements - variation of mechanical properties: yield strength, hardness and fatigue - effect of precipitate size - special advantages; fracture toughness and weldability- manufacturing steps of rings-

Ceramics: AX, AmXp, AmBmXp type crystal structures – imperfections in ceramics - stress strain behavior – applications.

Module 4

Titanium: Ti-based binary phase diagram - production of ingot - effect of forging temperature and forging pressure - closed die forgings - shear bands - pickling of titanium - Ti alloys - production if ingot- scrap recycling - closed die forging - problems in machining Titanium - shear bands - welding of titanium - Heat Treatment of Ti-properties of titanium aluminides - applications.

High temperature super alloys: Vacuum induction melting (VIM), vacuum arc remelting (VAR) – VIM, electroslag remelting (ESR) – VIM, ESR, VAR – freckles - super alloy cleanliness.

Molybdenum: Ferromolybdenum - production of molybdenum – properties - effect of molybdenum alloying on hot strength, corrosion resistance, and toughness – applications - TZM, TZC.

Niobium: Production of niobium - niobium alloys - niobium in steel making Ni alloys characteristics and applications.

References:

1. Anderson J. C. et. al., “Material science for engineers”, Chapman & Hall
2. Avner S. H., “Introduction to physical metallurgy”, McGraw Hill
3. Barret C. S. and Massalski T. B., “Structure of metals”, Pergamon Press
4. Callister William. D., “Material science and engineering”, John Wiley
5. Dieter George E., “Mechanical metallurgy”, McGraw Hill
6. Raghavan V., “Material science and engineering”, Prentice Hall
7. Reed Hill E. Robert, “Physical metallurgy principles”, East West Press
8. Van Vlack, “Elements of material science”, Addison Wesley
9. Westbrook J. H., “Intermetallic compounds”, John Wiley

10. “Source book of Maraging Steels”, American Society for Metals
11. Richard K. Wilson (Editor), “Maraging steels - recent development and applications”, TMS Publication.

MMECM 102 **COMPUTER AIDED PROCESS PLANNING AND CONTROL**

L	T	P	C
3	1	0	4

Module 1

Introduction: The place of process planning in the manufacturing cycle - process planning and production planning – process planning and concurrent engineering, capp, group technology. Design drafting - dimensioning - conventional tolerance - geometric tolerance - geometric modelling for process planning.

Module 2

Process engineering and process planning: GT coding - the optiz system - the MICLASS system. Experienced, based planning - decision table and decision trees - process capability analysis - process planning - variant process planning - generative approach – forward and backward planning, input format, AI**.**

Module 3

Computer aided process planning systems: Logical design of a process planning - implementation considerations – manufacturing system components, production volume, no. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

Module 4

Intergrated process planning systems: Totally integrated process planning systems - an overview - modulus structure – data structure, operation - report generation, expert process planning.

References:

1. Gideon Halevi and Roland D. Weill, “Principles of process planning - a logical approach”, Chapman & Hall, 1995
2. Tien-Chien Chang, Richard A.Wysk, “An introduction to automated process planning systems”, Prentice Hall, 1985
3. Chang, T. C., “An expert process planning system”, Prentice Hall, 1985
4. Nanua Singh, “Systems approach to computer integrated design and manufacturing”, John Wiley & Sons, 1996
5. Rao, “Computer aided manufacturing”, Tata McGraw Hill, 2000

Web References:

1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
2. http://Estraj.ute.sk/journal/engl/027/027.htm

MMECM 103 COMPUTER AIDED DESIGN IN MANUFACTURING

L	T	P	C
3	1	0	4

Module 1

Overview of CAD systems: Conventional and computer aided design processes – advantages and disadvantage – CAD hardware and software – analytical and graphics packages – networking of CAD systems.

Computer graphics and graphics transformation: Image processing – transport of graphics data – graphic standards – display and viewing – transformations – customizing graphics softwares.

Module 2

Geometric modeling: Wire frame, surface and solid modeling – applications and advantages – Boolean operations – half-spaces – filleting of edges of solids – boundary representations – constructive solid geometry – sweep representation

Module 3

Parametric design and object representation: Object-oriented representation – types of co-ordinate system – parametric design – definition and advantages – parametric representation of analytic and synthetic curves – parametric representation of surfaces and solids – manipulations. Mechanical assembly – mass property calculation.

Module 4

Introduction to finite element analysis: Basic steps in finite element problems formulation – element type and characteristics – element shapes – co-ordinate systems – 1D link elements and beam elements – shape functions – stiffness matrices – direct stiffness method – 2 D elements – axisymmetric elements – plane stress problem – higher order elements.

References:

1. New man & Sproull, "Principles of interactive graphics", McGraw Hill.
2. C. S. Krishnamoorthy and S. Rajeev, "Computer aided design", Narosa Publishing House, 1991
3. Ibrahim Zeid, "CAD/CAM theory and practice", McGraw Hill Inc, 1991
4. Vera B. Anand, "Computer graphics and geometric modelling for engineers", John Wiley & Sons Inc., 1993

5. Sandhu Singh, “Computer aided design and manufacturing”, Khanna Publishers, 1998
6. User’s Manuals for Ansys, Adams, Pro/Engineer, Cadds 5 and Autocad softwares.
7. R. D. Cook, “Concepts and applications of finite element analysis”
8. Daryl L. Logan, “A first course in the finite element method”
9. David V. Hutton, “Fundamentals of finite element analysis”
10. David F. Rogers and J. Alan Adams, “Mathematical elements for computer graphics”, Second Edition, McGraw Hill, 1990

MMECM 104 FINITE ELEMENT ANALYSIS IN MANUFACTURING

L	T	P	C
3	1	0	4

Module 1

Basics of FEM and brief history of finite element method - initial value and boundary value problems - weighted residual, Galerkin and Raleigh Ritz methods - review of variational calculus -integration by parts - basics of variational formulation.

Module 2

Global and natural co-ordinates - shape functions for one and two dimensional elements, compatibility, convergence and completeness requirements, stiffness matrix for truss and beam elements, element load vector, assembly and imposition of boundary conditions - One dimensional analysis in solid mechanics and heat transfer.

Module 3

Application in plane stress and plane strain problem - stiffness matrix for three nodded triangular and four-noded quadrilateral element - isoparametric elements – Jacobian matrices and transformations - basics of two dimensional axi symmetric analysis. Numerical integration: Gaussian quadrature. Solution and post processing - strain and stress computations. Introduction to FEM software.

Module 4

FE analysis of metal casting - special considerations, latent heat incorporation, gap element - time stepping procedures - crank - Nicholson algorithm - prediction of grain structure - basic concepts of plasticity - solid and flow formulation - small incremental deformation formulation - FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency.

References:

1. Reddy, J. N., “An introduction to the finite element method”, McGraw Hill, 1985
2. Rao S. S., “Finite element method in engineering”, Pergammon Press, 1989
3. Bathe K. J., “Finite element procedures in engineering analysis”, 1990
4. Kobayashi S, Soo-Ik-Oh and Altan T., “Metal forming and the finite element methods”, Oxford University Press, 1989

5. Lewis R.W., Morgan K, Thomas H. R., and Seetharaman, K. N., “The finite element method in heat transfer analysis”, John Wiley, 1994

Web References:

1. www.tbook.com
2. www.pollockeng.com

MMECM 105 - 1 METROLOGY AND COMPUTER AIDED INSPECTION

L	T	P	C
3	0	0	3

Module 1

Metrological concepts – Abbe's principle – need for high precision measurements – problems associated with high precision measurements. Standards for length measurement – shop floor standards and their calibration – light interference – method of coincidence – slip gauge calibration – measurement errors.

Module 2

Various tolerances and specifications – gauging principles – selective assembly – comparators. Angular measurements: principles and instruments. Thread measurements – surface and form metrology – flatness, roughness, waviness, roundness etc. – computer aided metrology – advantages and limitations.

Module 3

Laser metrology – applications of lasers in precision measurements – laser telemetric system – laser interferometer – speckle measurements – laser inspection – dimensional measurement techniques.

Co-ordinate measuring machine – contact and non-contact cmm – causes of errors – accuracy specifications – contact and non-contact probes.

Module 4

Calibration of CMM – measuring scales – Moiré fringes in linear grating – advantages and applications of CMM.

Machine vision system – image formation – binary and grayscale image – image histogram – histogram operations – pixel point processing and pixel group processing – image sharpening and smoothing – edge detection and enhancement.

References:

1. "Hand book of industrial metrology", ASME
2. Hume, "Metrology", McDonald
3. Sharp, "Metrology", ELBS
4. Taher, "Metrology", ELBS
5. Ted Busch, "Fundamentals of dimensional metrology", 3rd Edition, Delmar Publishers

MMECM 105 - 2 PRINCIPLES OF ROBOTICS AND APPLICATIONS

L	T	P	C
3	0	0	3

Module 1

Introduction: Definition, configurations, work envelopes, specifications, and other basic parameters of robots.

Module 2

Kinematic principles: Position and orientation, co-ordinate systems, relative frames, homogeneous co-ordinates, direct and inverse kinematics, differential motions and the Jacobeans.

Module 3

Introduction to dynamics: Types of motions**:** slew – joint-interpolated – straight line interpolated motions. Path planning – trajectory planning and control. Drives: electrical, hydraulic, and pneumatic drives – basics and relative merits. Components**:** harmonic reduction units, servo valves, and grippers**.** Sensors**:** basic types including vision, force – torque wrist sensors.

Module 4

Robot application: Robot motion planning – configuration space concepts. Robot programming concepts: off line programming and simulation – work cell application. Development: requirements – modeling – work cell calibration – layout planning.
Case studies.

References:

1. Shiman Y., "Handbook of industrial robotics", John Wiley & Sons, 1985
2. Deh S. R., "Robotics technology and flexible automation", Tata McGraw Hill, 1994
3. Craig, J. J., "Robotics: mechanics and control", Addison Wesley, 1989
4. Groover M. P., "Fundamentals of modern manufacturing materials, processes, and systems", Prentice Hall, 1996
5. Craig J., "Adaptive control of mechanical manipulators", Addison Wesley, 1988
6. Snyder W. E., "Industrial robots: computer interfacing and control", Prentice Hall, 1985
7. Song S. M., and Waldron K. J., "Machines that walk", MIT Press, 1988
8. IEEE journal of robotics and automation

9. International journal of robotics research
10. IEEE transactions on man, system, and cybernetics
11. Richard D. Klafter, Thomas A. Chmielwski, Michael Negin, Robotics engineering, an integrated approach, Prentice Hall of India. 1989
12. Mikell. P. Groover et al., Industrial robots – technology, programming and application, McGraw Hill, 1980

MMECM 105 - 3 **RAPID PROTOTYPING**

L	T	P	C
3	0	0	3

Module 1

Importance of being rapid – data processing for rapid prototype (RP): CAD model preparation and data interfacing for RP – stereo lithography (SL): SL process, photo polymerization of SL resins, absorption of laser radiation by the resin, recoating.

Module 2

SL curing and its implications, part quality and process planning – selective laser sinthering (SLS): principle, indirect and direct SLS, process accuracy - selective laser cladding (SLC) - laminated object manufacturing.

Module 3

Fused deposition modeling (FDM) – 3D printing and desktop processes – shape deposition manufacturing – vacuum casting – electroforming – freeze casting – 3D welding.

Module 4

Rapid tooling (RT): Classification of RT – indirect RT – applications of RP: - heterogeneous objects, assemblies, MEMS and other small objects, medicine and art.

References:

1. Patrik Venuvinod, Weiyuyin Ma, "Rapid prototyping", Kluwer Academic Publishers
2. T. A. Grimm & Associates, "Users guide to rapid prototyping", Society of Manufacturing Engineers (SME)
3. Frank W. Liou, "Rapid prototyping & engineering applications", CRC Press
4. Ali K. Kamarani, "Rapid Prototyping theory & practice", Manufacturing System Engineering Series, Springer Verlag
5. J. A. McDonalds, C. J. Ryall, "Rapid prototyping - case book", Wiley Eastern
6. C. E. Bocking, AEW Rennie, "Rapid & virtual prototyping and applications", Wiley Eastern

Web References:

1. http:// www_rpl.stanford.edu

2. http:// home.utah.edu/

3. http:// www.me.psu.edu

4. http:// itri.loyola.edu/rp/02

5. http:// www.udri.udayton.edu/

MMECM 105 - 4 DESIGN FOR MANUFACTURING AND ASSEMBLY

L	T	P	C
3	0	0	3

Module 1

Process capability and tolerances: Process capability, mean, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances - ISO standards - surface finish, review of relationship between attainable tolerance grades and different machining and sheet metal processes. Cumulative effect of tolerances - worst case method, root sum square method, dimensions following truncated normal distributions, Monte Carlo Simulation.

Selective assembly: Interchangeable past manufacture and selective assembly, deciding the number of groups - Model-I: Group tolerances of mating parts equal; Model-II: total and group tolerances of shaft equal. Control of axial play - introducing secondary machining operations, laminated shims, examples.

Module 2

Datum systems and fixture design: Degrees of freedom, grouped datum systems - different types, two and three mutually perpendicular grouped datum planes; grouped datum system with spigot and recess, pin and hole; grouped datum system with spigot and recess pair and tongue - slot pair - computation of translational and rotational accuracy, geometric analysis and applications.

True position theory: Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

Module 3

Form design of castings, weldments and sheet metal components: Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, form design aspects of sheet metal components.

Tolerance charting technique: Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

Module 4

Redesign for manufacture: Design features to facilitate machining: datum features - functional and manufacturing. Component design - machining considerations, redesign for manufacture, examples.

DFMA tools: Computer aided DFMA, Poke Yoka principles, axiomatic design method, quality function deployment, design for six sigma, lean manufacturing, waste identification and elimination, value stream mapping, sensor interface for fool-proof system design.

References:

1. Harry Peck, "Designing for manufacture", Pitman Publications, 1983
2. Matousek, "Engineering design - a systematic approach", Blackie and Son Ltd., London, 1974
3. Micheal Wader, "Lean tools: a pocket guide to implementing lean practices", Productivity and Quality Publishing Pvt Ltd., 2002
4. Spotts M. F., "Dimensioning and tolerance for quantity production", Prentice Hall Inc., 1983
5. Oliver R. Wade, "Tolerance control in design and manufacturing", Industrial Press Inc., New York, 1967
6. James G. Bralla, "Hand book of product design for manufacturing", McGraw Hill, 1983
7. Trucks H. E., "Design for economic production", Society of Manufacturing Engineers, Michigan, Second Edition, 1987
8. Poka - Yoke, "Improving product quality by preventing defects", Productivity Press, 1992
9. Basem Said El-Haik, "Axiomatic quality", John Wiley and Sons, 2005

MMECM 106 - 1 **PRODUCTION SCHEDULING**

L	T	P	C
3	0	0	3

Module 1

Introduction to scheduling – different production models – mass, batch or job shop production – objectives in scheduling - processing characteristics and constraints – performance measures - sequencing.

Module 2

Single machine scheduling – shortest processing time (SPT) rule to minimize mean flow time, earliest due date (EDD) rule to maximum lateness – branch and bound technique to minimize mean tardiness. Parallel processors – minimizing makesplan.

Module 3

Flow shop scheduling – Johnson's algorithm – branch and bound technique – Palmer's heuristic. Job shop scheduling – introduction to dispatching rules – SPT, MWKR, RANDOM – two jobs and m machines scheduling.

Module 4

Project scheduling – critical path method - Gantt chart - project evaluation and review technique – crashing – resource leveling and allocation.

References:

1. R. Paneerselvam, "Production and operations management", Prentice-Hall, New Delhi, 2005
2. Roberta S. Russell and Bernard W. Taylor III, "Operations management", Pearson Education, Delhi, 2003
3. Kenneth R. Baker, "Introduction to sequencing and scheduling", John Wiley and Sons, 1974
4. Michael Pinedoo, "Scheduling: theory, algorithms and systems", Prentice Hall, New Delhi, 1995

MMECM 106 - 2 RELIABILITY ENGINEERING

L	T	P	C
3	0	0	3

Module 1

Concepts of reliability: Definition of reliability - definition of failure - classification of failures - measures of reliability - failure rate, Mean Time Between Failures (MTBF), Mean Time to Failure (MTTF) - derivation of the reliability function - reliability specifications.

Module 2

Failure patterns and fitting curves: The bath tub curve - early failure period, constant failure period, the wear out failure period -the Weibull distribution - the Weibull distribution lo describe the bath tub curve - estimation of Weibull parameters, Weibull probability plot.

Module 3

Cost, performance and other related factors: Factors related to reliability - availability - utilization factor – system effectiveness - reliability and maintenance costs - factors affecting reliability and maintenance costs - eight basic stages in the achievement of reliability.

Module 4

Design and manufacture for reliability: Customer or market specifications for reliability - the reliability of parts and components - design for system reliability - blocks or units in series, dealing with variations in parts, the use of value analysis redundancy, types, application.

Reliability, prediction and management: Reliability prediction and control - the need for reliability control, feasibility studies - reliability management

References:

1. Rowland Caplan, "A practical approach to reliability", 1982
2. Govil A. K., "Reliability engineering", 1989
3. Carter A. D. S., "Mechanical reliability", 1989
4. Singiresu S. Rao, "Reliability – based design", McGraw-Hill Inc, New York, 1992

MMECM 106 - 3 QUALITY ENGINEERING AND MANAGEMENT

L	T	P	C
3	0	0	3

Module 1

Quality: Defining quality – philosophies of quality 'gurus'- dimensions of quality - measures of quality – cost of quality – direct costs & indirect costs – 'defectives' and its significance - traditional model and emerging model of 'cost-of-quality.'

Continuous process improvement: PDSA cycle – problem solving methodology

Module 2

Statistical process control: Statistical tools - control charts and use of probability distributions, process capability.

Quality function deployment: Concept - house of quality – QFD process.

Module 3

Design of experiments: ANOVA - full factorial and fractional factorial design.

Taguchi methods: Loss functions – signal-to-noise ratio - process optimization and robust product design using orthogonal arrays, parametric and tolerance design.

Module 4

Total quality management (TQM): Definition - basic concepts – strategies.

Six sigma methodology: Basic concepts – DMAIC problem solving technique.

Quality system and standards: An overview of ISO 9000 and ISO 14000 series of standards

References:

1. Dale H. Besterfield, Carol Besterfield, Glen H. Besterfield & Mary Besterfield, "Total quality management", Person Education, New Delhi, 2008.
2. R. Subburaj," ISO 9000: Path to TQM", Allied Publishers Limited, New Delhi, 1997
3. Bank J., "The essence of total quality management", Prentice Hall
4. Dale B. G., "Managing quality", Prentice Hall
5. A.V. Feigenbaum, "Total quality control", McGraw Hill
6. G. L. Taguchi and Syed et. al., "Quality engineering production systems", McGraw Hill
7. Essence of TQM John bank Prentice Hall
8. Zaidi, "SPC - concepts, methodology and tools", Prentice Hall
9. Perry L Johnson, "ISO 9000", McGraw Hill

MMECM 106 - 4 **LEAN MANUFACTURING**

L	T	P	C
3	0	0	3

Module 1

Lean manufacturing: Basics, principles & elements

Small-lot production: Lot-size basics; lot sizing; lot-size reduction; facilitating small lot size.

Setup-Time reduction: Setup reduction methodology; techniques for setup-reduction; setup reduction projects.

Module 2

Pull production systems: Pull systems and push systems; conditions for pull production systems; how to achieve pull production; mechanisms for signal and control.

Workcells and cellular manufacturing: Cell layout and capacity measures; design of workcells; worker assignment; implementation issues.

Module 3

Scheduling for smooth flow: Production leveling; level scheduling in pull production; master production scheduling.

Synchronising and balancing process: Synchronisation; bottleneck scheduling; balancing; adapting to schedule changes.

Module 4

Planning and control in pull production: Centralised planning and control system; decentralised planning and control system; adapting MRP-based production planning and control system to pull production

Maintaining and improving equipment: Equipment maintenance; equipment effectiveness; total productive maintenance.

References:

1. Harold J. Steudel and Paul Desruelle, “Manufacturing in the nineties – how to become a lean, world - class competitor”, Van Norstrand Reinhold, New York, 1992
2. John Nicholas, “Competitive manufacturing management - continuos improvement, lean production, and customer-focused qualities”, McGraw Hill International Edition, 1998
3. Ronald G. Askin & Jeffrey B. Goldberg, “Design and analysis of lean production systems”, John Wiley & Sons, 2003

MMECM 107 COMPUTER INTEGRATED MANUFACTURING LABORATORY I

L	T	P	C
0	0	3	2

1. 3D solid modeling and assembly using SOLIDWORKS
2. Modeling and analysis using FEA software
3. Manufacturing system simulation using software
4. Use of DFA software for evaluation of product design alternatives
5. Tolerance stack analysis using software
6. Design of experiments and analysis of data using analysis of mean and ANOVA
7. Application of software like Mat Lab, SPSS, ARENA, WITNESS etc for the modeling, simulation and analysis of decision problems in the following areas:
    - i. Quality management
    - ii. Production planning and control
    - iii. Reliability analysis
    - iv. Manufacturing system design
    - v. Performance of manufacturing systems
    - vi. Facilities planning

MMECM 108 **SEMINAR - I**

L	T	P	C
0	0	2	1

Each student shall prepare a seminar paper on any topic of interest related to the core/elective courses being undergone in the first semester of the M. Tech. programme. He/she shall get the paper approved by the Programme Coordinator/Faculty Members in the concerned area of specialization and shall present it in the class in the presence of Faculty in-charge of seminar class. Every student shall participate in the seminar. Grade will be awarded on the basis of the student's paper, presentation and his/her participation in the seminar.

MMECM 201 COMPUTER AIDED MANUFACTURING

L	T	P	C
3	1	0	4

Module 1

Introduction and design features of CNC machines: Working principles of typical CNC lathes, turning centre, machining centre, CNC grinders, CNC gear cutting machines, wire cut EDM, turret punch press, CNC press brakes etc. Selection of CNC machine tools. Structure, drive kinematics, gear box, main drive, feed drive, selection of timing belts and pulleys, spindle bearings arrangement and installation. Re-circulating ball screws, linear motion guide ways, tool magazines, ATC, APC, chip conveyors, tool turrets, pneumatic and hydraulic control systems.

Module 2

Control systems and interfacing: Open loop and closed loop systems, microprocessor based CNC systems, block diagram of a typical CNC system, description of hardware and software interpolation systems, standard and optional features of a CNC control system, comparison of different control systems. Feedback devices with a CNC system, spindle encoder.

Module 3

Part programming of a CNC lathe: Process planning, tooling, preset and qualified tools, typical tools for turning and machining centers. Axes definition, machine and work piece datum, turret datum, absolute and incremental programming, tape codes , ISO and EIA codes, G and M functions, tool offset information, soft jaws, tool nose radius compensation, long turning cycle, facing cycle, constant cutting velocity, threading cycle, peck drilling cycle, part programming examples.

Module 4

Manual part programming of a machining centre: Co-ordinate systems, cutter diameter compensation, fixed cycles, drilling cycle, tapping cycle, boring cycle, fine boring cycle, back boring cycle, area clearance programs, macros, parametric programming, part programming examples. CAD/CAM based NC programming, features of typical CAM packages.

References:

1. James Madison, “CNC machining hand book”, Industrial Press Inc., 1996
2. Steve Krar, Arthur Gill, “CNC technology and programming”, McGraw-Hill, 1990

3. Berry Leathan - Jones, “Introduction to computer numerical control”, Pitman, London, 1987
4. Hans B. Kief, T. Fredericx Waters, “Computer numerical control”, MacMillan / McGraw-Hill, 1992
5. Bernard Hodgers, “CNC part programming work book”, City and Guids / Macmillan, 1994.
6. David Gribbs, “An introduction to CNC machining”, Cassell, 1987
7. Sadasivan, T. A. and Sarathy, D., “Cutting tools for productive machining”, Widia (India) Ltd., 1999
8. Radhakrishnan, P., “Computer numerical control machines”, New Central Book Agency, 1992
9. Peter Smid, “CNC programming hand book”, Industrial Press Inc., 2000

MMECM 202 SIMULATION OF MANUFACTURING SYSTEMS

L	T	P	C
3	1	0	4

Module 1

System concept: Systems and system environment, components of a system, discrete and continuous systems, systems approach to problem solving, types of system study, system analysis, system design and system postulation, system modeling, types of models.

System simulation: Technique of simulation, comparison of simulation and analytical methods, types of system simulation, steps in simulation study, Monte Carlo simulation.

Concepts in discrete event simulation: Event scheduling/time advance algorithm, modeling world views, simulation programming tasks, comparison and selection of simulation languages.

Module 2

Random number generation: Techniques for generating random numbers, linear congruential method, test for random numbers, frequency tests, run tests, tests for autocorrelation, gap test, and Poker test.

Random variate generation: Inverse transformation technique, exponential, uniform, weibull, triangular, empirical-discrete and continuous distributions. Convolution method, acceptance - rejection technique.

Input modeling for simulation: Data collection, identifying the distribution with data, parameter estimation, goodness of fit test, Chi square, Klomogrov and Smirnov tests, selecting input model when data are not available.

Module 3

Verification and validation of simulation models: Verification of simulation models, calibration and validation of models, face validity, validation of model assumption, validating input-output transformation, input-output validation using historical input data.

Output analysis for a single model: Measures of performance and their estimation, point estimation, interval estimation, output analysis for terminating simulations and steady state simulations.

Module 4

Simulation modeling and analysis of manufacturing systems: Objectives, performance measures, issues in simulation of manufacturing systems, simulation software for manufacturing applications, simulation of job shop manufacturing systems, simulation modeling and analysis of single server and single queue systems, inventory systems and pert networks.

References:

1. Banks, J., Carson, J. S., Nelson, B. L., and Nicol, D. M., “Discrete-event system simulation”, Third Edition, Pearson Education, Inc., 2001
2. Gordon G., “System simulation”, Prentice Hall Ltd. 1991
3. Deo, N., “System simulation with digital computer”, Prentice Hall of India, 1997
4. Askin R. G. and Standridge, C. R., “Modeling and analysis of manufacturing systems”, John Wiley & Sons, 1993.

MMECM 203 FLEXIBLE MANUFACTURING SYSTEMS

L	T	P	C
3	1	0	4

Module 1

Introduction to FMS: Definition of FMS – types and configuration concepts – types of flexibility and performance measures. Functions of FMS host computer – FMS host and area controller function distribution.

Module 2

Development and implementation of FMS: Planning phases – integration – system configuration – FMS layouts – simulation – FMS project development steps. Project management – equipment development – host system development – planning - hardware and software development.

Module 3

Distributed numerical control: DNC system – communication between DNC computer and machine control unit – hierarchical processing of data in DNC system – features of DNC system.
Automated material handling: Function - types – analysis of material handling equipments. Design of conveyor and AGV systems.
Automated storage: Storage system performance – AS/RS – carousel storage system – WIP storage – interfacing handling storage with manufacturing.

Module 4

Programmable logic controllers: Components of the PLC – PLC operating cycle – additional capabilities of a PLC – programming the PLC - Ladder logic diagrams, counters etc– Industrial process control using PLC.
FMS rationale: Economic and technological justification for FMS – GT, JIT – operation and evaluation – personnel and infra structural aspects – typical case studies – future prospects.

References:

1. Parrish D. J, "Flexible manufacturing", Butterworth – Heinemann Ltd, 1990
2. Groover M. P, "Automation, production systems and computer integrated manufacturing", Prentice Hall India (P) Ltd., 2002

3. Shivanand H. K., Benal M. M and Koti V, “Flexible manufacturing system”, New Age International (P) Limited. Publishers, 2006
4. Kusiak A., “Intelligent manufacturing systems”, Prentice Hall, Englewood Cliffs, NJ, 1990
5. Considine D. M. & Considine G. D, “Standard handbook of industrial automation”, Chapman and Hall, London, 1986
6. Viswanadhan N. and Narahari Y, “Performance modelling of automated manufacturing systems”, Prentice Hall India (P) Ltd., 1992
7. Ranky P. G, “The design and operation of FMS”, IFS Pub, U. K, 1998

MMECM 204 AUTOMATION AND CONTROL SYSTEMS

L	T	P	C
3	1	0	4

Module 1

Automation: Introduction to automation: definition, types of automation, strategies merits and criticism – manufacturing plants and operations – automation strategies – basic elements of automated system – advanced automation functions – levels of automations – automated production lines – economic and social issues – impact on labor.

Module 2

Production automation: Industrial control systems – process layout for automation –discrete manufacturing industries – continuous and discrete control systems – overview of computer process control – fundamentals of automated assembly, parts feeding devices – production flow analysis: general terminology and analysis, analysis of transfer lines without storage, partial automation.

Module 3

Control systems: Servomechanisms – digital computer control – differential equations of physical systems – dynamics of robotic mechanisms – transfer functions – block diagram algebra – signal flow graphs.

Feedback and non-feedback systems – reduction of parameters variations

Module 4

Control over system dynamics – linearizing effect – regenerative feedback – linear approximation of nonlinear systems – controller components – stepper motor – hydraulic systems – pneumatic systems.

Design: Considerations of design – basic compensators – cascade compensation – PID controllers – feedback compensation – adaptive and fuzzy logic control.

References:

1. Gopal M., “Control systems principles and design”, TMH, New Delhi
2. Nagrath I. J. and Gopal M., “Control system engineering”, New Age International, New Delhi
3. Shinsky, “Process control system”, PHI, 2000
4. Troitskey A., “Principles of automation and automated production”, Mir Publishers, 1976

MMECM 205 - 1 MICROMACHINING AND PRECISION ENGINEERING

L	T	P	C
3	0	0	3

Module 1

Introduction to precision machining and manufacturing process - conventional and un-conventional machining process - precision machining processes- micromachining.

Electro Discharge Machining process: General principle and applications of electric discharge machining, electric discharge grinding and electric discharge wire cutting processes – power circuits for EDM, mechanics of metal removal in EDM, process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection - Wire EDM, principle, applications.

Module 2

Un-conventional machining processes: Principles, variables and applications of laser beam machining - general principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut, electron beam machining - generation and control of electron beam for machining, theory of electron beam machining, ion beam machining, plasma arc machining - application of plasma for machining - metal removal mechanism - process parameters - accuracy and surface finish and other applications of plasma in manufacturing industries, ultrasonic machining abrasive water-jet machining - basic principles – equipments - process variables - mechanics of metal removal – MRR - application and limitations, electro chemical machining.

Module 3

Electron beam micromachining: Mechanism of material removal in EB drilling- importance of vacuum- process parameters - effect of cutting speed, pulsed beam operation, heat affected zone.

Focused ion beam machining: equipment – applications.

Micro-electric discharge micromachining: Principle of micro-EDM – influence of pulse characteristics – high aspect ratio holes –heat affected zone.

Laser micromachining: Micromachining system - nanosecond, picosecond and femtosecond pulse micromachining.

Module 4

Diamond turn machining (DTM): Types of DTM – components of DTM: spindle system, workpiece tool positioning system, machine support system, tool measurement system, machine control system, material removal mechanism in DTM.

Magnetorheolegical nanofinishing processes: Magnetorheological polishing fluid – rheological characteristics of fluid – magnetorheological finishing (MRF) processes. Magnetorheological abrasive flow finishing processes (MRAFF). Magnetorheological jet finishing processes.

References:

1. Kluwer, " A new direction in manufacturing", Academic Publishers, London, 1997
2. Kalpakjian, "Manufacturing engineering & technology", Addison – Wesley, 4nd Edition
3. Debitson A., "Hand book of precision engineering"
4. J. A. McGeough, "Advanced methods of machining", Chapman and Hall, London, 1988
5. Jain V. K., "Introduction to micromachining", Narosa Publishers
6. M. Madou, "Fundamentals of microfabrication"
7. Momber A. W. and Kovacevic R., "Principles of water jet machining", Springer – Verlag
8. R. L. Murthy., "Precision engineering manufacturing", New Age International
9. G. Chryssolouris, "Laser machining – theory and practice", Springer Verlag, New York, 1991

MMECM 205 - 2 **ADVANCED TOOL ENGINEERING**

L	T	P	C
3	0	0	3

Module 1

Introduction to tool design: Introduction – tool engineering – tool classifications – tool design objectives – tool design in manufacturing- challenges and requirements.

Locating methods: Methods, degrees of freedom, pins, vertical holding, radial location, diamond pins - principles of pin location – V locators - tool forces in different processes - principle of clamping:- clamping types – quick action clamping, power clamping etc. - elements - work holding principle for irregular and round surfaces - rigid and elastic holding - types of work holders – work holder selection – analysis of clamping forces: strap clamp calculations, clamping force analysis of toggle and screw clamp - indexing devices: linear indexing, rotary indexing etc.

Module 2

Drill jigs: Types - leaf jigs, box jigs, channel jigs, template jigs and indexing jigs – chip formation in drilling –types of drill bushings.

Types of fixtures: Economics of fixture - vise fixtures –types and details of milling fixtures, requirements of milling fixtures, special vice jaws - facing, straddle, gang, index, rotary and reciprocal milling fixtures - types and details of boring, slotting, broaching fixtures - types and details of lathe fixtures, chucks, face plate, collets, mandrels, etc. - types and details of grinding fixtures.

Module 3

Tool design for CNC machine tools: Introduction – tooling requirements for numerical control systems – fixture design for CNC machine tools - Sub plate and tombstone fixtures - universal fixtures – cutting tools – tool holding methods– automatic tool changers and tool positioners – tool presetting– general explanation of the brown and sharp machine

Module 4

Machine tool slide ways: Different shapes – materials – hydrodynamic action - machine tool guides: - wearing of guides- guide materials – stick slip motion in guides - temperature deformation of guides – liquid friction in guides – determination of pressure on guides – accuracy and wear of guides - design of guides under hydrostatic lubrication.

Vibration of machine tools: Effects of vibration –sources of vibration- single and two degree of freedom chatter theory – chatter in lathe, radial drilling, milling and grinding machines – elimination of vibration.

References:

1. Edward G. Hoffman, "Jig and fixture design", Delmar Learning
2. Basu S. K., "Design of machine tools", Allied publishers, Bombay, 1965
3. Boyes E. William, "Jigs, fixtures & gauges", SME 1st Edition. 1986
4. Donaldson, Lecain and Goold, "Tool design", McGraw Hill, New York, 1976
5. Erik Karl Henriksen, "Jig and fixture design manual"
6. Henriksen E. K., "Jig and fixture design manual", Industrial Press, New York, 1973
7. Joshi P .H., "Jigs & fixtures", Tata McGraw Hill, 1999
8. Kempster M. H. A., "An introduction to jig and tool design", ELBS 3rd Edition, 1974
9. "Tool and manufacturing engineers handbook, volume 1: machining", SME
10. "Die Design Handbook", 3rd Edition, SME, 1990
11. Elanchezian C., "Design of jig and fixture and press tools", Esawr Press, Chennai

MMECM 205 - 3 **ANALYSIS AND CONTROL OF MANUFACTURING SYSTEMS**

L	T	P	C
3	0	0	3

Module 1

Manufacturing systems & control: Automated manufacturing systems - modeling - role of performance modeling - simulation models- analytical models. Product cycle - manufacturing automation - economics of scale and scope - input/output model - plant configurations. Performance measures - Manufacturing lead-time - work in process -machine utilization - throughput – capacity - flexibility - performability - quality. control systems - control system architecture - factory communications - local area networks - factory net works - open systems interconnection model - net work to network interconnections - manufacturing automation protocol - database management system.

Module 2

Manufacturing processes: Examples of stochastic processes - Poisson process discrete time Markov chain models -definition and notation - Sojourn times in states - examples of DTMCs in manufacturing - Chapman-Kolmogorov equation - steady-state analysis. Continuous time Markov chain models - definitions and notation - Sojourn times in states - examples of CTMCs in manufacturing - equations for CTMC evolution - Markov model of a transfer line. Birth and death processes in manufacturing - steady state analysis of BD Processes - typical BD processes in manufacturing.

Module 3

Queuing models and queuing networks: Notation for queues - examples of queues in manufacturing systems – performance measures - Little's result - steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns - analysis of a flexible machine center. Examples of QN models in manufacturing - Little's law in queuing networks – tandem queue - an open queuing network with feedback - an open central server model for FMS - closed transfer line - closed server model - Garden Newell networks.

Module 4

Petri nets: Classical Petri nets - definitions - transition firing and reachability – representational power - properties - manufacturing models. Stochastic Petri nets - exponential timed Petri nets - generalized stochastic Petri nets - modeling of KANBAN systems – manufacturing models.

References:

1. Viswanadham N. and Narahari Y., "Performance modeling of automated manufacturing systems", Prentice Hall of India, New Delhi, 1994
2. Trivedi, K. S., "Probability and statistics with reliability, queuing and computer science applications", Prentice Hall, New Jersey, 1982
3. Gupta S. C., & Kapoor V. K., "Fundamentals of mathematical statistics", 3rd Edition, Sultan Chand and Sons, New Delhi, 1988

MMECM 205 - 4 MANUFACTURING INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

Module 1

Introduction: The evolution of order policies, from MRP to MRP II, the role of production organization, operations control. Data base terminologies - entities and attributes - data models, schema and subschema - data independence – ER diagram - trends in database.

Module 2

Designing database: Hierarchical model - network approach - relational data model -concepts, principles, keys, relational operations - functional dependence - normalisation, types - query languages.

Module 3

Manufacturing consideration: The product and its structure, inventory and process flow - shop floor control - data structure and procedure - various model - the order scheduling module, input / output analysis module the stock status database – the complete IOM database.

Module 3

Information system for manufacturing: Parts oriented production information system - concepts and structure - computerised production scheduling, online production control systems, computer based production management system, computerised manufacturing information system - case study.

References:

1. Luca G. Sartori, “Manufacturing information systems”, Addison Wesley Publishing Company, 1988
2. Date. C. J., “An introduction to database systems”, Narosa Publishing House, 1997
3. Orlicky G., “Material requirements planning”, McGraw Hill, 1975
4. Kerr R., “Knowledge based manufacturing management”, Addison Wesley, 1991

Web Reference:

1. www.ist.psu.edu

MMECM 206 - 1 ADVANCED OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Module 1

Linear programming

Problem formulation, graphical solution, simplex method, big M method, two phase method, dual simplex method, duality theory, sensitivity analysis

Module 2

Integer programming

The branch and bound technique, Gomory's cutting plane method

Module 3

Network analysis

Shortest route problem, minimal spanning tree problem, maximum flow problem

Module 4

Goal programming

Goal programming formulation, simplex method for solving goal programming

Deterministic dynamic programming

Cargo loading model, reliability improvement model, single machine scheduling model

References:

1. Hamdy A. Taha, "Operations research", Pearson, 2004
2. R. Paneerselvam, "Operations research", PHI, New Delhi, 2008
3. Ravindran, Phillips, Solberg, "Operations research principles and practice", Willey & Sons 1987

MMECM 206 - 2 ADVANCED OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

Module 1

Nonlinear optimization: Introduction - one-dimensional optimization - elimination methods - unrestricted search, exhaustive scare Fibonacci and Golden section methods - Interpolation methods - quadratic and cubic interpolations, direct root methods.

Module 2

Unconstrained nonlinear optimization: Direct search methods - random search methods - pattern search methods – method of rotating coordinates - descent methods - steepest descent, conjugate gradient, Quasi-Newton, and variable metric methods.

Module 3

Constrained nonlinear optimization: Direct methods - the complex method, cutting plane method, methods of feasible directions - indirect methods - transformation techniques, interior and exterior penalty function methods.

Module 4

Non-traditional optimization: Introduction to genetic algorithms, simulated annealing, tabu search, and ant colony optimization.

References:

1. Singiresu S. Rao, "Engineering optimization: theory and practice", 3rd Edition, Wiley Interscience, 1996
2. Kalyanmoy Deb, "Optimization for engineering design", PHI, New Delhi, 2000
3. David E. Goldberg, "Genetic algorithms in search, optimization and machine learning", Addison Wesley Pub. Co., 1989
4. Harvey M. Salkin, "Integer programming", Addison-Wesley Pub. Co., 1975
5. Stephen C. Nash and Ariela Sofer, "Linear and nonlinear programming", McGraw Hill College Div., 1995
6. Fred Glover, Manuel Laguna, and Fred Laguna, "Tabu search", Kluwer Academic Publishers, 1997

MMECM 206 - 3 **RESEARCH METHODOLOGY**

L	T	P	C
3	0	0	3

Module 1

Research: Meaning – purpose - types of research - identification, selection and formulation of research problem - research questions - research design - formulation of hypothesis - review of literature.

Data for research: Primary and secondary data - collection methods – processing data

Basic statistical measures: Measures of central tendency and variation - skewness and kurtosis.

Module 2

Measures of relationship: Correlation – correlation coefficient for ungrouped data and grouped data – rank correlation – auto correlation, linear regression - simple regression and multiple regression.

Probability: Definition – discrete and continuous probability distributions: binomial, poison, uniform, exponential and normal distributions.

Sampling technique: Sampling theory – sampling methods – sampling distributions – confidence interval estimation - sample size – advantages and limitations of sampling.

Module 3

Hypothesis testing and estimation: Fundamentals of hypothesis testing - testing of significance mean, proportion, variance and correlation – goodness of fit test.

Non - parametric tests: Sign test, Kolmogorov-Smirnov test – Mann-Whitney test - Kruskal-Wallis test.

Module 4

Design of experiments: Analysis of variance (ANOVA) - completely randomized design - randomized complete block design - latin square designs, Factorial design - 2^n factorial design – 2^2 and 2^3 factorial design - Yates' algorithm for 2^n factorial experiment.

References:

1. Panneerselvam, R., "Research methodology", Prentice Hall of India Private Limited, New Delhi, 2006

2. Kothary, C. R., “Research methodology: methods and techniques”, New Age International, New Delhi, 2008
3. Goddard, W. and Melville, S., “Research methodology – an introduction”, Juta & Co. Ltd., Lansdowne, 2007

MMECM 206 - 4 **ARTIFICIAL INTELLIGENCE**

L	T	P	C
3	0	0	3

Module 1

Human and machine intelligence: Concepts of fifth generation computing, programming in AI environment, developing artificial intelligence system, natural language processing, neural networks.

Introduction to fuzzy logic: Basic concepts in fuzzy set theory – operations of fuzzy sets – fuzzy relational equations – propositional, predicate logic – inference – fuzzy logic principles – fuzzy inference – fuzzy rule based systems – fuzzification and defuzzification – types.

Module 2

Fuzzy logic applications: Fuzzy logic controllers – principles – various industrial applications of fuzzy logic control – adaptive fuzzy systems – fuzzy decision making – fuzzy classification – fuzzy pattern recognition – image processing applications – fuzzy optimization.

Introduction to artificial neural networks: Fundamentals of neural networks – neural network architectures – learning methods – taxonomy of neural network architectures – standard back propagation algorithms – selection of various parameters – variations.

Module 3

Associative memory – exponential bidirectional associative memory – adaptive resonance theory – introduction – adaptive resonance theory 1 – adaptive resonance theory 2 – applications – Kohen self organizing maps – counter propagation networks – industrial applications.

Expert system development: Definition, choice of domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing.

Module 4

Industrial application of AI and expert systems: Robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition.

Recent advances: Fundamentals of genetic algorithms – hybrid systems – meta heuristic techniques like simulated annealing, tabu search, ant colony optimization, perpetual self organizing, artificial immune systems – applications in design and manufacturing.

References:

1. Robert Levine et al, "A comprehensive guide to AI and expert systems", McGraw Hill Inc, 1986
2. Henry C. Mishkoff, "Understanding AI", BPB Publication, New Delhi, 1986
3. Peter Jackson, "Introduction to expert systems", First Indian Reprint, 2000, Addison Wesley
4. Stuart Russell and Peter Norvig, "Artificial intelligence: a modern approach", Prentice Hall, 1995
5. Elaine Rich et al., "Artificial intelligence", McGraw Hill, 1995
6. Winston P H, "Artificial intelligence", Addison Wesley, Massachusetts, Third Edition, 1992

MMECM 207 COMPUTER INTEGRATED MANUFACTURING LABORATORY II

L	T	P	C
0	0	3	2

1. Programming of CNC lathe using software, programming of a machining centre using software
2. Automation using pneumatics
3. Automation using power hydraulics
4. Automation using PLCs for pneumatic control
5. Transducer interface with PC
6. Stepper motor interface with PC
7. Study of Reverse Engineering using CMM, Rapid prototyping techniques and Robot programming
8. Machineability of composites - Analysis based on cutting force measurement using dynamometer
9. Process capability evaluation based on inspection data.

MMECM 208 **SEMINAR- II**

L	T	P	C
0	0	2	1

Each student shall prepare a seminar paper on any topic of interest related to the core/elective courses being undergone in the second semester of the M. Tech. programme. He/she shall get the paper approved by the Programme Coordinator/Faculty Members in the concerned area of specialization and shall present it in the class in the presence of Faculty in-charge of seminar class. Every student shall participate in the seminar. Grade will be awarded on the basis of the student's paper, presentation and his/her participation in the seminar.

MMECM 301 INDUSTRIAL TRAINING

L	T	P	C
0	0	20	10

The student shall undergo an industrial training for a minimum period of 12 weeks in an industry / company approved by the institution and under the guidance of a staff member in the concerned field. The candidate is also required to identify, define, formulate and offer an acceptable solution for a problem observed in the organization. At the end of the training he/she has to submit a report on the work being carried out.

MMECM 302 THESIS – PHASE I

L	T	P	C
0	0	10	5

The thesis (Phase I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject of specialization or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed.

In Phase I of the thesis it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national and international journals, proceedings of national and international seminars. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work/experimentation carried out on the thesis topic.

Student should submit Phase I thesis report in two copies covering the content discussed above and highlighting the features of work to be carried out in part I of the thesis. Student should follow standard practice of thesis writing.

The candidate will deliver a talk on the topic and the assessment will be made on the basic of the term work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in thesis work Phase II.

MMECM 401 **THESIS – PHASE II**

L	T	P	C
0	**0**	**30**	**15**

In the fourth semester the student has continue thesis work and present the report. At the end of successfully finishing the work he/she has to submit a detailed report and has to present for a viva–voce.

The work carried out should lead to a publication in a National / International Conference. They should submit the paper before the evaluation of the thesis and specific weightage will be given to accepted papers in reputed conferences.

MMECM 402 **MASTER'S COMPREHENSIVE VIVA**

A comprehensive Viva-voce examination will be conducted to assess the student's overall knowledge in the specified field of engineering. At the time of viva-voce, certified reports of seminar, team exercise, industrial training and thesis works are to be presented for evaluation.