

**COURSE STRUCTURE FOR M.TECH.
IN MECHANICAL ENGINEERING
(SPECIALIZATION: MANUFACTURING ENGINEERING)**

Course structure

Semester I

Sl. No.	Course no.	Subject	L-T-P	Credit Hours
1.	AMC 51101	Advanced Numerical Methods and Applied Statistics	4-0-0	8
2.	MCC 51106	Precision Engineering	3-0-0	6
3.	MCC 51107	Theory of Machining	3-1-0	7
4.	MCC 51108	Thermo Production Processes	3-1-0	7
(5)	Elective (Any One)		3-0-0	6
	MCC 51101	Fundamentals of Tribology		
	MCE 51104	Rapid Prototyping		
	MCE 51105	Kinematics & Dynamics of Robots		
	MCE 51102	Finite Element Method		
	MCC 51102	Mechanical Vibration		
	MCE 51106	Laser Processing of Materials		
PRACTICAL AND OTHERS				
6	MCC 51401	Seminar	0-0-2	2
7	MCC 51203	Advanced Manufacturing Engineering -I	0-0-3	3
8	AMC 51201	Advanced Numerical Methods and Applied Statistics	0-0-2	2
Total			15-2-7	39

Semester II

Sl. No.	Course no.	Subject	L-T-P	Credit Hours
1.	MSC 52105	Operation Research-II	3-1-0	7
2.	MCC 52106	Non-traditional Machining Process	3-1-0	7
3.	MCC 52107	Computer Aided Manufacturing	3-1-0	7
4.	MCC 52108	Theory of Metal Forming	3-1-0	7
(5)	Elective (Any one)		3-0-0	6
	MCE 52105	Advanced manufacturing system		
	MCE 52102	Composite Materials		
	MCE 52106	Optimization Theory		
	MCE 52107	Micro-Electro-Mechanical-Systems (MEMS)		
	MCC 52103	Automation and Control		
	MCE 52108	Quality Engineering and Management		
	MCE 52119	Surface Engineering		
PRACTICAL AND OTHERS				
6.	MCC 52501	Comprehensive Viva-voce	0-0-0	(2)
7.	MCC 52201	Advanced Manufacturing Engineering -II	0-0-3	3
8.	MCC 52401	Seminar	0-0-2	2
9.	MCC53901	MCC53901 Industrial Training/Minor Project of 4 weeks to be credited in III semester	-	-
Total			15-4-5	39+(2)

III SEMESTER

Sl. No.	Course No.	Subject	L-T-P	Credit Hours
1	MCC53901	Industrial Training/Minor Project (taken in II semester)	0-0-0	5
2.	MCC53401	Seminar and Viva-voce on Industrial Training	0-0-0	5
3.	MCC53801	Dissertation (Interim)	0-0-0	15
4.	MCC53402	Seminar and Viva-voce on Dissertation	0-0-0	10
5.	MCC53001	Teaching Assignment/Laboratory Development Work	0-0-0	5
		Total	0-0-0	40

IV SEMESTER

Sl. No.	Course No.	Subject	L-T-P	Credit Hours
1	MCC54801	Dissertation	0-0-0	20
2.	MCC54401	Seminar on Dissertation	0-0-0	5
3.	MCC54501	Viva-vice on Dissertation	0-0-0	10
4.	MCC54001	Teaching Assignment/Laboratory Development Work	0-0-0	5
		Total	0-0-0	40

Syllabus

Semester I

Theory

AMC 51101 Advanced Numerical Methods and Applied Statistics (4-0-0)

Section A: Adv. Num. Methods – Review of solution of system of linear simultaneous equation. Solution of tridiagonal system, Ill conditioned system and iterative method to improve accuracy of an ill conditioned system. Evaluation of double and triple integrals by numerical methods and its application, solution of non-linear simultaneous equations, numerical solutions of integral equations, advanced method of interpolation, spline interpolation, numerical solution of simultaneous first order ordinary differential equations and higher order O.D.E. Initial and boundary value problems; Numerical solution of partial differential equations; Laplace and Poisson equation; heat conductive and wave equations; Writing computer program in the above methods.

Section B: Applied Statistics – Review of binomial, negative binomial, Poisson, normal and log normal distribution.

Test of significance of mean, variance, correlation and regression coefficients; χ^2 test of goodness of fit; attributes and contingency table; F tests, tests of proportions, tests of significance under large sample approximation. Non-parametric tests: Wald-Wolfowitz run tests, tests of randomness, median tests, sign tests, Mann-Whitney Wilcoxon U-tests. Time series analysis, introduction to reliability and life testing experiments in engineering problems. One way and two-way analysis of variance, Completely Randomized Design (CRD), Randomized block Design (RBD), Latin Square Design (LSD).

MCC 51106 Precision Engineering (3-0-0)

Introduction to precision engineering for manufacturing. Emphasis on design and performance of precision machinery for manufacturing. machine tool elements and structure, sources of error: thermal, static, dynamic and process related; precision machining processes and process model: diamond turning, fixed and free abrasive processes, sensors for process monitoring and control, metrology, actuators, examples of precision component manufacture, role of CAD/CAM in precision manufacturing, and aspects of sustainable manufacturing and design for sustainability.

References

1. Precision Manufacturing, by David Dornfeld and Dae-Eun Lee, Springer, 2008.
2. Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer.
 - A. H. Slocum, Precision Machine Design , 1992, Prentice-Hall.
3. H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press.
4. P. Seyfried, H. Kuntzmann, P. McKeown and M. Weck, eds., Progress in Precision Engineering, Springer-Verlag, 1991.
5. C. Evans, Precision Engineering; An Evolutionary View, Cranfield Press, 1989.
6. Tlusty, J., Manufacturing Processes and Equipment, Prentice-Hall, Upper Saddle River NJ, 2000.
7. Thomas, T. Rough Surfaces, 2nd ed., Imperial College Press, London, 1999.
8. Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing, Philadelphia PA,1994.

MCC 51107 Theory of Machining (3-1-0)

Need and Classifications of Machining Processes; Types of Study in Machining Processes-Experimental and Theoretical; CONVENTIONAL MACHINING: Mechanics of Metal Cutting: Chipping action; Cutting parameters; Orthogonal and Oblique cutting; Mechanism and Types of chips; Cutting forces and Stresses; Power and Energy; Heat and Temperature; Tool Materials and Tool Life; Tool Geometry and Mechanics of Turning, Drilling and Milling; ABRASIVE MACHINING: Mechanics of Metal Grinding: Grinding Wheel and Chip Formation; Grinding Forces and Power; Grinding Temperature; Advanced Abrasive Processes.

References:

1. Materials and Processes in Manufacturing, Degarmo, J. T. Black, Prentice Hall Of India Pvt Ltd.
2. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Prentice Hall.
3. Principles of Machine Tools, G. C. Sen and A, Bhattacharya, New Central Book Agency
4. Theory of Metal Cutting, A. Bhattacharya.
5. Manufacturing Science : Ghosh and Mallick, East-West Press Private Limited
6. Machining and Metal Working Handbook, Ronal A Walsh and Denis Cormier McGraw Hill Publication.

MCC 51108 Thermo Production Processes (3-1-0)

INTRODUCTION: Need and Classifications of Thermo-production Processes; METAL CASTING: Need and Limitations; Classification of Casting Processes; Sand Mould Casting: Classification of foundry sands; Composition, Properties and Testing of Moulding Sand; Design of Pattern and Core; Parting Line Design; Gating System Design-Types of gating systems; Design of pouring basin, sprue, runner and ingate; Mould filling velocity and time including friction and velocity distribution in the conduit; Determination of solidification time of castings; Riser design and Placement; Description of Precision Sand Mould Casting Processes; Metal Mould Casting: Preparation of metal mould; Determination of solidification time of castings; Description of Die Casting, Centrifugal casting and Continuous Casting;

METAL WELDING: Need and Limitations; Classification of Welding Processes; Arc Welding- Characteristics of arc and mode of metal transfer; Welding fluxes and coatings; welding machine characteristics-conventional and pulsed power sources, inverter type; Working and Modeling of arc welding processes; Resistance Welding-Principles and technology; power sources; Modeling of resistance welding processes; Beam Welding– Working and modeling of Laser Beam Welding and Electron Beam Welding; Solid Welding– Modeling and analysis of Friction Stir Welding, Explosive welding and Ultra-sonic welding, Weldability of cast iron, plain carbon and low alloy steels, stainless steels, Defects and Inspection of welds; Weld cracking and prevention;

POWDER METALLURGY: Production of metal powders; Blending and Mixing; Compacting and Sintering; Densification and Sizing; Impregnation and Infiltration; Advances in powder metallurgy-Isostatic pressing, Hot pressing and Spark sintering.

References :

1. Materials and Processes in Manufacturing, Degarmo, J. T. Black, Prentice Hall Of India Pvt Ltd.
2. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Prentice Hall.
3. Fundamentals of modern manufacturing processes, M. P. Groover.
4. Manufacturing Science : Ghosh and Mallick, East-West Press Private Limited
5. Machining and Metal Working Handbook, Ronal A Walsh and Denis Cormier McGraw Hill Publication.

Elective Papers (3-0-0)

MCC 51101

Fundamentals of Tribology

3 0 0

Introduction: Friction, wear and lubrication.

Engineering surfaces, nature of surface and surface measurements.

Friction: Origin of Friction; Friction theories; Measurement methods.

Wear: Types of wear - adhesive, abrasive, fatigue, corrosive etc.; Testing methods; Wear debris analysis; Wear reduction methods.

Lubrication: Basic equations of the theory of lubrication, calculation of oil flow rate; Methods of lubrication; Types of industrial lubricants and their standard grades; Boundary, hydrostatic and hydrodynamic lubrication.

References:

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|--------------------------------|-----------------------|
| 1. Principles of Tribology | J. Halling |
| 2. Engineering Tribology | Prasanth Sahoo |
| 3. Friction & Wear | B. Pugh |
| 4. Fundamentals of Tribology | Basu, Sengupta, Ahjua |
| 5. Friction, Wear, Lubrication | K. C Ludema |

MCE 51104 Rapid Prototyping (3-0-0)

Introduction to RP processes, applications, benefits, limitations, comparison between RP processes and CNC Machining. **Different Rapid Prototyping Processes** – namely Stereolithography (STL), Laser Sintering; Fused Deposition Modeling (FDM), Solid Ground Curing (SGC); Laminated Object Manufacturing (LOM), Ballistic Particle Manufacturing (BPM), Three Dimensional Printing (3DP), numerical Examples. **Materials of RP Technology** - Photo Sensitive Resin, Wax etc. **RP interfacing with Manufacturing processes** - Investment Casting, Vacuum Casting, Laser Additive Manufacturing. Rapid manufacturing processes like - Vacuum Casting Processes via RP Processes, Electroplated Prototypes, RTV Silicon Moulds, Direct Inkjet SL Tooling, Electron Beam Melting

References

1. Rapid Manufacturing: An Industrial Revolution for the Digital Age. Neil Hopkinson, Richard Hague, Philip Dickens (Editors); Wiley; Jan., 2006; ISBN:10: 0470016132; 13: 978-0470016138.
2. Additive Manufacturing Technologies; Rapid Prototyping to Direct Digital Manufacturing. Ian Gibson, David W. Rosen, Brent Stucker; Springer; January, 2010; ISBN: 978-1-4419-1119-3.
3. Rapid Prototyping: Principles and Applications. Rafiq I. Noorani; Wiley; Oct., 2005; ISBN: 10: 0471730017; 13: 978-0471730019.
4. User's Guide to Rapid Prototyping. Todd Grimm; Society of Manufacturing Engineers; February, 2004; ISBN: 0-87263-697-6.
5. Rapid Prototyping - Laser-based and Other Technologies. Patri K. Venuvinod and Weiyin Ma; Kluwer Academic Publishers; October, 2003; ISBN: 1-4020-7577-4.
6. Rapid Prototyping. Andreas Gebhardt; Hanser Gardner Publications; 1st ed., June 1, 2003; (Originally published in German, 1995); ISBN: 156990281X.
7. Rapid Prototyping: Principles and Applications (2nd Edition). Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing; World Scientific Pub Co; March, 2003; ISBN: 9812381171.
8. Rapid Prototyping: Theory and Practice. Ali Kamrani, Emad Abouel Nasr (Editors); Springer; 1st ed., Jan., 2006; ISBN:10: 0387232907; 13: 978-0387232904.
9. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov.

MCE 51105 Kinematics & Dynamics of Robots (3 – 0 – 0)

Definition and classification of ROBOTS and manipulators, motion and degrees of freedom, motion categories, uses, field of applications, Robot Arm Kinematics: Direct and Inverse, Robot arm dynamics, Manipulator trajectories, control of robot manipulators, spatial analysis, Introduction to sensing and vision in robotics.

References:

1. Selig, J.M.: Introductory robotics, Englewood Cliffs (N.J.): Prentice Hall, 1992
2. Craig, J.J.: Introduction to robotics: mechanics and control, Reading (Mass.): Addison-Wesley, 1986
3. Sciavicco L., Siciliano B.: Modeling and control of robot manipulators, New York (N.Y.): McGraw-Hill, 1996
4. Asada H., Slotine J.-J. E.: Robot analysis and control, New York (N.Y.): John Wiley & Sons, 1986
5. Reza N. Jazar : Theory of Applied Robotics: Kinematics, Dynamics, and Control, 1st edition (2007), Springer, ISBN-10: 0387324755.
6. Mark W. Spong, Seth Hutchinson: Robot Modeling and Control, Wiley (2005), ISBN-10: 0471649902

MCE 51104 FINITE ELEMENT METHOD 3-0-0

Principles of variation calculus.

Methods of Finite element analysis: stiffness method, potential energy and Rayleigh-Ritz method, Galerkin FE formulation, element formulation, and coordinate transformation, isoparametric formulation.

Applications: problems of structural mechanics and solid mechanics. Plane stress & plane stress problems, 3-D problems. Torsion, bending of plates and shells. FE formulations for vibrations, heat transfer and fluid flow problems. Associated flowcharts and computer programming.
Non-linear bending of straight beams and elastic plates

References:

1. Introduction to Finite Elements in Engineering, T. R. Chandrupatla & A. D. Belegundu, 2nd Ed., PHI, 2001.
2. An Introduction to the Finite Element Method, Reddy, J. N., 2005.
3. The Finite Element Method, O. C. Zienkiewicz, 3rd Ed., McGraw-Hill, 1997.
4. The Finite Element Method in Engineering, S. S. Rao, 2nd Ed., Elmsford, Pergamon, 1989.
5. Introduction to the Finite Element Method: A Numerical Method for Engineering Analysis, Desai, C. S. and Abel, J. F., 1972

MCE 52106 Optimization Theory

Basic Concepts: optimal problem formulation.

Single variable optimization algorithms: bracketing, region elimination, point estimation, and gradient based methods, root finding.

Multivariable optimization algorithms: unidirectional search, direct search methods, simplex search and gradient based methods.

Constrained optimization algorithms: penalty function method, method of multipliers, sensitivity analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, and gradient projection method.

Nontraditional optimization algorithms: Genetic algorithms, simulated annealing, and global optimization

Computer programming practice for general design applications

References:

1. Deb, K. Optimization for engineering design: algorithms and examples. Prentice Hall of India, New Delhi.
2. Rao, S.S.. Engineering Optimization: Theory and Practice. Wiley.
3. Bradley, S.; Hax, A.; [Magnanti, T.](#) Applied mathematical programming. Addison Wesley.
4. Rardin, Ronald L. Optimization in operations research. Prentice Hall.
5. Strang, Gilbert. Introduction to applied mathematics. Wellesley-Cambridge Press.

MCC 51102 MECHANICAL VIBRATION 3-0-0

Free and Forced vibration of single degree of freedom system with and without damping concept of phase plane. Response of single degree of freedom system to impulse, periodic and non-periodic excitation. Multi degree of freedom free, forced, undamped and damped vibration; Multi degree of freedom systems- exact analysis and numerical methods; Vibration in continuous systems; Vibration isolation, absorption and measurements in industrial machines

References:

1. Vibration fundamentals and practices; Clarence W. de Silva; CRC Press.
2. Vibrations and noise for engineers; Kewal Pujara; Dhanpat Rai & Sons.
3. Theory of vibrations with applications; William T Thomson; CBC Publishers & Distributors.
4. Vibrations, waves and acoustics; D Chattopadhyay, P C Rakshit; Books & Allied (P) Ltd.
5. Elements of vibration analysis; Leonard Meirovitch; McGraw-Hill International Editions.
6. Textbook of mechanical vibrations; Rao V Dukkupati, J Srinivas; Prentice Hall of India Pvt. Ltd.

MCE 51106 Laser Processing of Materials

Main industrial lasers: He-Ne, CO₂, Excimer, Nd:YAG, Diode, Fiber and Ultra-short pulse lasers and their output beam characteristics; laser beam delivery systems. Overview of Industrial & Scientific Applications of laser: Metrological applications, Holography, Laser Isotope Separation, Laser fusion. Laser processing fundamentals: Laser beam interaction with metal, semiconductor and insulator, Ultra-short laser pulse interaction, heat flow theory and

metallurgical considerations. Laser Material Processing Applications: Laser cutting and drilling: Process characteristics, material removal modes, practical performances. Laser welding: Process mechanisms like keyhole and plasma effect, operating characteristics and process variation. Laser surface modifications: Heat treatment, surface remelting, surface alloying and cladding, surface texturing, LCVD and LPVD. Laser rapid manufacturing. Laser metal forming: Mechanisms involved including thermal temperature gradient, buckling, upsetting. Laser peening: Fundamentals of Laser Shock Processing, Effects of various laser and process parameters, Mechanical effects and microstructure modification during laser shock processing. Theoretical modelling of laser material processing. On-line Process monitoring & control: Laser and process parameters, and workpiece characteristics. Economics of Laser Applications in Manufacturing. Laser Safety: Laser safety standards and safety procedures.

Reference:

Practical

MCC 51203 Advanced Manufacturing Engineering Laboratory-I (0-0-3)

1. Measurement and analysis of Cutting Force and Temperature in Turning operation
2. Measurement and analysis of Grinding Force and Estimation of Temperature
3. Imparting geometry to cutting tools
4. Assessment of surface integrity due to Grinding and other machining processes
5. Measurement of MRR for Gear Hobbing and Gear Shaping
6. Gear manufacturing (with measurement) on milling/gear hobbing/gear shaping machine tool.
7. Sand preparation and testing: specimen preparation for testing permeability, clay content, grain fineness number, moisture content, green compression strength, green shear strength, splitting strength, hardness, etc.;
8. Casting of metals after preparation of suitable moulds; Experiments on properties of post casting, fettling, cleaning, deburring, and polishing operations;
9. Experiments on different welding process.
 - a. Inspection of welded joints as per BIS.
 - b. Analysis of Microstructure of welded joints
 - c. Inspection of welded joints by dye penetration and ultrasonic method.

Semester II

MSC52105 Operation Research-II (3-1-0)

Review of linear programming technique and its solution methodology; Integer programming and its application in managerial decision making, solution methodologies, zero-one programming; Dynamic programming; principle of optimality, concepts of state and stage, solution of discrete and continuous dynamic programming problems; Introduction of Markov decision process; Queuing theory: definitions and classification; Applications; Discrete event simulation and its applications; Concept of multi criteria decision making; Stochastic decision making models: decision tree, introduction to stochastic programming model; soft optimization methods: Genetic Algorithm, Simulation annealing, Neural network and heuristic programming methods.

MCC 52106 Non-traditional Machining Process (3-1-0)

Need and Classification; Process Principle, Applications, Equipments, Process Analysis of Abrasive Jet, Water Jet, Ultrasonics, Electrochemical Machining and grinding, polishing, sharpening, honing and turning. Electrochemical Discharge machining and Grinding; Electrostream and Shaped Tube Electrolytic Machining.

Chemical Machining, Thermal energy methods of material processing (machining/welding/heat treatment) by Electro-discharge, Laser and Electron beam, Plasma arc and Ion beam. Physical Vapour and Chemical Vapour Deposition and Plasma Spraying. High Energy Rate Forming and Electroforming; Hybrid machining processes. Conventional Micromachining, Abrasive Micromachining, Nonconventional Micromachining and Combined Micromachining.

References:

1. Materials and Processes in Manufacturing, Degarmo, J. T. Black, Prentice Hall Of India Pvt Ltd.
2. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Prentice Hall.
3. Manufacturing Science : Ghosh and Mallick, East-West Press Private Limited
4. Fundamentals of modern manufacturing processes, M. P. Groover.
5. Unconventional Machining, P K Mishra
6. Unconventional Machining, V K Jain
7. Unconventional Machining, Pandey and Mishra

MCC 52107 Computer Aided Manufacturing (3-1-0)

Basic principles of automation; Extending the capabilities of conventional machines through improved devices and manipulators; Basic principles of numerical control; CNC, DNC and Machining Centres; Manual part programming(industrial controller like Fanuc/Siemens); APT programming; System devices; Adaptive control; Economics of numerical control.

Introduction to Robotics: Synthesis of elements with movability constraints; Elements of robot anatomy; Hydraulic, pneumatic and electrical manipulators; End-effectors and their design; Controllers with microprocessors; Robot Sensors; Applications of industrial robots; Economics of robotics.

Reference:

1. CAD/CAM Theory and Practice, Ibrahim Zeid, Tata McGraw Hill Publication
2. CAD/CAM Principle and Application, P. N. Rao, Tata McGrawHill Publication.
3. users guides to Rapid Prototyping, Todd Frimm, Society of Manufacturing Engineers
4. Computer control of Manufacturing system, Yoram koren, McGraw Hill Publication.
5. Machining and Metal Working Handbook, Ronal A Walsh and Denis Cormier McGraw Hill Publication.
6. Machining and CNC Technology, M. Fitzpatrick, McGraw-Hill Publication.
7. Journey from Rapid Prototyping to Rapid Manufacturing, S Chattopadhyaya, Lambert Publication.

MCC 52108 Theory of Metal Forming (3-1-0)

Need and Classification of Forming Processes, Theory and practice of Forming Processes;

CONVENTIONAL FORMING PROCESSES: Massive metal and Sheet metal forming-Comparisons; Fundamentals of Plastic Deformations: Elastic and Plastic Deformation, Yielding Criterion and Flow Rules; Plastic Anisotropy and Viscoplasticity; Concept of solid and flow formulations; Plastic Deformation Analysis Techniques-Slab Method, Upper Bound Method and Slip Line Method; Analysis (using Slab, Upper Bound and Slip Line Method) of: Plain strain Problems: Drawing of Sheet and Extrusion of Plate, Rolling of Plate and Forging of Strip; Axisymmetric Problems: Drawing of Wire and Extrusion of bar and tube, Forging of Solid and Hollow Disc; Bending and Deep Drawing;

UNCONVENTIONAL FORMING PROCESSES: Classification; Process Principle, Applications, Equipments, Process Analysis and Die Design of Explosive Forming; Electro-Magnetic Forming ; Electro-Hydraulic Forming; Laser Beam Bending and Laser Assisted Deep Drawing;

MICRO FORMING PROCESSES: Classification; Process Principle and Applications of Conventional Micro-Forming Processes and Unconventional Micro-Forming Processes.

References:

1. Materials and Processes in Manufacturing, Degarmo, J. T. Black, Prentice Hall Of India Pvt Ltd.
2. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Prentice Hall.
3. Fundamentals of modern manufacturing processes, M. P. Groover.
4. Manufacturing Science : Ghosh and Mallick, East-West Press Private Limited
5. Machining and Metal Working Handbook, Ronal A Walsh and Denis Cormier McGraw Hill Publication.

Elective (Any one)

MCE 52105 Advanced manufacturing system

Group Technology: Concepts, applications, Opitz system of classifications, merits and demerits. Cellular Manufacturing system(CMs): Principle of cell formations, applications, different methods of cell formations, Scheduling in CMS, merits and demerits., Assignment scheduling and sequencing problems, Lean Manufacturing: concepts, implementation methodology, case studies, Agile Manufacturing: Definition, agility, method of implementation, relationship between lean and agile manufacturing, Concepts of Flexible manufacturing system (FMS), components of FMS, FMS layouts and design, Computer Integrated Manufacturing system(CIM): Concepts, applications

References:

1. Automation Production System & CIM, M. P. Groover.
2. Materials & processes in Manufacturing, Degarmo, J. T. Black.
3. Lean Manufacturing System & Cell Design, J. T. Black.

MCE 52102 Composite Materials (3-0-0)

Introduction to composites: Basic concepts, Structural applications, Classification, Strength and stiffness advantages, Manufacturing aspects of composites.

Micro-mechanics : Mechanics of materials method, Bounding methods, Semiempirical methods, Longitudinal and Transverse elastic properties, Inplane Shear modulus, Stress – strain relations for General anisotropic, Specially orthotropic and Transversely isotropic Materials, 2D Transformation of Stress – strain, Elastic parameters, Engineering constants, 3D Transformation of Stress – strain, and Elastic parameters.

Macro-mechanics: Strength analysis of Unidirectional Lamina under various loading conditions, Failure theories, Computational procedure for determination of Lamina strength – Tsai – Wu criterion.

Elastic behavior of Multidirectional laminates – symmetric and asymmetric laminates, Computational procedure for determination of engineering elastic properties, Carpet plots for multidirectional laminates.

Stress and failure analysis of multidirectional laminates, Hygrothermal effects, Experimental methods for characterization and testing of Composite materials. design of laminates.

References:

1. Mechanics of composite materials, R. M. Jones, 2nd Edn. Taylor & Francis, 1999.
2. Engineering mechanics of composite materials, I. M. Daniel & O. Ishai, 2nd Edn., Oxford University Press, 2006.
3. Principles of composite material mechanics, R. F. Gibson, 2nd Edn. CRC Press, 2007

MCE 52107 Micro-Electro-Mechanical-Systems (MEMS) (3-0-0)

Introduction to MEMS & materials, fabrication processes, MEMS sensors and actuators, scaling issues in MEMS, electro mechanics, modelling and design techniques, packaging and reliability, measurement techniques for MEMS.

References:

1. MEMS: Introduction and Fundamentals by [Mohamed Gad-el-Hak](#) –
2. MEMS mechanical sensors by [Stephen Beeby](#)
3. Microsensors, MEMS, and smart devices by [Julian W. Gardner](#), [V. K. Varadan](#), [Osama O. Awadelkarim](#)
4. MEMS and microsystems: design, manufacture, and nanoscale engineering- [Tai-Ran Hsu](#) –
5. MEMS by N P Mahalik

MCC 52103 Automation and Control (3-0-0)

Introduction; Mathematical models of physical system; Feedback characteristics of control systems; Control systems and components; Time response analysis, design specifications and performance indices; Concepts of stability and algebraic criteria; Root locus technique; Frequency response analysis; Stability in frequency domain; State variable analysis and design; Controllability and Observability; Optimal control; Adaptive control; Open loop control and closed loop control, Positive and negative feedback, Stepper motor and servo motor, PTP and Continuous control, PID Control Introduction to digital control systems; 8085/8080A Microprocessor architecture and programming.

References:

1. Automatic Control Engineering by F.H.Raven, 5th ed., McGrawHill International.
2. Modern Control Engineering by K.Ogata, Prentice Hall.
3. Digital Control Systems by B.C.Kuo, Prentice Hall.
4. Microprocessor architecture, programming, and applications with the 8085/8080A by Ramesh S. Gaonkar, Wiley Eastern Ltd.
5. Fundamentals of Linear State Space Systems by John S. Bay, WCB/McGraw-Hill

MCE 52119 Surface Engineering (3-0-0)

Fundamentals of surface engineering: definition, scope, classification, and general principles, surface dependent properties and failures, Surface and surface energy: Structure and types of interfaces.

Conventional surface engineering practice: Surface engineering by material removal: like etching, grinding, polishing, etc. Surface engineering by material addition: like hot dipping, Electro-plating, carburizing, Cyaniding, etc.

Advanced surface engineering practices: Surface engineering by energy beams: Laser assisted microstructural modification like surface melting, hardening, shocking etc., Laser assisted compositional modification like surface alloying, surface cladding, composite surfacing etc. Ion beam assisted microstructure and compositional modification, Surface engineering by spray techniques like Flame spray, cold spray etc., Sputter deposition of thin films & coatings, PVD coating processes, Chemical vapour deposition and PECVD

Characterization of coatings and surfaces: Measurement of coatings thickness, porosity & adhesion of surface coatings, Measurement of residual stress & stability, Surface microscopy, topography and Spectroscopic analysis of modified surfaces.

References:

1. Introduction to Surface Engineering by P. A. Dearnley,
2. Surface Engineering for Corrosion and Wear Resistance by J.R. Davis
3. Laser surface modification of alloys for corrosion and wear resistance by Chi Tat Kwok
4. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs, 1988.
5. Tadeusz Burakowski Tadeusz Wierzchon: "Surface Engineering of Metals: Principles, Equipment, Technologies", CRC, 1998
6. ASM Hand book – Surface Engineering

MCC 52201

Advanced Manufacturing Engineering Laboratory-II

(0-0-3)

1. Work space analysis of manipulator
2. Writing a part program for profile cutting operation on CNC milling machine.
3. Writing a part program for different turning on CNC lathe.
4. Part programming using canned cycle for various machining operations.
5. Writing a part programming in APT for drilling operation (point to point).
6. Writing a part programming in APT for milling operation (contouring).
7. Simulation of various machining operations using CAM packages.
8. Experiment related to simulation of manufacturing processes in FMS.

9. Study of material handling system in FMS environment.
10. Study of system device such as motors, feed back devices etc.
11. Study of various sensors used in factory.
12. Experiment on measuring capabilities of CMM.
13. Effect of process parameters in non-traditional machining process (Electrochemical Jet Drilling, Electro-discharge Machining, Wire and die sinking –EDM, ultrasonic machining)