

Institution electives offered by
Manufacturing Science and Engineering

**Scheme and Syllabus for
M.Tech-Manufacturing Science and Engineering
With effect from A. Y-2017 – 18**

Institution Elective	
16MEMSIECM	Computational methods in Engineering analysis
16MEMSIEDE	Design of Experiments
16MEMSIEDM	Design for Manufacture

Computational Methods in Engineering Analysis

Subject Code	16MEMSIECM	CIE Marks	50
L-T-P-S	4-0-0-0	SEE Marks	50
Total no. of Lecture Hours.	52	Exam Hours	03

Course Content:

Unit-1

Approximations and Round off Errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling and Engineering problem solving, simple mathematical model, Conservation Laws of Engineering.

Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.

15 Hours

Unit-2

Roots of Polynomial: Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.

Numerical Differentiation and Numerical Integration: Newton –Cotes and Gauss Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae.

15 Hours

Unit-3

System of Linear Algebraic Equations And Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods.

8 Hours

Unit-4

Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method.

7 Hours

Unit-5

Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering

Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets, Orthogonal projections, The Gram- schmidt process, Least Square problems, Inner product spaces.

7 Hours

Text Books:

1. S.S.Sastry “**Numerical Analysis for Engineers**”-Tata McGraw Hill Edition.
2. Steven C.Chapra, Raymond P. Canale “**Numerical Methods for Engineers**”- fourth Edition, Tata McGraw Hill.
3. M K.Jain, S.R.K Iyengar, R K. Jain "Numerical Methods for Scientific and Engg. Computation”. NEW AGE INTERNATIONAL Publishers.

Reference Books:

1. Pervez Moin “**Application of Numerical methods to Engineering**”.
2. David. C. Lay, “**Linear Algebra and its applications**” -3rd edition, Pearson Education.

E-BOOKS :

1. <http://nptel.ac.in/syllabus/103106074/>
2. http://nptel.ac.in/syllabus/syllabus_pdf/103106074.pdf

MOOCS:

1. https://onlinecourses.nptel.ac.in/noc16_ch01/preview

Course Out comes

CO1	Construct and analyze mathematical models of physical applications. Find the roots of polynomials, algebraic, transcendental or simultaneous system of equations in science and engineering problems
CO2	Integrate and differentiate a function for given set of tabulated data with greater accuracy for engineering problems. Solve system of linear algebraic equations and compute eigen values and eigen vectors of matrices
CO3	Present case studies with technical reports on current research in the relevant field

Scheme of Examination:

Answer five full questions selecting one from each unit. To set one question each from units 3, 4 and 5 and two questions each from units 1 and 2.

DESIGN OF EXPERIMENTS

Subject Code	16MEMSIEDE	CIE Marks	50
L-T-P-S	4-0-0-0	SEE Marks	50
Total no. of Lecture Hours.	52	Exam Hours	03

Course Content:

Unit-1

Quality by Experimental Design:

Quality, western and Taguchi quality philosophy, Elements of cost, Noise factors causes of variation, Quadratic loss function and variation of quadratic loss functions.

Robust Design: Steps in robust design: parameter design and tolerance design, reliability improvement through experiments, illustration through numerical examples.

Experimental Design: Classical experiments: factorial experiments, terminology, factors. Levels, Interactions, Treatment combination, randomization, 2-level experimental design for two factors and three factors. 3-level experiment designs for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples. **15 Hours**

Unit-2

Measures of Variability:

Measures of variability, Concept of confidence level, Statistical distributions: normal, log normal and Weibull distributions. Hypothesis testing, Probability plots, choice of sample size illustration through numerical examples. Analysis and interpretation of experimental data: Measures of variability, Ranking method, column effect method and plotting method, Analysis of variance (ANOVA), in factorial experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, illustration through numerical examples. **8 Hours**

Unit-3

Taguchi's Orthogonal Arrays:

Types orthogonal arrays, Selection of standard orthogonal arrays, Linear graphs and interaction assignment, dummy level technique, Compound factor method, modification of linear graphs, Column merging method, Branching design, Strategies for constructing orthogonal arrays. 54
Signal to Noise ratio (S-N Ratios) : Evaluation of sensitivity to noise, Signal to noise ratios for

static problems, Smaller – the – better types, Nominal – the –better – type, larger – the- better – type. Signal to noise ratios for dynamic problems, Illustrations through numerical examples.

15 Hours

Unit-4

Parameter Design and Tolerance Design:

Parameter and tolerance design concepts, Taguchi's inner and outer arrays, Parameter design strategy, Tolerance design strategy, Illustrations through numerical examples. **7 Hours**

Unit-5

Reliability Improvement Through Robust Design:

Role of S-N ratios in reliability improvement; Case study; Illustrating the reliability improvement of routing process of a printed wiring boards using robust design concepts.

7 Hours

Text Books:

1. Madhav S. Phadake, "Quality Engineering using Robust Design", Prentice Hall, 1989.
2. Douglas Montgomery, "Design and analysis of experiments", Willey India Pvt. Ltd., 2007.
3. Phillip J. Ross, Taguchi, "Techniques for Quality Engineering", McGraw Hill Int. Ed., 1996.

Reference Books:

1. Thomas B. Barker, "Quality by Experimental Design", Marcel Dekker IncASQC Quality Press, 1985
2. C.F. Jeff Wu, Michael Hamada, "Experiments planning, analysis and parameter design optimization", John Willey Ed., 2002

E-BOOKS:

1. <http://nptel.ac.in/courses/111104075/2>

MOOCS:

1. http://onlinevideolecture.com/?course_id=554&lecture_no=8

Course Out comes

CO1	Choose an appropriate experiment to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results
CO2	Plan, design, and conduct experimental investigations efficiently and effectively
CO3	Understand strategy in planning and conducting experiments and review recent advances in experimentation and give a oral presentation

Scheme of Examination:

Answer five full questions selecting one from each unit. To set one question each from units 2, 4 and 5 and two questions each from units 1 and 3.

DESIGN FOR MANUFACTURE

Subject Code	16MEMSIEDM	CIE Marks	50
L-T-P-S	4-0-0-0	SEE Marks	50
Total no. of Lecture Hours.	52	Exam Hours	03

Course Content:

Unit-1

Material and process selection – Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, Selection of materials, Primary process/ materials selection, Systematic selection of processes and materials. Case studies on machining sequence **8 Hours**

Unit-2

Engineering Design features – Dimensioning, Tolerances, General Tolerance, Geometric Tolerances, Assembly limits, achieving larger machining tolerances, Screw threads, Ground surfaces, holes. Examples

Datum features – Functional datum, machining sequence, manufacturing datum, changing the datum. Examples

Component design – Machining Considerations – Drills, Milling cutters, Drilling, Keyways, Dowels, Screws, Reduction in machining areas, Simplification by separation and amalgamation, work piece holding, surface grinding, Examples **15 Hours**

Unit-3

Component design – Casting Considerations – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores. Examples

Design for Injection molding and Sheet metal working – Injection molding materials, Molding cycle, Systems, molds, machine size, cycle time, Cost estimation, Insert molding, Design guidelines, Introduction to sheet metalworking, Dedicated Dies and Press working, Press selections, Design Rules. **15 Hours**

Unit-4

Design for Die casting and Powder metal processing – Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines. **7 Hours**

Unit-5

Geometric Tolerance – Symbols, Three datum concept of dimensioning, Straightness, concentricity, Run-out, Location Tolerance, Assembly of parts having concentric cylinders, Control of feature location by true position, Body of revolution, Roundness, Profile dimensioning, Tapers, Shaft of two diameters. Examples. **7 Hours**

TEXT BOOKS:

1. Product Design for Manufacture and Assembly – Geoffrey Boothroyd - Peter Dewhurst - Winston Knight – Marcel Dekker, Inc. – Newyork - Second Revision, ISBN 0-8247-0584-X.
2. Designing for Manufacturing – Harry Peck - Pitman Publications – 1983.
3. Dimensioning and Tolerancing for Quantity Production – Merhyle F Spotts –Inc. Englewood Cliffs - New Jersey - Prentice Hall, 5th edition.

E-BOOKS:

1. <http://nptel.ac.in/courses/112101005/>
2. <http://nptel.ac.in/courses/112101005/11>

Course Out comes

CO1	Selection of materials and processes for designed component
CO2	Design of inspection, cutting tools & fasteners, casting, injection moulding & die casting, sheet metal operation and powder metallurgy tools
CO3	Make oral presentations and prepare report on current research on product design

Scheme of Examination:

Answer five full questions selecting one from each unit. To set one question each from units 1, 4 and 5 and two questions each from units 2 and 3.