Scheme for B.Tech. Engineering with Minor in Mathematics
Department of Mathematics

S. No.	Course Name	Semester	Type	Credits	L	T	P
1	Numerical Methods	V	Theory	3	3	0	0
2	Linear Algebra	V	Theory	3	3	0	0
3	Probability and Statistics	VI	Theory	3	3	0	0
4	Discrete Mathematical Structures	VI	Theory	3	3	0	0
5	Complex Analysis	VII	Theory	3	3	0	0
6	Operation Research	VIII	Theory	3	3	0	0
		Total Credits:		18			

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : **Department of Mathematics**

Course Code :

Course Name : **Numerical Methods**

Credits : 3 L- 3 T- 0 P- 0

Course Type :

Prerequisites : **MAT101: Mathematics - I and MAT102: Mathematics – II**

Course Contents

Error analysis: Representation of numbers in computers and their accuracy, floating point arithmetic, concept of zero, errors in computations, types of errors, propagation of errors, computational methods for error estimation, general error formulae, approximations of functions and series.

Roots of algebraic and transcendental equations: Bisection method, Regula-falsi method, fixed-point iteration, Newton-Raphson method.

Solution of simultaneous algebraic equations: Gauss elimination method, Gauss Jordan method, decomposition method, Jacobi and Gauss-Seidel iteration methods.

Interpolation and finite differences: Forward, backward and central differences, relations between the operators, Newton's forward and backward differences interpolation formulae, Stirling, Bessel and Gauss formulae for central difference, numerical differentiation, Lagrange's and Newton's divided difference interpolation formulae for unequal interval.

Numerical Integration: Gaussian-Legendre quadrature formula, Trapezoidal, Simpson's one-third, Simpson's three-eighth quadrature formula, Weddle's rule.

Ordinary Differential Equations: Taylor's series method, Picard's method, Euler's and modified Euler's methods, Runge-Kutta fourth-order method, Milne's Predictor-Corrector method.

Recommended Readings

Textbooks:

1. Jain M.K., Iyengar S.R.K., and Jain R.K., *Numerical Methods for Scientific and Engineering Computation*, Wiley Eastern Limited, 2012.
2. Burden R. L. and Faires J. D., *Numerical Analysis*, 9th Edition, Cengage learning, 2011.

Reference books:

1. Gerald C.F and Wheatly P.O., *Applied numerical analysis*, Seventh Edition, Pearson Addison-Wesley Pub. Co, 1985.
2. Sastry S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall of India, 2012.
3. Sharma J.N., *Numerical methods for Engineers and Scientists*, 2nd edition, Narosa Publishing House, New Delhi, 2008.

Online resources:

NPTEL course *Numerical Methods*, coordinated by IIT Roorkee available at the link: https://nptel.ac.in/courses/111/107/111107105/ (as on 04.09.2021).

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mathematics

Course Code :

Course Name : Linear Algebra

Credits : 3 L - 3 T - 0 P - 0

Course Type :

Prerequisites : MAT-102 (Mathematics-II)

Course Contents

Vector space and subspaces, Linear independence and dependence, Spanning set, Basis, linear transformations, matrix representation, change of basis.

Inner product spaces, Gram-Schmidt orthogonalization, QR-factorization, best approximation, least square approximation. Adjoint of an operator, hermitian, unitary and normal operators.

Diagonalizability of linear operators of finite dimensional vector space. The primary decomposition theorem, generalized eigenvectors, Jordan form. Singular Value Decomposition and its applications. Introduction of bilinear and quadratic forms.

Recommended Readings

Text books-

1. Strang G., *Linear Algebra and Its Applications*, 4th edition Cengage Learning, 2006.
2. Anton H., Rorres C., *Elementary Linear Algebra: Applications*, 11th edition, Wiley, 2013.

Reference books-

1. Hoffman K. and Kunze R., *Linear Algebra*, 2nd edition, PHI Learning, 2009.
2. Artin M., Algebra, 2nd Edition, Pearson education, 2011.
3. Kumaresan S., *Linear Algebra: A Geometric Approach*, PHI Learning, 2000.
4. Lewis D. W., *Matrix Theory*, World Scientific, 1991.
5. Lang S., *Introduction to Linear Algebra*, 2nd Edition, Springer India, 2005.

Online resources-

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre	:	**Department of Mathematics**
Course Code	:	
Course Name	:	**Probability and Statistics**
Credits	:	3 L- 3 T- 0 P- 0
Course Type	:	
Prerequisites	:	**Mathematics-I and II**

Course Contents

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, problems. Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles.

Special Distributions: Discrete uniform, binomial, geometric, negative binomial, hypergeometric, Poisson, continuous uniform, exponential, gamma, Weibull, beta, normal, lognormal, inverse Gaussian distributions, reliability and hazard rate, reliability of series and parallel systems, problems, Function of a random variable.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution, problems. Transformations: functions of random vectors, distributions of order statistics, distributions of sums of random variables, problems.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems.

Descriptive Statistics: Graphical representation, measures of locations and variability,

Recommended Readings

Text books:

1. Ravichandran J., *Probability and statistics for Engineers*, Wiley India, 2019
2. Ross S.M., *Introduction to Probability and Statistics for Engineers and Scientists,* Elsevier Third Edition Academic Press 2008.

Reference books:

1. Gupta S. C. and Kapoor V. K., *Fundamentals of Mathematical Statistics* , Sultan Chand & Sons (1 January 2014)
2. Shanker Rao G., *Probability and statistics for Science and Engineering*, Universities Press, 2011.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mathematics
Course Code : _____
Course Name : Discrete Mathematical Structures
Credits : 3 L- 3 T- 0 P- 0
Course Type :
Prerequisites : **none; [preferred – understanding of basic mathematics]**

Course Contents

Set Theory: Review of basic set operations, cardinality of a set. Countable and uncountable sets. Relations, Types of relations, operations of relations and applications, Poset, Congruence arithmetic.
Logic: Propositional Logic, language of propositional logic, truth table, natural deduction, predicate logic: language of predicate logic, Logical inference with Quantifiers. Proof techniques: Introduction to different standard proof techniques.
Combinatorics: Counting techniques: Pigeon Hole principle, inclusion exclusion principle, recurrence relation and generating function.
Graphs: Complete graphs, regular graphs, bipartite graphs, Vertex degree, subgraphs, paths and cycles, Hamiltonian graphs, Planar graphs, the matrix representation of graphs, trees, Graph coloring, shortest path problems.

Recommended Readings

Text books-

1. Rosen K. H., *Discrete Mathematics and its Applications with Combinatorics and Graph Theory*, 7th Edition, Tata McGraw-Hill Edu. 2012.
2. Liu C. L. and Mohapatra D., *Elements of Discrete Mathematical*, 4th Ed., Tata McGraw-Hill, 2012.

Reference books-

1. Kolman B., Busby R. and Ross S. C., *Discrete mathematical structures*, 4th edition. Prentice Hall of India, 2002.
2. Bondy J. A. and Murty U. S. R., *Graph Theory*, Springer, 2008.
3. Mott J.L., Kandel A. and Baker T.P., *Discrete Mathematics for Computer Scientists and Engineers*, 2nd Ed. PHI, 2003.

Online resources-https://nptel.ac.in/courses/106/108/106108227/

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mathematics

Course Code : _____

Course Name : Complex Analysis

Credits : 3 L - 3 T - 0 P - 0

Course Type :

Prerequisites : MAT-101 and MAT-102

Course Contents

Metric Properties of Complex Plane: Usual metric on complex plane, open sets, closed sets, accumulation point, connectedness and path connectedness.

Analytic Functions: Complex valued functions of the form f(t), functions of a complex variable, limits and continuity, differentiability, Cauchy – Riemann equations, analytic function, harmonic functions, conjugate functions. Mappings or transformations, conformal mapping, necessary and sufficient conditions for $w = f(z)$ to represent conformal mapping, bilinear transformations.

Complex Integration: Line integral of functions of the form f(t), Contour integrals, Antiderivative, Cauchy fundamental theorem, Cauchy-Goursat theorem, Cauchy integral formula and its extension, Morera's theorem, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus principle.

Expansion of analytic function: Taylor and Laurent series, zeros and poles, isolated and essential singularities.

Calculus of Residues: Residue at simple pole, residue at a pole of order greater than unity, the Cauchy's residue theorem, evaluation of real definite integrals.

Recommended Readings

Text books-

1. Churchill R. V. and Brown J. S., *Complex Variables & Applications* –Tata McGraw Hill Eduction, 2009.
2. Kreyszig E., *Advanced Engineering Mathematics*, John Wiley, 10th edition, 2015.

Reference books-

1. Ahlfors L., *Complex Analysis*, McGraw Hill, 3 edition, 1979.
2. Ponnusamy S., *Foundations of Complex Analysis*, Alpha Science Intl Ltd; 2nd edition, 2006.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Centre : Department of Mathematics
Course Code :

Course Name : Operations Research
Credits : 3 L - 3 T - 0 P - 0
Course Type :
Prerequisites : Mathematics-I and II

Course Contents

An overview of optimization problem, some examples of optimum design problem. Concepts and terms related to optimization problem, necessary and sufficient conditions for a multivariable function. Effects of scaling or adding a constant to an objective function and understanding constrained and unconstrained optimization problems. Concept of Lagrange multipliers and its application to unconstrained optimization problem.

Linear programming: Introduction, general structure of linear programming (LP) models, methods of solving: graphical method, simplex method. Duality in LP, Assignment problem, Game theory. Transportation Problem: Mathematical statement of transportation problem, methods of finding basic feasible solution (BFS), test of optimality, MODI'S method for optimal solution, variation in transportation problem.

Convex sets, convex and concave functions, properties of convex function, definiteness of a matrix and test for concavity of function. Problem statement of convex optimization, quadratic optimization, quadratically constrained quadratic optimization, local and global optima.

Quadratic programming: Wolfe's and Beale's method. Network Analysis: Project planning and control with PERT-CPM.

Recommended Readings

Text books:

1. Taha H.A., *Operations Research - An Introduction*, Pearson Education Limited, 2017.

Reference Books:

1. Hillier F.S. and Liebraman G.J., *Introduction to Operations Research*, McGraw Hill, 2014.
2. Arora J.S, *Introduction to optimum design*, Elsevier, 2016.
3. Rao S.S, *Engineering Optimization: Theory and Practice*, Wiley, 2009.
4. Ravindran A, Ragsdell K.M and Reklaitis G.V, *Engineering optimization: Methods and Applications,* John Wiley &Sons, 2006.
5. Deb K, *Optimization for Engineering Design: Algorithms and Examples*, PHI Learning,2012.