KONERU LAKSMAIAH EDUCATION FOUNDATION (KLEF)
DEPARTMENT OF MATHEMATICS
M.Sc Applied Mathematics
2018-19

Applicable for students admitted into

M.Sc., Program 2018-2019

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

AND

PROGRAM OUTCOMES (POs)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The objectives of the M.Sc program in Applied Mathematics are :

1.	To assimilate and understand a large body of complex concepts and their interrelationships.
2.	Apply Advanced Mathematical Techniques to formulate, solve and analyze mathematical models of real life problems.
3.	To identify and apply suitable computational mathematical tools and techniques to solve various complex Engineering problems and meaningful physical interpretation.
4.	To Demonstrate, communicate, and work, with people having diversified backgrounds in individual and group settings, in an ethical and professional manner.
5.	To maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for life long learning.
6.	Promote interdisciplinary research among allied subjects related to applied mathematics
7.	Use symbolic and numerical software as part of practical computation.

PROGRAM OUTCOMES (POs):

Upon completion of the program, graduates will be able to

1.	To identify, formulate, abstract, and solve mathematical problems that use tools from a variety of mathematical areas, including algebra, analysis, probability, numerical analysis and differential equations
2.	The program prepares students for a variety of mathematical careers. The current program has three identified tracks viz: Cryptography, Data analysis, Applied Mechanics, and Ph.D preparation. Students should be prepared for employment requiring mathematical skill and sophistication at the Master's level.
3.	Apply mathematics and technology tools (MATLAB, R, MINITAB) to solve problems.
4.	Ability to do research in a particular topic agreed with a Supervisor, on which the student publish a research paper in a peer reviewed indexed journal.

ACADEMIC RULES & REGULATIONS

FOR

M.Sc.(APPLIED MATHEMATICS) PROGRAM

2018-19

ACADEMIC REGULATIONS FOR
M.Sc.(APPLIED MATHEMATICS) PROGRAM

This document supplements the KLEF rules and regulations to provide assistance to all M.Sc. Applied Mathematics students. It is required that every individual has to abide by these regulations.

Note: The regulations stated in this document are subject to change or can be relaxed / modified without prior notice at the discretion of the Hon'ble Vice Chancellor.

CHAPTER 1
ELIGIBILITY CRITERIA FOR ADMISSION INTO M.Sc. (APPLIED MATHEMATICS) PROGRAM

Candidates should have passed B.Sc. / B.Sc Honors from recognized Indian or foreign universities/institutions in respective discipline with minimum of 55% marks or equivalent CGPA. Furthermore, the candidates should have secured a qualifying rank in the PG entrance Examination i.e., KLEF Entrance /any other equivalent examination.

For foreign students who wish to study at the University, please refer to the "Foreign Student Admission Procedures" stated separately and comply with the study requirements of the Ministry of HRD, Govt. of India.

CHAPTER 3
M.Sc.(APPLIED MATHEMATICS) PROGRAM ON OFFER

3.1 M.Sc. APPLIED MATHEMATICS PROGRAM

The students are admitted into the 2 year full time M. Sc Program

3.2 M.Sc. APPLIED MATHEMATICS DEGREE REQUIREMENTS

K L E F confers M. Sc. degree to candidates who are admitted in the Program and fulfills the following requirements for the award of the degree.

1. Must successfully earn minimum of 91 credits, as stipulated in the program structure.
2. Must successfully complete three (3) Elective Courses from the program with 9 credits.
3. Must successfully complete the Seminars .
4. Have participated in social service activities for a minimum duration of 20 hours.
5. Must successfully complete Dissertation.
6. Must have published a minimum of one publication (along with Supervisor) in Scopus indexed Journal.
7. Must have successfully obtained a minimum CGPA of 5.5 at the end of the program.

8. Must have finished all the above-mentioned requirements in two years from the period mentioned in the Academic structure of the program, which includes debarred period if any, from the University.

CHAPTER 4
M.Sc.(APPLIED MATHEMATICS) PROGRAM CURRICULUM

For an academic program the curriculum is the basic framework that will stipulate the credits, category, course code, course title, course delivery (Lectures / Tutorials / Lab / Project), in the choice based credit system.

4.1 PROGRAM STRUCTURE

a) Each Academic Year is divided into two semesters, each of, approximately, 18 weeks duration:

- Odd Semester (July – December).
- Even Semester (January – May)

b) All courses are categorized into three streams even, odd and dual semester courses.

c) Even semester courses are offered only during even semester i.e., January-May, Odd semester courses are offered only during odd semester i.e., July-December and dual semester courses are offered during both even & odd semesters.

d) A Program is a set of courses offered by the University that a student can opt and complete certain stipulated credits to qualify for the award of a degree.

e) A student can opt for dissertation either by means of research at the University (or) through Internship at an Industry; this is however allowed during 3^{rd} (or) 4^{th} semesters only.

4.2 COURSE STRUCTURE

a. Every course has a Lecture-Tutorial-Practice-Skill (L-T-P-S) component attached to it.

b. Based upon the L-T-P-S structure the credits are allotted to a course using the following criteria.

- Every Lecture / Tutorial hour is equivalent to one credit.
- Every Practical hour is equivalent to half credit.
- Every skill-based practice hour is equivalent to quarter credit.
- If the calculated value of credit is a fraction, it is rounded to the next integer.

Semester-1									
Sl#	Year	Semester	Course Code	Course Title	L	T	P/S	Cr	CH
1	1	1	18AM1101	Real Analysis	4	0	0	4	4
2	1	1	18AM1102	Ordinary Differential Equations	3	0	2	4	5
3	1	1	18AM1103	Numerical Methods	3	0	2	4	5
4	1	1	18AM1104	Complex Analysis	4	0	0	4	4
5	1	1	18AM1105	Mathematical Statistics	4	0	0	4	4
6	1	1	18AM1106	Seminar-1	0	0	2	1	2
Total					**18**	0	**6**	**21**	**24**

Semester-2									
Sl#	Year	Semester	Course Code	Course Title	L	T	P/S	Cr	CH
1	1	2	18AM1206	Topology	4	0	0	4	4
2	1	2	18AM1207	Abstract Algebra	4	0	0	4	4
3	1	2	18AM1208	Transform Techniques	3	0	2	4	5
4	1	2	18AM1209	Discrete Mathematics	4	0	0	4	4
5	1	2	18AM1210	Introduction to Computer Programming	3	0	2	4	5
6	1	2	18AM1211	Seminar-2	0	0	2	1	2
Total					**18**	0	**6**	21	24

Semester-3									
Sl#	Year	Semester	Course Code	Course Title	L	T	P/S	Cr	CH
1	2	1	18AM2111	Partial Differential Equations	4	0	0	4	4
2	2	1	18AM2112	Continuum Mechanics	4	0	0	4	4
3	2	1	18AM2113	Data Structures	3	0	2	4	5
4	2	1	18AM2114	Functional analysis	4	0	0	4	4
5	2	1		Elective-I	4	0	0	4	4
6	2	1	18AM2105	Seminar-3	0	0	2	1	**2**
7	2	1	18AM2101	Technical Skills	0	0	4	1	**4**
Total					**19**	0	**8**	22	**27**

Semester-4									
Sl#	Year	Semester	Course Code	Course Title	L	T	P/S	Cr	CH
1	2	2	18AM2215	Fluid Dynamics	4	0	0	4	4
2	2	2	18AM2216	Operation Research	4	0	0	4	4
3	2	2		Elective-II	4	0	0	4	4
4	2	2		Elective-III	4	0	0	4	4
5	2	2	18AM2226	Dissertation with Research Publication	0	0	8	12	12
Total					**16**	0	**0**	**28**	**28**

List of Electives

S. No	Subject Code	Subjects	L	T	P/S	Cr	CH
		Elective-I					
1	18AM2011	Mathematical Control Theory	**4**	**0**	**0**	**4**	**4**
2	18AM2012	Statistical Inference	**3**	**0**	**2**	**4**	**5**
3	18AM2013	**Database Management System**	**3**	**0**	**2**	**4**	**5**
		Elective-II					
1	18AM2021	Fuzzy mathematics and applications	**4**	**0**	**0**	**4**	**4**
2	18AM2022	Advanced Numerical Analysis	**3**	**0**	**2**	**4**	**5**
3	18AM2023	**Design and Analysis of Algorithms**	**3**	**0**	**2**	**4**	**5**
		Elective-III					
1	18AM2031	Dynamical Systems	**4**	**0**	**0**	**4**	**4**
2	18AM2032	Number Theory	**4**	**0**	**0**	**4**	**4**
3	18AM2033	Mathematical Modeling	**3**	**0**	**2**	**4**	**5**

18AM1101 – **Real Analysis**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 1.2 Course Outcomes of 18AM1101

CO. No.	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Describe the fundamental properties of the real numbers that lead to the formal development of real analysis.	**PO2, PO5, PO6, PO7**	3
CO2	Demonstrate an perceptive of limits and how they are used in sequences, series, differentiation and integration	**PO2, PO5, PO6, PO7**	3
CO3	Describe and apply the important properties of the limit and continuity and the differentiation and integration of the sequences and series of functions. Explain the basic properties of the Riemann integration	**PO2, PO5, PO6, PO7**	3
CO4	Determine the Riemann integrability of a bounded or unbounded function and prove a selection of theorems concerning integrations.	**PO2, PO5, PO6, PO7**	3

Real number system, Cauchy sequences, Darboux's theorem, Weierstrass approximation , Reimann integrals

Syllabus

Real number system, ordering, bounded sets, order completeness axiom, mathematical induction, well ordering principle; Archimedian property, Dedekind's theorem, complete ordered field, limit point of a set, Bolzano-Weierstrass theorem, open and closed sets, compact sets and Heine-Borel theorem.

Sequences, Cauchy's first and second limit theorems, Cauchy sequences, Cauchy criterion for convergent sequences, bounded and monotonic sequences, Euler's constant, subsequences, limit superior and limit inferior. Series of real valued functions and their Tests for convergence. Limit and continuity, uniform continuity, monotonic functions, functions of bounded variation, absolutely continuous functions, Taylor's theorem (finite form), Lagrange's form of remainder.

Sequences and series of real valued functions, their point-wise, absolute and uniform convergence, Cauchy's general principle of uniform convergence, continuity of the limit (sum) function, differentiation and integration of the sequences and series of functions, Weierstrass approximation theorem. Riemann integration, Darboux's theorem, necessary and sufficient conditions for integrability.

Functions defined by integrals, fundamental theorem of calculus, first and second mean value theorems of integral calculus. Improper Integrals: Introduction, Integration of unbounded functions with finite limit of Integration, comparison tests for convergence at a point infinity□, infinite Range Integration.

Integral as a product of functions.

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Royden. H.L. and Fitzpatrick. P.M., Real Analysis, Prentice Hall India Pvt. Ltd.	2010
2.	Apostol, T. M., Mathematical Analysis, Narosa PublishingHouse.	2002
3.	Lang. S., Real and Functional Analysis, Springer - Verlag.	1993
4.	Rudin. W., Principles of MathematicalAnalysis, McGraw-Hill Book Company.	1976
5.	Goldberg, R.R., Methods of Real Analysis, Oxford and IBH Publishing company Pvt. Ltd.	1970

18AM1102-Ordinary Differential Equations

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 1.3 Course Outcomes of 18AM1102

CO No:	Course Outcomes	PO's/PSO's	BTL
CO 1	Apply the existence and uniqueness conditions of solution of the homogeneous/non-homogeneous differential equation and the system of differential equations.	PO2, PO3, PS01	3
CO 2	Apply the power series method of solution to second order ODE arising in mathematical physics- Gauss hypergeometric , Hermit and Chebyshev polynomials.	PO1, PO2 PS04	3
CO 3	Apply Green's function method to study behavior of the Boundary Value Problems (BVP) for second order ODE.	PO2 PS01	3
CO 4	Determine the oscillatory solutions of BVP and illustrate their qualitative properties.	PO2, PS04	3
CO 5	Verify the solution of the ODE through MATLAB.	PSO3	3

Existence, uniqueness of solutions of first order ODE, Power series, Boundary value problems, Oscillation theory, Eigen values and Eigen functions.

Syllabus

Existence, uniqueness and continuation of solutions of a differential equation and system of differential equations; Applications. Differential and integral inequalities. Fixed point methods. Linear systems, properties of homogeneous and non- homogeneous systems, behaviour of solutions of n^{th} order linear homogeneous equations.

Review of power series, Power series solution of second order homogeneous equations, ordinary points, regular singular points, solution of Gauss hypergeometric equations, Hermite and Chebyshev polynomials.

Boundary value problems for second order differential equations, Green's function and its applications. Eigen value problems, self adjoint form, Sturm –Liouvile problem and its applications.

Oscillation Theory and boundary value problems: Qualitative properties of solutions –The Sturm comparison theorem- Eigen values, Eigen functions and the vibrating string.

List of lab Experiments:

Lab session No	Experiment	CO-Mapping
1	Introduction to MATLAB.	CO1
2	Solving first and second order ODE.	CO1
3	Determine solutions of homogeneous system of ODE.	CO1
4	Determine solutions of non-homogeneous system of ODE.	CO2
5	Determine the singular and regular points of second order ODE.	CO2
6	Determine Hermite and Chebyshev polynomials.	CO2
7	Solutions of BVP for second order ODE.	CO3
8	Solutions of Strum-Liouvile problem.	CO3
9	Solution of BVP using Green's function.	CO3
10	Oscillatory solutions of BVP.	CO4
11	Determine the Eigen values and Eigen functions.	CO4
12	Determine the solution of vibrating string.	CO4

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Braun, M. "Differential Equations and Their Applications", 4th Ed., Springer	2011
2.	Brauer, F. and Nohel, J.A., "The Qualitative Theory of Ordinary Differential Equations", Dover Publications	1989
3.	Coddington E.A., "Ordinary Differential Equations", Tata McGraw Hill	2002
4.	Deo, S.G., Lakshmikantham, V., and Raghvendra, V.,"Text Book of Ordinary Differential Equations", 2nd Ed., Tata McGraw Hill	2010
5.	Simmons G.F., "Ordinary Differential Equations with Applications", Tata McGraw Hill	2003

18AM1103 –**Numerical Methods**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 1.4 Course Outcomes of 18AM1103

CO No:	Course Outcomes	PO's/PSO's	BTL
CO 1	Identify the difference between solutions of system linear and roots of non-linear equations by direct, bisection methods.	PO2, PO3, PS01	3
CO 2	Construct the interpolation forward and backward tables and find the Eigen values and vectors by using mat lab also.	PO1, PO2, PS04	3
CO 3	Apply Numerical differentiation and integration problems for different methods and find the values and compare the values by using mat lab also.	PO2, PS01	3
CO 4	Construct numerical solutions of first and second order ordinary differential equations and compare the numerical values with mat lab also.	PO2, PS04	3
CO 5	Verify the solution of the N.M. through MATLAB.	PSO3	3

System of linear equations, Roots of non-linear equations, Eigen values and Eigen vectors, Interpolation Numerical differentiation, Numerical integration, Numerical solution of first and second order ordinary differential equations.

Syllabus

Solution of system of linear equations: (i) Direct methods: Gauss elimination method without pivoting and with pivoting, LU-decomposition method. (ii) Iterative methods: Jacobi and Gauss-Seidel methods. Roots of non-linear equations: Bisection method, Regula-Falsi method, Newton-Raphson method, direct iterative method with convergence criteria,Newton- Raphson method for solution of a pair of non-linear equations. Eigen values and Eigen vectors: Dominant and smallest Eigen values/Eigen vectors by power method.Interpolation: Finite difference operator and their relationships, difference tables, Newton, Bessel and Stirling's interpolation formulae, Divided differences, Lagrange interpolation and Newton's divided difference interpolation.Numerical differentiation: First and second order derivatives by various interpolation formulae. Numerical integration: Trapezoidal, Simpsons $1/3^{rd}$ and $3/8^{th}$ rules with errors and their combinations, Gauss Legendre 2-points and 3-points formulae. Numerical solution of first and second order ordinary differential equations: Picard's method, Taylor's series method, Euler, Modified Euler, Runge-Kutta methods, Predictor-Corrector ,Method's- Milne's method.

Suggested Books:

S.No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1	Gerald, C. F. and Wheatly, P. O.," Applied Numerical Analysis", 6th Ed., Wesley.	2002
2	Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", New Age Pvt. Pub, New Delhi.	2000
3	Conte, S. D. and DeBoor, C., "Elementary Numerical Analysis", McGraw- Hill Publisher	1982
4	Krishnamurthy, E. V. & Sen, S. K., "Applied Numerical Analysis", East West Publication.	1998

18AM1104 –**Complex Analysis**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 2.6 Course Outcomes of 18AM1104

CO No:	Course out come	PO/ PSO	BTL
CO1	Explain the definition of continuity, differentiability, **apply** the concepts of analytic function and harmonic function to explain Cauchy-Riemann equations; Understganding Power Series.	**PO1, PSO1**	**3**
CO2	Apply the concept of conformal mapping, and describe the mapping properties of Möbius transformations and how to apply them for conformal mappings in Fluid Dynamics,etc.	**PO2, PO7, PSO4**	**3**
CO3	Explain complex contour integrals; Understand simple sequences and series **apply** the convergence properties of a power series, and to determine the Taylor series or the Laurent series of an analytic function.	**PO1, PO7 PSO1, PSO4**	**3**
CO4	Explain properties of singularities and poles of analytic functions and **apply** to compute residues integrals by **applying** residue techniques.	**PO1 PSO1, PSO4**	**3**

Analytic Functions, Cauchy-Reimann equations, Complex integration, Residue Calculus, Conformal Mapping:, Evaluation of real integrals.

Syllabus

Analytic Functions: Functions of a complex variable. Limits, continuity, uniform continuity, differentiability and analyticity of functions, C-R equations, necessary and sufficient conditions, applications to the problems of potential flow, Harmonic functions, Harmonic conjugates, Milne's method. Sequences, Series, Uniform convergence, power series. Complex integration: Rectifiable arcs, contours, complex line integration, Cauchy's theorem for simply and multiply connected domains, Cauchy's integral formula for the derivatives of an analytic function, Winding Numbers, Cauchy's estimate, Morera's theorem, Liouville's theorem, Fundamental theorem of Algebra. Maximum modulus principle, Schwarz Lemma, Taylor series, Laurent series, Zeros and poles of a function, Meromorphic function.

Residue Calculus**:** The residue at a singularity, Residue theorem, the argument principle, Rouche's theorem, contour integration and its applications to improper integrals, evaluation of a real integrals, improper integrals involving sines and cosines, definite integrals involving sines and cosines, integration through branch cut.

Conformal Mapping**:** Definition of Conformal and Bilinear transformations, Cross ratio, the mappings from disc to disc, disc to half plane and half plane to half plane. Mapping of elementary transformations. Space of continuous functions, the space of analytic functions, the space of meromorphic functions, Riemann-mapping theorem.

Applications: Applications of conformal mapping to steady temperature, electrostatic potential, two–dimensional fluid flow, stream function.

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1	Churchill, J. W. and Brown, R. V., "Complex Analysis", Mcgraw-Hill.	2009
2	Gamelin, T. W., "Complex Analysis", Springer-Verlag	2001
3	Greene R., and Krantz, S. G., "Function Theory of One Complex Variable", 3rd Ed., GSM, Vol. 40, American Mathematical Society.	2006
4	Kreyszig, E., "Advanced Engineering Mathematics", Wiley, New York	2009
5	Lang, S., "Complex Analysis", Springer –Verlag.	2003
6	Mathews, J. H. and Howell, R. W., "Complex Analysis for Mathematics and Engineering", Narosa	2009

18AM1105 – **Mathematical Statistics**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 1.6 Course Outcomes of 18AM1105

CO No:	Course Outcomes	PO/PSO	BTL
CO 1	Explain the concepts of random variable, probability distribution, distribution function, expected value, variance and higher moments, and calculate expected values and probabilities associated with the distributions of random variables	PO3 ,PS02	3
CO 2	Explain the concepts of independence, jointly distributed random variables and conditional distributions, and use generating functions to establishthe distribution of linear combinations of independent randomvariables.	PO2,PS01	3
CO 3	..Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions.State the central limit theorem, and apply it.	PO1,PS02	3
CO 4	Construct the sampling distribution of mean and variance and calculation of mean and variance of sampling distribution of mean and variance..	PO3,PS02	3

Conditional Probability, discrete distributions, Random variables, Simple random sampling with replacement and without replacement, Fundamental sampling distributions.

SYLLABUS

Concept of probability, Axioms of Probability, Conditional Probability, Addition, Multiplication and Baye's Theorems, Random variable and Distribution function of discrete and continuous distributions, Mathematical expectation, Moments and Moment generating function.

Some discrete distributions: Binomial, Poisson, Geometric and Hypergeometric; Some continuous distributions: Uniform, Exponential, Weibull, Gamma and Normal.

Bivariate Random variables: Joint, Marginal, Conditional distribution, Statistical independence, product moments, correlation, regression, transformation of random variables, Law of large numbers and Central limit theorem.

Simple random sampling with replacement and without replacement, Parameter and statistic, Mean and variance of sampling distributions, order statistics and distribution of order statistics, Fundamental sampling distributions from normal population viz. χ^2 , t, f and Z (central).

Suggested Books:

S.No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Miller, I. and Miller, M., "Freund's Mathematical Statistics with Applications",7th Ed., Prentice Hall PTR .	2006
2.	Hogg, R. V. and Craig, A., "Introduction to Mathematical Statistics", 6th Ed., Pearson Education,	2006
3.	Rohatgi, V. K. and Md. Ehsanes Saleh, A. K., "An Introduction to Probability and Statistics", 2nd Ed., John Wiley and Sons.	2000
4.	Papoulis, A., Pillai, S.U., Probability, "Random Variables and Stochastic Processes", 4th Ed.,Tata McGraw-Hill.	2002
5.	Bhatt B.R., "Modern Probability Theory", 3rd Ed., New Age International Ltd.	1999

2. COURSE OFFERED IN FIRST YEAR SEMESTER-2

18AM1206-**Topology**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 4.2 Course Outcomes of 18AM1206

CO No:	Course Outcome	PO/PSO	BTL
CO1	Explain the definition of Finite, countable, uncountable sets and apply the concepts of composite function and Axiom of choice to explain Zorn's Lemma.	**PO1 PSO1,2**	**3**
CO2	Explain the concept of open sets, closed sets and basis for a topology describe the properties of product space and apply the concept of topological space and continuous function.	PO1 PSO1, PSO2	**3**
CO3	Explain the definition of compact space and connected space and apply the concept of finite intersection property and Bolzano weierstrass property.	PO1 PSO1, PSO2	**3**
CO4	Explain the properties of Hausdorff's space and normal space and apply the Urysohn's lemma to determine the urysohn's metrization theorem, Tietze extension theorem, and tychonoff theorem.	PO1 PSO1, PSO2	**3**

Countable, uncountable sets, functions, relations, Topological Spaces and Continuous functions

Connectednessan d Compactness, Countability and Separation axiom.

Syllabus

Introduction: Finite, countable, uncountable sets, functions, relations, Axiom of choice, Zorn's Lemma
Topological Spaces and Continuous functions: Open sets, closed sets, basis for a topology, Sub basis, T_1 and T_2 Spaces, Order topology, product topology, subspace topology, limit point, continuous function, general product topology, metric space and its Topology, quotient topology.
Connectedness and Compactness: Connected spaces, connected subspaces, Local connectedness, compact subspace, limit point compactness, Local compactness.
Countability and Separation axiom: Countability axioms, separation axioms. Regular and NormalSpaces, Urysohn's Lemma, Urysohn metrization Theorem. Tietze Extension Theorem, Tychonoff Theorem

Suggested Books:

S.No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Munkres, J.R., "Topology", 2nd Ed., PHI	2010
2.	Mansfield, M.J., "Introduction to Topology", East-West student Edition	1973
3.	Simmons, G.F., "Introduction to Topology & Modern Analysis", Krieger Publishing Company.	2003
4.	Mendelson, B., "Introduction to Topology," 3rd Ed., Dover Publications	1988
5.	Gamelin, T.W. and Greene, R.E., "Introduction to Topology", 2nd Ed., Dover Publications	1999
6.	Min, Y., "Introduction to Topology: Theory & Applications", Higher Education Press	2010

18AM1207 – **Abstract Algebra**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.4 Course Outcomes of 18AM1207

CO No:	Course out come	PO/PSO	BTL
CO1	Define group, subgroup and quotient group with examples, and proving some preliminary lemmas.	PO3, PSO2	2
CO2	Define homomorphism and automorphisim of groups .Explain Cayley's and Sylow's theorems of finite groups and demonstrate the problems.	PO1, PSO1	2
CO3	Define a ring, homomorphismof rings, ideal, quotient rings with examples. Explain principal ideal domain, unique factorization domain, modules over PID theorems and demonstrate the problems.	PO2, PSO1	2
CO4	Define field and Polynomial ring with examples. Explain the field of Quotients of an integral domain and Euclidean and polynomial rings with problems.	PO4, PSO2	2

Group theory, Ring theory, Vector Spaces, Fields, Euclidean rings, polynomial rings.

Syllabus

Group theory: Definition and some examples of groups, some preliminary lemmas, subgroups. Homeomorphisms, auto orphisms, Canley's theorem, permutation groups, Solow's theorems.

Ring theory: Definition and examples of Rings, some special classes of Rings, homomorphisms Ideal and Quotient rings. Maximal Ideal, Integral domain, Principal Ideal domain(PID), unique factorization.

Vector Spaces, Sub Spaces, Dimension, Basis, Inner Product Space, Schewarz inequality, Grahm–Smith Orthogonalization process, Modules, Modules over PID, Modules with chain conditions.

Definition of field and some examples, the field of Quotients of an Integral domain, Euclidean rings, polynomial rings.

Suggested Books:

S.No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication/ Reprint
1.	Herstein, I. N., "Topics in Algebra", 2nd Ed., John Wiley & Sons.	2004
2.	Fraleigh, J. B., "A First Course in Abstract Algebra", 7th Ed., Pearson Education	2003
3.	Dummit, D. S. and Foote, R. M., "Abstract Algebra", 3rd Ed., John Wiley & Sons.	2004
4.	Artin M., “Algebra”, 2nd Ed., Prentice Hall India	2011
5.	Gallian J. A., “Contemporary Abstract Algebra”, 8th Ed., Cengage Learning	2013

18AM1208-**Transform Techniques**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 3.5 Course Outcomes of 18AM1208

CO No:	CO	PO/PSO	BTL
CO 1	Apply Laplace transform techniques to solve linear differential equations in system analysis where initial conditions can be easily included to give system response.	PO1, PO3, PO4, PS03	3
CO 2	Applying z- transform and Mellin transform to the analysis and characterization of Discrete Time systems.	PO1, PO3, PS03	3
CO 3	Apply Fourier series to analyze various signals.	PO4, PS03	3
CO 4	Apply Fourier transforms to analyze various signals.	PO6, PS03	3
CO 5	Verify the solution of the Transform techniques through MATLAB.	PSO3	3

Laplace transforms, Inverse Laplace transforms, Applications, Mellin Transform, Fourier Series, Fourier Transforms

Syllabus

Laplace Transform: Laplace of some standard functions, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, Heaviside unit step function and Dirac delta function, Applications of Laplace transform to solve ODEs. **Finite Laplace Transform:** Definition and properties, Shifting and scaling theorem. **Z-Transform:** Z–transform and inverse Z-transform of elementary functions, Shifting theorems, Convolution theorem, Initial and final value theorem, Application of Z-transforms to solve difference equations.

Mellin Transform: Definition and properties of Mellin transform, Shifting and scaling properties, Mellintransforms of derivatives and integrals, Applications of Mellin transform

Fourier series: Trigonometric Fourier series and its convergence. Fourier series of even and odd functions, Gibbs phenomenon, Fourier half-range series, Parseval`s identity, Complex form of Fourier series. Solving ODE using Fourier series.

Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral representation, Fourier transform, Fourier transform of derivatives and integrals, Fourier sine and cosine transforms and their properties, Convolution theorem, Application of Fourier transforms to Boundary Value Problems.

List of Lab Experiments:

Lab session No	List of Experiments	CO-Mapping
1	Introduction and Review of MATLAB.	CO1
2	Determine the Laplace transforms of the function using derivatives and integrals property.	CO1
3	Calculate the Inverse Laplace transforms of the given function.	CO1
4	Solving ODE by Laplace transforms.	CO2
5	Using the Shifting, Convolution, Initial and finalvalue theorems of Z-transforms to the function .	CO2
6	Using Z-transforms to solve the difference equations.	CO2
7	Determine the Mellin transforms of derivatives and integrals.	CO3
8	Obtain the Complex form of Fourier series of the function.	CO3
9	Determine the Fourier series of even and odd functions.	CO3
10	Solving ODE using Fourier series.	CO4
11	Expressing the Fourier sine and cosine integrals and Complex form of Fourier integral representation of the function.	CO4
12	Application of Fourier transforms to Boundary Value Problems (BVP).	CO4

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Kreyszig, E., "Advanced Engineering Mathematics", John Wiley & Sons	2011
2.	Jain, R. K. and Iyenger, S. R. K., "Advanced Engineering Mathematics", Narosa Publishing House	2009
3.	Hildebrand F. B., "Methods of Applied Mathematics", Courier Dover Publications	1992
4.	Debanth L. and Bhatta D., Integal Tranforms and Their Applications, 2nd Ed., Taylor and Francis Group	2007

18AM1209- **Discrete Mathematics**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 2.5 Course Outcomes of 18AM1209

CO No:	Course out come	PO/PSO	BTL
CO1	Apply the rules of Propositional logic to establish valid results and apply rules of valid inference and hence understand how to construct correct mathematical arguments, Mathematical Induction	**PO3, PO6, PO7 PSO2**	**2**
CO2	Understand the concept of relations, functions and discrete structures , Count discrete event occurrences , lattices, to represent the Boolean functions by an expression	**PO2, PO3, PO6, PO7 PSO3**	**3**
CO3	Formulate and solve recurrence relations of homogeneous and non homogeneous relations, understand some recursive algorithms.	**PO2, PO3, PO6, PO7 PSO3**	**3**
CO4	Use graph theory for various techniques to study and analyze different problems associated with computer design, logic design, Formal languages, Artificial Intelligence etc, Analysis of different traversal methods for trees and graphs.	**PO2, PO3, PO5, PO6, PO7 PSO3**	**3**

Fundamentals of logic, Partially ordered sets, Lattices, Recurrence Relation, Graphs, colouring theorems, isomorphism of graphs.

Syllabus

Proposition, predicate logic, logic connectives, methods of proofs. Mathematical induction. Relation and Function: Definitions and properties, pigeonhole principle, extended pigeonhole principle, equivalence relations and equivalence classes. representation of relations by binary matrices and digraphs; operations on relations. closure, Warshall's algorithm, discrete numeric functions, growth of functions, big O, big hash function. Partial Order.

Partially ordered sets, lattices, isomorphism of lattices - Boolean algebra and Boolean functions, different representations of Boolean functions, application of Boolean functions to synthesis of circuits, circuit minimization and simplification, Karnaugh map.

Recurrence Relation: Linear recurrence relations with constant coefficients, homogeneous and non-homogeneous relations, discussion of several special cases to obtain particular solutions. Generating functions, solution of linear recurrence relations using generating functions. Some recursive algorithms.

Definition of Graphs, Finite & infinite graphs, Incidence & degree, Walks, paths and circuits, trees, their properties and fundamental circuits, cut-sets and cut-vertices, Euler, Hamiltonian path & circuit, planar graphs, colouring theorems, isomorphism of graphs.

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Kenneth, H. R., Discrete Mathematics and its Applications, 7th Ed., Tata McGraw Hill,	2012
2.	Liu, C. L., Elements of Discrete Mathematics, Tata McGraw Hill	2007
3.	Johnsonbaugh, R., Discrete Mathematics, 6th Ed., Maxwell Macmillan International	2006
4.	Mott, J.L., Kandel, A. and Baker, T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall India Pvt Ltd	2001
5.	Kolman, B., Busby, R. and Ross, S.C., Discrete Mathematical Structure, 6th Ed., Pearson	2008

18AM1210- **Introduction to Computer Programming**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 1.5 Course Outcomes of 18AM1210

CO No:	Course outcomes	PO/PSO	BTL
CO 1	Introduction to basic computer organization and computer fundamentals. Introduction to Programming language fundamentals. Illustrate and use Control Flow Statements in C++.	**PO1, PSO2**	**1**
CO 2	Introduction to functions in C++ and Decomposition of programs through function.	**PO1, PSO2**	**2**
CO 3	Interpret & Illustrate user defined C++ functions and different operations on list of data.	**PO1, PSO2 ,3**	**3**
CO 4	Illustrate Object Oriented Concepts and implement linear data structures	**PO1, PSO2**	**3**
CO 5	Develop the code for the algorithms in C++	**PO8 PSO3**	

Computer Fundamentals, Computer Fundamentals, Programming through functional decomposition and Data hiding, Data structures. Dynamic binding and virtual functions, Polymorphism, Dynamic data in classes.

Syllabus

Basic Computer Fundamentals: Introduction to computer systems; number system, integer, signed integer, fixed and floating point representations; IEEE standards, integer and floating point arithmetic; CPU organization, ALU, registers, memory, the idea of program execution at micro level. **Basic Programming in C++**: Input/output; Constants, variables, expressions and operators; Naming conventions and styles; C; Looping and control structures (while, for, do-while, break and continue); Arrays; File I/O, header files, string processing; Pre-processor directives such as#include, #define, #ifdef, #ifndef; Compiling and linking.

Programming through functional decomposition: Design of functions, void and value returning functions, parameters, scope and lifetime of variables, passing by value, passing by reference, passing arguments by constant reference, recursive functions; Function overloading and defaultarguments;Library functions.

Object Oriented Programming Concepts: Data hiding, abstract data types, classes, access control; Class implementation-default constructor, constructors,copy constructor, destructor, operator overloading, friend functions.

Introduction to data structures, use of pointers in linked structures. **Pointers**: Pointers; Dynamic data and pointers, dynamic arrays. Object oriented design (an alternative to functional decomposition) inheritance and composition; Dynamic binding and virtual functions;Polymorphism; Dynamic data in classes.

List of Lab Experiments

Lab session No	List of Experiments	CO-Mapping
1	Write a program that enters a 10- digit telephone number (the first three digits refer to the area code, the next three digits refer to the exchange code, and the remaining four digits refer to number), prints the parts of the number and complete telephone number and addition of area code and exchange code in the following format.	CO1
2	The government of India passed a GO regarding tax payment and you have to develop a C program based on some conditions. If the income is less than 1,50,000 then no tax. If taxable income is in the range 1,50,001-3,00,000 then charge 10% of tax. If taxable income is in the range 3,00,001-5,00,000 then charge 20% of tax. If taxable income is in the range 5,00,001 above then charge 30% of tax. Calculate the amount of tax he/she has to pay.	CO1
3	https://www.hackerrank.com/challenges/staircase Consider value of n = 5: 1 2 3 4 5 2 3 4 5 6 3 4 5 6 7 4 5 6 7 8 5 6 7 8 9 Write a program that prints the above pattern for given n.	CO1
4	a) Write a C++ program to solve the second degree equation $aX^2 + bX + c = 0$ for any real a, b and c. b) Find the greatest and smallest of given 3 numbers	CO2
5	a). A company is having N no of employees. Calculate their net salary the with the following details of HRA,DA and TAX on basic salaryIf basic salary is in between 80000 to 60000 then HRA = 30% DA = 20% Tax= 10% If the basic is in between 59000 to 40000 HRA = 25% (on basic) DA = 12% Tax= 8% If basic is below 39000 DA = 12% Tax= 8% For basic more than 80000 HRA = 30% (on basic) DA = 30% Tax= 20% b) Create a file named "inventory.dat" that stores item name, quantity and price for a single item. Write a program to read the values from the file and calculate bill amount and re write the same into the same file.	CO2
6	a) Write a C++ program to read N values and get their mean and the standard deviation. b) Write a C++ program to perform binary search.	CO2
7	a). Write a C++ program to convert a given decimal number to binary using recursion b) Write an efficient function to return maximum occurring character in the input string e.g., if input string is "test" then function should return 't'.	CO3
8	a) Write a function *reverse(int n)* which reverses the digits of given number and returns the result. For Example, if n is 927, it would return 729 b) Write a C++ program to perform different arithmetic operation such as addition, subtraction, and multiplication using inline function	CO3
9	a) Write a C++ program to swap two number by both call by value and call by reference mechanism, using two functions swap_value() and swap_reference respectively , by getting the choice from the user and executing the user's choice by switch-case.	CO3

	b). Create a class Student which has data members as name, branch, roll no, age ,sex ,marks in five subjects and display them.	
10	a) Write a program to print the names of students by creating a Student class. If no name is passed while creating an object of Student class, then the name should be "Unknown", otherwise the name should be equal to the String value passed while creating object of Student class. b) Write a Program to design a class complex to represent complex numbers. The complex class should use an external function (use it as a friend function) to add two complex numbers. The function should return an object of type complex representing the sum of two complex numbers.	CO4
11	Write a program to overload unary operator ++ and – (prefix)	CO4
12	Create a base class basic_info with data members name ,roll no, sex and two member functions getdata and display. Derive a class physical_fit from basic_info which has data members height and weight and member functions getdata and display. Display all the information using object of derived class.	CO4

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	H.M. Deitel and P.J. Deitel. C++ How to Program. 8thEd., Prentice Hall.	2011
2.	B. Eckel. Thinking in C++ Volume 1 & 2. 2ndEd., Prentice Hall.	2003
3.	I. Koren. Computer Arithmetic Algorithms. 2ndEd., A.K. Peters Ltd.	2001
4.	S.B. Lippman, J. Lajoie, and B.E. Moo. The C++ Primer. Addison-5thEd., Wesley Professional.	2012
5.	S. Oualline. Practical C++ Programming. 2ndEd., O'ReillyMedia.	2003
6.	S. Prata. C++ Primer Plus. 5thEd., Sams.	2004
7.	W. Stallings. Computer Organisation and Architecture: Designing for Performance. 7thEd., Prentice-Hall.	2005
8.	B. Stroustrup. The C++ Programming Language. Addison-3rd Ed., Wesley.	1997
9.	R. Lafore. Object-Oriented Programming in C++.4thEd., Sams Publishing.	2001

18AM2111- **Partial Differential Equations**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2111

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Model the relevant phenomena as a Partial differential equations and obtain the solutions	PO2, PSO1	3
CO2	Understand the Nature of the higher order Partial differential equation and obtain the solutions	PO3, PSO4	3
CO3	Express the Laplace equation in Various coordinate systems and solve by Fourier series method	PO1, PO5 PSO1	3
CO4	Solve the Hyperbolic and Parabolic differential equations by Separation of variable method	PO1, PO5 PSO1	3

Formation of PDE, Classification of second order equation, Hyperbolic, Parabolic and Elliptic equations of separation of variables, Solutions in cylindrical and spherical equation, The maximum principle for the heat equation.

Syllabus

Modelling with partial differential equations, Partial differential equations of first order, Cauchy problem, Linear first order P.D.E., Method of characteristics, Lagrange, Charpit's and Jacobi's method. Partial differential equation of second order, Classification of second order equation, Hyperbolic, Parabolic and Elliptic equations, Linear second order partial differential equations with constant coefficients.

Elliptic Equations: Laplace equation in Cartesian, polar, spherical and cylindrical coordinates and its solution by Fourier series method, Poisson equation in 2D.

Hyperbolic differential equations, One dimensional wave equation, Solution of the wave equation by separation of variables, d'Alembert's solution, Boundary and initial value problem of two dimensional wave equation.

Parabolic differential equations, One dimensionaldiffusion equation, Boundary conditions; Dirichlet, Neumann and Robin type boundary conditions, Method of separation of variables, Solutions in cylindrical and spherical equation, The maximum principle for the heat equation.

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1.	Zachmanoglou, E.C., Thoe, D.W., "Introduction to Partial Differential Equattions with Applications", Dover Publications.	1986
2.	Sneddon, I. N., "Elements of Partial Differential Equations", McGraw-Hill Book Company.	1988
3.	Amarnath, T., "An Elementary Course in Partial Differential Equations", 2nd Ed., Narosa Publishing House.	2012
4.	Rao, K. S., "Introduction to Partial Differential Equations", 2nd Ed., PHI Learning Pvt. Ltd.	2012
5.	Lawrence C. Evans, "Partial Differential Equations", American Mathematical Society	2010

18AM2112 – **Continuum Mechanics**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 1.2 Course Outcomes of 18AM2112

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Concept of fluids, Continum Hypothesis, Density, Specific etc Equation of State, First and Second Law of Thermodynamics and Clausius Inequality	PO2, PSO1	3
CO2	Eulerian and Lagranges methods of Description of Fluids, Newtonian Fluids, Non Newtonian Fluids, Visco elastic fluids	PO3, PSO4	3
CO3	Equation of conservation of Mass, Equation for the conservation of momentum, Equation for energy, Basic equations in different coordinate systems, Boundary conditions Voretex motion, velocity potential due to a vortex, velocity potential due to a vortex	PO1, PO5 PSO1	3
CO4	Flow between two parallel plates, Plane ciutte flow, Plane poiseuille flow, Flow over an inclined plane, Flow through circular pipe,Flow through an annulus, Flow between two porous plates, Unsteady flows, Unsteady flow over a flat plate, Unsteady flow between two parallel plates.	PO1, PO5 PSO1	3

Physical Properties of Fluids, Introduction to thermodynamics, Kinematics of Fluids, Stress in Fluids and Constitutive Equations and Conservation Laws, Incompressible Viscous Fluid Flows.

Syllabus

Physical Properties of Fluids: Concept of fluids, Continum Hypothesis, Density, Specific Weight and Specific Volume, Pressure, Viscosity and Surface tension. **Thermodynamics of Fluids:** Introduction to thermodynamics, Equation of State, First Law of thermodynamics, Second Law of Thermodynamics and Clausius Inequality

Kinematics of Fluids: Eulerian and Lagranges methods of Description of Fluids, Equvalence of Lagrangian and Eulerian Methods, Translation, Rotation and Deformation of Fluid Elements, Analytical Approach to Deformation, Stress - strain relations, Steady and unsteady flows, Stream Lines, Path Lines and Streak Lines. **Stress in Fluids and Constitutive Equations:** Stress tensor, Normal Stresses, Shear Stresses, Symmetry of Shear of Stress tensor, newtonian Fluids, Non Newtonian Fluids, Purely viscous fluids, Reiner Rivlin Fluids, Power Law Fluids, Visco elastic fluids.

Conservation Laws: Equation of conservation of Mass, Equation for the conservation of momentum, Equation for energy, Basic equations in different coordinate systems, Boundary conditions. **Irrotational and Rotational Flows:** Kelvins minimum energy theorem, Gauss theorem, Bernoullis equation and its application, 2D irrotational incompressible flows, D' Alemberts paradox, Flow due to a moving cylinder with circulation, Flow over an aerofoil, Voretex motion, velocity potential due to a vortex, velocity potential due to a vortex

Incompressible Viscous Fluid Flows: Flow between two parallel plates, Plane ciutte flow, Plane poiseuille flow, Flow over an inclined plane, Flow of two immissible fluids, Flow through circular pipe,Flow through an annulus, Flow between two porous plates,Plane couette flow, Flow through convergent and divergent channels, Stagnent point, Unsteady flows, Unsteady flow over a flat plate, Unsteady flow between two parallel plates.

Suggested Books:

1. S. Valiappan: Continum Mechanics, Oxford & IBH Publishing Company
2. Goldstein : Classical Mechanics, Narosa Publications
3. R. K. Rathy, An Introduction to Fluid Mechanics, Oxford & IBH Publishing Company
4.Fluid Mechanics : Frank M. White, Fluid Mechanics, McGraw Hill Publications

18AM2113-**Data Structures**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 2.3 Course Outcomes of 18AM2113

CO#	Course Outcome	PO/PSO	BTL
CO1	Analyze and compare stack ADT and queue ADT implementations using linked list andapplications.	PO1, PO4, PSO1, PSO2	4
CO2	Analyze the linked lists and types of Binary trees and their representations.	PO1, PO4, PSO1, PSO2	4
CO3	Apply measures of efficiency on algorithms and Analyze different Sorting Algorithms, Analyze the linked implementation of Binary,Balanced Trees and different Hashing techniques.	PO1, PO2, PSO1 PSO2	4
CO4	Analyze different representations, traversals, applications of Graphs and Heap organization.	PO2, PO4, PSO1, PSO2	4
CO5	Develop and Evaluate common practical applications for linear and non-linear data structures.	PO1, PO2, PSO1, PSO2	5

Data structures, Arrays, Binary trees, General lists: Representations, operations,dynamic storage management, garbage collection, compaction. minimum spanning tree, shortest path algorithm

Syllabus

Introduction to data structures. Arrays: One and two dimensional arrays, storage allocations. String representation. Implementation of abstract data types (ADT). Stacks: LIFO structure, push, pop, create, delete and empty stack. Queues: FIFO structure, operations on queues, priority queues, circular queues. Linear lists, list v/s array, internal pointer & external pointer, head, tail of a list, null list, length of a list. Linked Lists: nodes, linked list data structure, algorithms: insert, delete and retrieve node, create, search, print, append linked list, array of linked lists, header nodes, circularly-linked list, doubly linked list: insertion, deletion.

Binary trees: definition, array, linked and threaded representations, traversal, (Pre, Postand Symmetric order), expression trees (Infix, Prefix and Postfix). Sorting: Selection sort, bubble sort, exchange sort, quick sort, heap sort and merge sort. Analysis of sorting techniques. Searching: sequential search, binary search, search trees AVL trees, M-way search trees, B trees, hash tables, hashing functions, collision resolution techniques.

General lists: Representations, operations, dynamic storage management, garbage collection, compaction.

Graphs: array and linked representation, operations: add, delete and find vertex, add, delete edge, traverse graph (depth-first, breadth-first). Networks: minimum spanning tree, shortest path algorithm (Dijkstra's algorithm and Kruskal'salgorithm).

Lab session No	Experiment	CO-Mapping
1	Traversal, insertion, deletion in a linear array.	CO1
2	Stacks using arrays.	CO1
3	Linear Queue using arrays.	CO1
4	Circular Queue using arrays	CO1
5	Stacks and Queues using linked list.	CO1
6	Singly Linked circular List.	CO1
7	Doubly Linked List.	CO1
8	Polynomial Arithmetic using linked list.	CO1
9	Insertion sort, Exchange sort, Selection sort	CO2
10	Quick sort	CO2
11	Heap Sort.	CO2
12	Binary Tree Traversal (pre, post and symmetric order)	CO4
13	Sequential Search and Binary Search.	CO4
14	Binary Search Tree	CO4

Suggested Books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication/ Reprint
1	Langman, Y., Augenstein, M.; Tennenbaum A.M. Data Structure Using C and C++. Prentice Hall of India.	1998
2	Sahni S., Data Structures Algorithms and Applications in C++, McGraw Hill	2005
3	Dale N., C++ Plus Data Structures. Narosa Publications.	2000
4	Tenenbaum A. M., Data Structures Using C, Pearson Edn, India.	1990
5	Kruse Robert L., Ryba Alexander J., Data Structures and Program Design in C++	1998

18AM2114- **Functional Analysis**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 2.3 Course Outcomes of 18AM2114

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Understand the concepts of Banach and Hilbert spaces and to learn to classify the standard examples. In particular, spaces of sequences and functions	PO2, PSO1	3
CO2	learn to use properly the specific techniques for bounded operators over normed and Hilbert spaces	PO3, PSO4	3
CO3	Eplain the fundamental results in the theory with accuracy and proper formalism.	PO1, PO5 PSO1	3
CO4	Apply the spectral analysis of compact self-adjoint operators to the resolution of integral equations	PO1, PO5 PSO1	3

Fundamentals of metric spaces, Normed linear spaces, Banach spaces, Hilbert spaces Contraction Mappings with examples, Banach–fixed point theorems and applications and Open mapping Theorem and applications

Syllabus

Fundamentals of metric spaces, Completion metric spaces, normred spaces, Hölder inequality, Minkowski inequality and vector spaces with examples of ℓ_p and L_p spaces.

Normed linear spaces, Banach spaces with examples, Convergence and absolute convergence of series in a normed linear space. Inner product spaces, Hilbert spaces, Relation between Banach and Hilbert spaces. Schwarz inequality.

Convex sets, Existence and uniqueness of a vector of minimum length, Projection theorem. Orthogonal and orthonormal systems in Hilbert space with examples, Bessel's inequality, Parseval's identity, Characterization of complete orthonormal systems.

Continuity of linear maps on normed linear spaces, Four equivalent norms on B(N,N`), Conjugate and Dual spaces, The Riesz Representation Theorem.

Adjoint operators, self adjoint operators, normal operators, Unitary operators on Hilbert spaces (H) and their properties. Isometric isomorphism of H onto itself under Unitary operators and their importance . Projection operators on Banach spaces and Hilbert spaces. Orthogonal Projections.

Contraction Mappings with examples, Banach–fixed point theorems and applications.

The Closed Graph Theorem, The Uniform Boundedness Principle and its applications, The Hahn – Banach Extension and Separation Theorems, Open mapping Theorem and applications

Suggested books:

S. No.	**Name of Authors / Books / Publishers**	**Year of Publication/ Reprint**
1	Simons, G. F., "Introduction to Topology and Modern Analysis", McGraw Hill.	2004
2	Debnath L. K. and Mikusinski P., "Introduction to Hilbert Spaces with Applications", Academic Press.	2005
3	Bachman G. and Narici L., "Functional Analysis", Academic Press.	1972
4	Ponnusamy S., "Foundation of Functional Analysis", Narosa Publication.	2002
5	Jain P. K. and Ahuja O. P., "Functional Analysis", New Age International Publishers.	2010
6	Nair, M. T., "Functional Analysis: A First Course", PHI Pvt. Ltd.	2004

18AM2101- **Technical Skill**

L-T-P/S	0-0-4
Credits	1
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2101

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Apply MATLAB operators and functions for symbolic processing and solving equations	PO1,2/PSO1	3
CO2	Apply MATLAB functions and codes to fit discrete and continuous probability distributions and use statistical plots to evaluate goodness of fit.	PO1,2/PSO1	3
CO3	Apply MATLAB tools and codes for regression analysis and interpolation.	PO1,2/PSO1	3
CO4	Apply MATLAB tools and codes for solving linear and nonlinear programming problems.	PO1,2/PSO1	3

Calculus, Probability Distribution, Functions for fitting curves and surfaces to data, Linear programming (LP), mixed-integer linear programming (MILP), quadratic programming (QP), nonlinear programming.

Syllabus

Calculus, linear algebra, algebraic and ordinary differential equations, equation simplification, and equation manipulation using symbolic computation.

Probability Distribution: Fit continuous and discrete distributions, use statistical plots to evaluate goodness-of-fit, compute probability density functions and cumulative distribution functions, and generate random and quasi-random numbers from probability distributions.

Functions for fitting curves and surfaces to data. Exploratory data analysis, preprocess and post- process data, compare candidate models, and remove outliers. Regression analysis using the linear and nonlinear models. Non parametric modeling techniques, such as splines, interpolation, and smoothing.

Functions for finding parameters that minimize or maximize objectives while satisfying constraints. Linear programming (LP), mixed-integer linear programming (MILP), quadratic programming (QP), nonlinear programming (NLP), constrained linear least squares, nonlinear least squares, and nonlinear equations.

Text books:

1. P. Mohana Shankar, Differential Equations: A Problem Solving Approach Based on MATLAB, CRC Press; 1 edition (23 May 2018).
2. Cesar Perez Lopez, MATLAB Optimization Techniques, Apress Academic, Springer, 2014.

Reference Books:

1. Xue, Dingyu and YangQuan Chen, Solving Applied Mathematical Problems with MATLAB, , CRC Press, Taylor & Frances, Boca Raton, 2009.
2. Nikolaos Ploskas and Nikolaos Samaras, Linear Programming Using MATLAB, 1 edition 2017, Springer.
3. Braselton J. **Curve Fitting with MATLAB, LINEAR and NON LINEAR REGRESSION, INTERPOLATION**, CreateSpace Independent Publishing Platform, 2016, USA.

18AM2215- **Fluid Dynamics**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2215

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Under stand irrotational flows, boundary surface, streamlines, path lines, streak lines, vorticity.	PO1,2/PSO1	2
CO2	Explain General equations of motion, in viscid case, Bernoulli's theorem,	PO1,2/PSO1	3
CO3	Develop energy equation, Dynamical similarity.	PO1,2/PSO1	3
CO4	Solve Momentum integral equations by Karman- Pohlhausen	PO1,2/PSO1	3

Continuum hypothesis, forces acting on a fluid, Lagrangian and Eulerian descriptions, General equations of motion, Navier-Stokes equations and Dimensional analysis.

Syllabus

Continuum hypothesis, forces acting on a fluid, stree tensor, analysis of relative motion in the neighborhood of a point. Euler's theorem, equation of continuity.

Lagrangian and Eulerian descriptions, Continuity of mass flow, circulation, rotational and irrotational flows, boundary surface, streamlines, path lines, streak lines, vorticity.

General equations of motion: inviscid case, Bernoulli's theorem,compressible and incompressible flows, Kelvin's theorem, constancy of circulation

Stream function, Complex-potential, source, sink and doublets, circle theorem, method of images, Theorem of Blasius, Strokes, stream function, Motion of a sphere.

Helmholtz's vorticity equation, vortex filaments, vortex pair.

Navier-Stokes equations, dissipation of energy, diffusion of vorticity, Steady flow between two infinite parallel plates through a circular pipe (Hagen-Poiseuille flow), Flow between two co- axial cylinders, Energy equation, Dynamical similarity

Dimensional analysis, large Reynold's numbers; Laminar boundary layer equations, Similar solutions; Flow past a flat plate, Momentum integral equations, Solution by Karman- Pohlhausen methods, impulsive flow Reyleigh problem, dynamical similarity Thermal boundary layer equation for incompressible flow; Temperature distribution in Coutte flow and in flow past a flat plate. Introduction to Complex fluids

Suggested Books:

S. No.	Title/Authors/Publishers	Year of Publication/ Reprint
1.	Batechelor, G.K., “An Introduction to Fluid Dynamics”, Cambridge Press.	2002
2.	Schliting, H. , Gersten K., “Boundary Layer Theory”, Springer, 8^{th} edition.	2004
3.	Rosenhead, “Laminar Boundary Layers”, Dover Publications	1963
4.	Drazin, P.G., Reid W. H., “Hydrodynamic Stability”, Cambridge Press	2004

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18AM2216- **Operations Research**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2101

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Solving LPP by Simplex Method, Big – M Method, Two Phase Method, Revised Simplex Method.	PO1,2/PSO1	3
CO2	Solve parametric LPP	PO1,2/PSO1	3
CO3	Solve Transportation and Assignment Problems	PO1,2/PSO1	3
CO4	Find the solution of non linear LPP	PO1,2/PSO1	3

Introduction to linear programming, Simplex Method, Big – M Method,Two Phase Method, Revised Simplex Method, Duality Theory, Transportation Problems and Assignment Problems and Non-linear optimization.

Syllabus

Introduction to linear programming: Convex Sets, Graphical Method, Simplex Method, Big – M Method,Two Phase Method, Revised Simplex Method

Duality Theory, Dual Simplex Method, Sensitivity Analysis, Parametric Linear Programming

Transportation Problems and Assignment Problems

Non-linear optimization: Unconstrained and constrained optimization of several variables, Lagranges multipliers, Khun-Tucker theory, numerical methods for optimization.

Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Taha, H.A., "Operations Research: An Introduction", MacMillan Pub Co., NY, 9th Ed. (Reprint).	2013
2	Mohan, C. and Deep, K., "Optimization Techniques", New Age India Pvt. Ltd, New Delhi.	2009
3	Mittal, K.V. and Mohan, C., "Optimization Methods in System Analysis and Operations Research", New Age India Pvt. Ltd, New Delhi.	1996
4	Ravindran, A., Phillips, D.T. and Solberg, J.J., "Operations Research: Principles and Practice", John Wiley and Sons, NY, 2nd Ed. (Reprint).	2012
5	Pant, J.C., "Introduction to Optimization/Operations Research", Jain Brothers, New Delhi, 2nd Ed.	2012

ELECTIVE-I

18AM2011- **Mathematical control theory**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2011

CO No:	Course out come	PO/PSO	BTL
1	Develop conditions for the controllability and observability of the linear control systems and validate with suitable example.	**PO1, PO2 PSO1**	**3**
2	Obtain conditions for the controllability and observability for the nonlinear control systems and illustrate with suitable example.	**PO1, PSO1**	**3**
3	Determine the stability for the linear and nonlinear control systems.	**PO1, PSO1**	**3**
4	Solve the optimal control problems for linear and nonlinear control systems.	**PO1, PSO1**	**3**

Mathematical control theory, Controllability and observability for Linear and non linear systems, Stability of non-Linear systems and Optimal controllability.

Syllabus

Introduction Problems of mathematical control theory, Specific models.
Controllability and observability for Linear systems Linear differential equations, The controllability matrix , Rank condition , Kalman decomposition and Observability.
Controllability and observability for non-Linear systems Nonlinear differential equations, Controllability and linearization, Lie brackets, The openness of attainable sets and Observability.
Stability of Linear systems Stable linear systems , Stable polynomials. The Routh theorem, Stability, observability, and Liapunov equation, Stabilizability and controllability.
Stability of non-Linear systems The main stability test, Linearization, The Liapunov function method , La Salle's theorem Necessary conditions for stabilizability**.**
Optimal controllability Bellman's equation and the value function. The linear regulator and stabilization, Impulse control problems, An optimal stopping problem. Iterations of convex mappings.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Jerzy Zabczyk, Mathematical Control Theory: An Introduction, Birkhauser, Boston, Springer.	2008
2	S.Barnett, R.G. Cameron, Introduction to mathematical control theory, Clarendon Press.	1985
3	E.D.Sontag, Mathematical control theory: Deterministic finite dimensional systems, Springer.	1998
4	John B. Baillieul, J.C. Willems, Mathematical control theory, Springer.	1999

18AM2012- **Statistical Inference**

L-T-P/S	4-0-0
Credits	4
Contact Hours	5

Table 2.4 Course Outcomes of 18AM2012

CO No	Course Outcome (CO)	POS/PSOs	Blooms Taxonomy Level (BTL)
CO1	Obtain estimates of parameters and identify the various methods to estimateit.	PO1, PS02	3
CO2	Apply various principles for the data reduction and draw conclusion about the population based upon samples drawn from it	PO2, PS02	3
CO3	Describe the tests of significance and draw conclusion about the population and sample using various tests.	PO3, PS02	3
CO4	Testing the hypothesis to analyze the variance and also predict the linear relationship between the two variables	PO3, PS02	3

Theory of Estimation, Principle of Data Reduction, Testing of Hypothesis and Analysis of Variance

Syllabus

Theory of Estimation: Basic concepts of estimation, Point estimation, , methods of estimation; method of moments, method of maximum likelihood; Unbiasedness, Minimum variance estimation, Cramer – Rao bound and its generalization, Rao Blackwell theorem, Existence of UMVU Estimators. Interval Estimation, Some results for normal population case.

Principle of Data Reduction: Sufficiency principle, Factorization criterion, minimal sufficiency, Completeness and bounded completeness, Likelihood principle, Equivariance principle.

Testing of Hypothesis: Null and alternative hypothesis, Type I and II errors error probability and power function, Method of finding tests, Neyman – Pearson lemma, Uniformly most powerful tests, Likelihood ratio principle, Likelihood ratio test, Sequential probability ratio test, Some results based on normal population.

Analysis of Variance: one way classification; simple linear regression analysis with normal distribution.

Suggested books:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication/ Reprint
1	Miller, I. and Miller, M.,"Freund's Mathematical Statistics with Applications",7th Ed., Prentice Hall PTR.	2006
2	Lehman, E.L., "Testing of Statistical Hypothesis", Wiley Eastern Ltd	1959
3	G. Casella, R. L. Berger, "Statistical Inference", Duxbury Press	2002
4	Lehman, E.L., "Point Estimation", John Wiley & sons	1984
5	Rohatgi, V.K., "Statistical Inference", Dover Publications	2011

18AM2013- **Data Base Management systems**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 3.3 Course Outcomes of 18AM2013

CO#	Course Outcome	PO/PSO	BTL
CO1	Illustrate the functional components of DBMS, importance of data modelling in design of a database.	PO1, PO5, PSO2	2
CO2	Build queries using SQL and concepts of PL/SQL	PO1, PSO2	3
CO3	Apply normalization techniques and indexing to construct and access decent database.	PO5, PSO1	3
CO4	Identify the importance of transaction processing, concurrency control and recovery techniques	PO1, PSO4	3
CO5	Develop a good database and define SQL queries for data analysis	PO3, PSO2	3

Database Fundamentals, Relational Algebra & SQL, Database Design and Transaction Management &Recovery Techniques

Syllabus

Database Fundamentals: DBMS Characteristics & Advantages, Database Environment, Database Users, Database Architecture, Data Independence, Languages, Tools and Interface in DBMS, DBMS types. **Data Modelling:** ER Model, Notation used in ER Diagram, Constraint, Types, Relationships in ER Model and other considerations in designing ER diagram. Enhanced ER data Model, EER Diagram, Relational Model: concepts, constraints, schemas, ER to Relational Model.

Relational Algebra & SQL: Relational Algebra :Operators in relational algebra, Data Definition and other languages in SQL, Creating tables and Data types, Constraints, DML statements, Functions and writing SQL statements using nested sub queries, complex queries, joining relations, views, compound statements, user defined functions, user defined procedures, cursors, Triggers.

Database Design: Guidelines for good database design, Normalization- Normal Forms, First, Second, Third Normal Forms, BCNF, Multi value and join dependencies, 4th and 5th normal forms. File and storage structures: File storage, Indexstructures,Indexing and hashing, query processing and optimization.

Transaction Management &**Recovery Techniques:** Transaction processing issues, Transaction states, problems during multiple transactions processing, ACID properties, system log and concurrency control techniques: Lock based techniques, and Timestamp based techniques, Multiversion based Techniques. Recovery concepts, shadow paging, ARIES.

SuggestedBooks:

S. No.	Author(s) / Title/ Edition No./ Publisher	Year of Publication
1	Ramez Elmasri and shamkant B Navathe, "Database Systems: Models, Languages, Design and Application Programming", 6th Ed., Pearson Education.	**2013**
2	. CONNOLLY,Database Systems : A Practical Approach to Design, Implementation and Management, 6thEd., Pearson Education	Latest Eddition
3	A.Silberschatz Henry F Korth,S.Sudarsan, " Database System Concepts", 6th Ed., Tata McGrawhHill	**2011**
4	Raghu RamaKrishnan , Johannes Gehrke, "Database Management Systems", 3rd Ed., Tata McGraw Hill.	**2014**
5	Ivan Bayross, "SQL, PL/SQL: The Programming Language of Oracle", 2nd Ed., BPB Publications.	Latest Eddition
6	C. J. Date, A. Kannan and S. Swamynathan, An Introduction to Database Systems, 8th Ed., PearsonEducation.	**2009**

List of Lab Experiments:

Experiment - 1:

Introduction to DBS lab, Tools used in the lab(TerraER2.23for ER diagrams, MYSQL5.7server and client)

Experiment - 2:

Draw an ER diagram that captures thisinformationabout university database by considering the followinginformation

- Professors have an SSN, a name, an age, a rank, and a researchspecialty.
- Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and abudget.
- Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.).
- Each project is managed by one professor (known as the project's principalinvestigator).
- Each project is worked on by one or more professors (known as the projects co-investigators).
- Professors can manage and/or work on multiple projects.
- Each project is worked on by one or more graduate students (known as the project's researchassistants).
- When graduate students work on a project, a professor must supervise their work on the project.
- Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for eachone.
- Departments have a department number, a department name, and a mainoffice.
- Departments have a professor (known as the chairman) who runs thedepartment.
- Professors work in one or more departments, and for each department that they work in, a

time percentage is associated with theirjob.

- Graduate students have one major department in which they are working on theirDegree.
- Each graduate student has another, more senior graduate student (known as a Student advisor) who advises him or her on what courses to take.
- Capture dependent details of the professor to offer medical insurance to theirfamily.
- Capture information regarding the clients who sponsored projects to theprofessors.
- Capture informationregardingthe expenditure and income and details of the project along with PIdetails.

ELECTIVE-II

18AM2021- Fuzzy mathematics and applications

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2021

CO No:	Course out come	PO/PSO	BTL
1	Understand cartesian Product of Crisp Sets Crisp Relations on Sets.	PO1, PO2 PSO1	2
2	Explain Concept on a Fuzzy Set.	PO1, PSO1	2
3	Apply Projections of Fuzzy Relations and sets	PO1, PSO1	3
4	Apply fuzzy methods in control theory	PO1, PSO1	3

Crisp set, Fuzzy set theory, Fuzzy relations, Fuzzy logic, switching functions and switching circuits, applications fuzzy methods in control theory.

Syllabus

CRISP SET THEORY: Introduction; Relations between Sets; Operations on Sets; Characteristic Functions; Cartesian Product of Crisp Sets; Crisp Relations on Sets.

FUZZY SET THEORY: Introduction; Concept on a Fuzzy Set; Relations between Fuzzy Sets; Operations of Fuzzy Sets; Properties of the Standard Operations; Certain numbers Associated with a Fuzzy Set; Certain Crisp Sets Associated with a Fuzzy Set; Certain Fuzzy Sets Associated with a Given Fuzzy Set; Extension Principle.

FUZZY RELATIONS: Introduction; Fuzzy Relations; Operations on Fuzzy Relations; α-Cuts of a Fuzzy Relation; Composition of Fuzzy Relations; Projections of Fuzzy Relations; Cylindrical Extensions; Cylindrical Closure; Fuzzy Relation on a Domain.

FUZZY LOGIC: Introduction; Three-valued Logics; N-valued Logics $N \geq 4$; Infinite- valued Logics; Fuzzy Logics; Fuzzy Propositions and Their Interpretations in Terms of Fuzzy Sets; Fuzzy Rules and Their Interpretations in Terms of Fuzzy Relations.

SWITCHING FUNCTIONS AND SWITCHING CIRCUITS: Introduction; Switching Functions; Disjunctive Normal Form; Relation between Switching Functions and Switching Circuits; Equivalence of Circuits; Simplification of Circuits.

APPLICATIONS FUZZY METHODS IN CONTROL THEORY: Introduction; Introduction to Fuzzy Logic Controller; Fuzzy Expert Systems; Classical Control Theory vs. Fuzzy Control; Illustrative Examples; Working of an FLC through Examples; Details of the Components of FLC; Mathematical Formulation of an FLC; Real-life Examples.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication
1	M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI.	2001
2	G. J. Klir and B. Yuan , Fuzzy Sets and Fuzzy Logic theory and applications, PHI.	1997
3	T.J.Ross, Fuzzy Logic with engineering Applications, McGraw-Hill Inc.	1995
4	H.J.Zimmerman, Fuzzy sets, Decision making and expert systems, Kluwer, Boston.	1987

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18AM2022- **Advanced Numerical Analysis**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 3.2 Course Outcomes of 18AM2022

CO No:	Course out come	PO/PSO	BTL
1	Find of Eigen Values of a Matrix by using poer and Jacobi methods.	**PO1, PO2 PSO1**	**3**
2	Solve initial value problems.	**PO1, PSO1**	**3**
3	Classify and solve PDE.	**PO1, PSO1**	**3**
4	Apply Galerkins, Rayleigh-Ritz methods and their compatibility.	**PO1, PSO1**	**3**

Eigen values of a matrix, Initial value problems, inverse interpolation, Finite difference, Elliptic, Hyperbolic and parabolic PDE.

Syllabus

Computations of Eigen Values of a Matrix: Power method for dominant, sub-dominant and smallest eigen-values, Method of inflation, Jacobi, Givens and Householder methods for symmetric matrices, LR and QR methods.

Initial Value Problems: Multistep methods, their error analysis and stability analysis.

Inverse interpolation: Their developments and applications

Finite Difference: Review of finite difference operators, finite difference methods.

Elliptic PDE: Five point formulae for Laplacian, replacement for Dirichlet and Neumann's boundary conditions, curved boundaries, solution on a rectangular domain, block tri-diagonal form and its solution using method of Hockney, condition of convergence.

Parabolic PDE: Concept of compatibility, convergence and stability, Explicit, full implicit, Crank-Nicholson, du-Fort and Frankel scheme, ADI methods to solve two-dimensional equations with error analysis.

Hyperbolic PDE: Solution of hyperbolic equations using FD, and Method of characteristics,Limitations and Error analysis.

Weighted residual methods: Collocation, least squares, Galerkins, Rayleigh-Ritz methods and their compatibility.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Gerald, C. F. and Wheatly P. O., “Applied Numerical Analysis”, 6th Ed., Addison-Wesley Publishing	2002
2	Smith, G. D., “ Numerical Solution of Partial Differential Equations”, Oxford University Press.	2001
3	Jain, M. K., “ Numerical Solution of Differential Equations”, John Wiley.	1991
4	Fausett, L. V., “Applied Numerical Analysis”, Prentice Hall, 2nd Ed.	2007
5	Froberg, C. E., "Introduction to Numerical Analysis", 2nd Ed., Addison Wesley.	2004

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18AM2023- **Design and Analysis of Algorithms**

L-T-P/S	3-0-2
Credits	4
Contact Hours	5

Table 3.2 Course Outcomes of 18AM2023

CO No:	Course out come	PO/PSO	BTL
1	Understand notions of algorithm, pseudo code conventions, Performance analysis, Time and space .	PO1, PO2 PSO1	2
2	Solve the recurrence relations	PO1, PSO1	3
3	Develop the search algorithms.	PO1, PSO1	3
4	Apply naive string matching algorithm, The Rabin-Karp algorithm.	PO1, PSO1	3

Pseudo code conventions, Performance analysis, Recurrence relations, Merger sort, Quick sort, Strassen's matrix multiplication method. Introduction to dynamic programming.

Syllabus

Notion of algorithm, pseudo code conventions, Performance analysis, Time and space complexities, Asymptotic notation, Big oh notation, omega notation, theta notation, Average and worst case analysis, Probabilistic analysis, Amortized analysis.

Recurrence relations, Divide and conquer relations, Solving of recurrences by iteration method and substitution method, Master theorem, Binary search algorithm, Merger sort, Quick sort, Strassen's matrix multiplication method.

Greedy strategy, Huffman coding algorithm, Data structures of disjoint sets, Complexity analysis of Depth first search, Breadth first search, Prim's algorithm, Kruskal's algorithm, Dijkstra's and Bellman-Ford algorithms, Knapsack problem, Warshall's and Floyd's algorithms.

Introduction to dynamic programming, Principle of optimality, Optimal binary search trees, Matrix-chain multiplication, Longest common subsequence.

String matching, The naive string matching algorithm, The Rabin-Karp algorithm.
Introduction to computability, Reducibility, Polynomial-time verification, NP-completeness, NP-complete problems.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Cormen T. H., Leiserson C. E., Rivest R. L. and Stein C., "Introduction to Algorithms", Prentice Hall India, (3rd Edition)	2004
2	Aho A. V., Hopcroft J. E. and Ullman J. D., "The Design and Analysis of Computer Algorithms", Pearson Education	2002
3	Horowitz E., Sahni S. and Rajasekaran S., "Fundamentals of Computer Algorithms", Orient Longman	2006
4	Kleinberg J. and Tardos E., "Algorithm Design", Pearson Education	2008
5	Levitin A., "Introduction to the Design and Analysis of Algorithm", (2nd edition) Pearson Education	2003

ELECTIVE-III

18AM2031- **Dynamical Systems**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2031

CO No:	Course out come	PO/PSO	BTL
1	Understand Periodic points, Itineraries , Invariant sets of one dimensional maps.	PO1, PO2 PSO1	2
2	Explain the functions with several variables	PO1, PSO1	2
3	Apply limit sets, Chaotic Attractors, Lyapunov Exponents	PO1, PSO1	3
4	Apply Periodic points of Higher Dimensional maps.	PO1, PSO1	3

Periodic points, Itineraries , Invariant sets of one dimensional maps and Periodic points of higher dimensional maps. Functions with several variables.

Syllabus

Iteration of functions as dynamics: One dimensional maps. Functions with several variables

Periodic points of one dimensional maps: Periodic points, Iteration using the graph, Stability of periodic points, Critical points and Basins, Bifurcation of periodic points.

Itineraries for one-dimensional maps: Periodic points from transition Graphs, Topological Transitivity, Cantor sets, Piecewise expanding maps and sub shifts, Applications **Invariant sets for one dimensional maps:** Limit sets, Chaotic Attractors, Lyapunov Exponents Invariant measures, Applications. **Periodic points of Higher Dimensional maps:** Dynamics of Linear maps, classification of periodic points, stable manifolds, Hyperbolic Toral automorphisms, Applications.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	R. Clark Robinson, An Introduction to Dynamical Systems- continuous and discrete, Second Edition, AMS	2012
2	Anatole Katok, Introduction to Modern theory of Dynamical systems, Cambridge University press.	1997
3	Boris Hasselblatt, Anatole Katok, First Course in Dynamics: with a Panorama of Recent Developments, Cambridge University press	2003

18AM2032- **Number Theory**

L-T-P/S	4-0-0
Credits	4
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2032

CO No:	Course out come	PO/PSO	BTL
1	Under stand divisibility, Euclidean algorithm,, Fundamental theorem of arithmetic, Congruences, Chinese Remainder Theorem, Euler's totient function, Euler-Fermat theorem, Wilson's theorem.	PO1, PO2 PSO1	2
2	Identify the residue systems, Quadratic residues, quadratic reciprocity, the Jacobi symbols.	PO1, PSO1	3
3	Develop the Mobius function and Mobius inversion formula, finite and infinite continued fractions.	PO1, PSO1	3
4	Explain the concepts of cryptography, public key cryptography, RSA.	PO1, PSO1	3

Divisibility, Euclidean algorithm, Linear Diophantine equations, solutions of linear congruences, Chinese Remainder Theorem, Euler's totient function, Euler-Fermat theorem, Wilson's theorem. Introduction to cryptography, public key cryptography, RSA.

Syllabus

Divisibility, Euclidean algorithm, Linear Diophantine equations, Prime numbers, Fundamental theorem of arithmetic, Prime number theorem (statement only). Congruences, solutions of linear congruences, Chinese Remainder Theorem, Euler's totient function, Euler-Fermat theorem, Wilson's theorem, non-linear congruences, Hensel's lemma, primitive roots and power residues. Polynomial congruences, Reduced residue systems.Quadratic residues, quadratic reciprocity, the Jacobi symbols. The greatest integer function, Arithmetic functions, Mobius function and Mobius inversion formula.Finite continued fractions, infinite continued fractions, approximation to irrational numbers. Introduction to cryptography, public key cryptography, RSA.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Niven I., Zuckerman H. S., and Montgomery H. L., "An Introduction to the Theory of Numbers", John Wiley & Sons (5th Ed.)	1991
2	Hardy, G., H. and Wright, E. M, "An Introduction to the Theory of Numbers ", Oxford University Press (6th Ed.)	2008
3	Burton D., M., "Elementary Number Theory", McGraw Hill (7th Ed.)	2010
4	Andrews G. E., “Number Theory”, Dover Publications	1994
5	Koblitz N., A Course in Number Theory and Cryptography, Springer (2nd Ed.)	1994

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18AM2033- **Mathematical Modeling**

L-T-P/S	3-0-2
Credits	5
Contact Hours	4

Table 3.2 Course Outcomes of 18AM2033

CO No:	Course out come	PO/PSO	BTL
1	Understand the Merits and Demerits of Mathematical Modeling.	**PO1, PO2 PSO1**	**3**
2	Solve linear , Non-linear Difference equations.	**PO1, PSO1**	**3**
3	Identify various mathematical models and solve them.	**PO1, PSO1**	**3**
4	Solve the wave equation, Vibrating string, Traffic flow problems	**PO1, PSO1**	**3**

Merits and Demerits of Mathematical Modeling, Introduction to difference equations, Non-linear Difference equations, Introduction to Continuous Models, Carbon Dating, Fluid flow through a porous medium.

Syllabus

Mathematical Modeling, History of Mathematical Modeling, latest development in Mathematical Modeling, Merits and Demerits of Mathematical Modeling.

Introduction to difference equations, Non-linear Difference equations, Steady state solution and linear stability analysis. Introduction to Discrete Models, Linear Models, Growth models,

Decay models, Newton's Law of Cooling, Bank Account Problem and mortgage problem, Drug Delivery Problem, Harrod Model of Economic growth, War Model, Lake pollution model, Alcohol in the bloodstream model, Arm Race models, Linear Prey-Predator models,Density dependent growth models with harvesting,

Introduction to Continuous Models, Carbon Dating, Drug Distribution in the Body, Growth and decay of current in a L-R Circuit, Horizontal Oscillations, Vertical Oscillations, Damped Force Oscillation, Dynamics of Rowing, Combat Models, Mathematical Model of Influenza Infection (within host), Epidemic Models (SI, SIR, SIRS, SIC), Spreading of rumour model, Steady State solutions, Linearization and Local Stability Analysis, logistic and gomperzian growth, prey-predator model, Competition models.

Fluid flow through a porous medium, heat flow through a small thin rod (one dimensional), Wave equation, Vibrating string, Traffic flow, Theory of Car-following, Crime Model, Linear stability Analysis: one and two species models with diffusion, Conditions for diffusive instability with examples.

Suggested books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Albright, B., "Mathematical Modeling with Excel", Jones and Bartlett Publishers.	2010
2	Marotto, F. R., "Introduction to Mathematical Modeling using Discrete Dynamical Systems", Thomson Brooks/Cole.	2006
3	Kapur, J. N., "Mathematical Modeling", New Age International	2005
4	Barnes, B. and Fulford, G. R., "Mathematical Modelling with Case Studies", CRC Press, Taylor and Francis Group.	2009
5	Edsberg, L., "Introduction to Computation and Modeling for Differential Equations", John Wiley and Sons.	2008