Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester I
MA 94105: Computer Aided Numerical Analysis

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Numerical Analysis and Numerical Methods, Numerical computing process, Approximations and errors in computing, and the taxonomy of errors	02
2.	Errors classification, error approximation, different measurements of numerical errors, Errors in numerical computations and, errors in the approximation of a function	02
3.	Numerical stability, ill-condition and convergence, numerical algorithm and Numerical Flow Charts	02
	UNIT 2	
4.	Different forms of mathematical equations, Basic properties of equations, Existence of imaginary roots, Initial approximation, and Graphical solution of equations	01
5.	Solution of Algebraic and Transcendental Equations: Bisection (or Bolzano) method, method of false position, Newton Raphson method	03
6.	Solution of Simultaneous algebraic equations: Direct methods- Gauss Elimination method Gauss Jordan method	02
7.	Solution of Simultaneous algebraic equations: Iterative methods-Jacobi's method, Gauss Seidal method	02
	UNIT 3	
8.	Calculus of finite differences: definitions, forward and backward differences,properties of forward difference operator, difference table, Factorial polynomial and its differences. Properties of operators and relation between them	02
9.	Interpolation: Missing term interpolation, interpolation with equal intervals, Newton-Gregory forward and backward interpolation	02
10.	Interpolation with unequal intervals, Central difference formula, Lagrange interpolation formula	02
11.	Numerical differentiation, first, second and third derivatives, using forward and backward interpolation formula	02
12.	Numerical Integration: derivation of general quadrature formula, deriving Trapezoidal rule, Simpson's one-third and three-eighth rules from quadratureformula	02
	UNIT 4	
13.	Definition and formation of difference equations, Linear difference equations with constant coefficient	02
14.	Solution of difference equations, Rules for finding Complimentary functions and solutions based on them	02
15.	Solution of difference equations, Rules for finding particular integral, four cases and solutions based on them	02
16.	Difference equations reducible to linear form. Simultaneous difference equations with constant coefficient	02
	UNIT 5	
17.	Numerical solution of Ordinary Differential Equations: Initial value problem, Euler's method, Picard's method, Taylor's method, modified Euler's method	02
18.	Numerical solution of Ordinary Differential Equations: Runge method, Runge-Kutta method, Adams-Bashforth method, Milne's method	02
19.	Numerical solution of Partial Differential Equations: Classification of second order equations, finite difference approximations to partial derivatives	02
20.	Numerical solution of Partial Differential Equations: Elliptic, Parabolic and Hyperbolic equations	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester I
MA 94106: Computer Architecture

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Introduction to CA , Number system	02
2.	Von Neumann Model , Digital devices : Logic gates	01
3.	flip flops	02
4.	Logic Design : Boolean Algebra , K-map , Method of simplification of Logic expression	02
5.	Combinational & Sequential circuits	02
	UNIT 2	
6.	CPU Organization : ALU , Control unit , Registers	01
7.	Memory organization, memory properties	01
8.	Associative memory, Cache memory	02
9.	Machine language level, instruction types	01
10.	Input Output Organization : I/O interface , Modes of transfer	02
	UNIT 3	
11.	Memory mapped I/O and I/O mapped I/O	01
12.	Concepts of interrupts and DMA	02
13.	I/O processors	02
14.	Concept of hardwired and micro programmed control instruction	02
	UNIT 4	
15.	Parallel processing	01
16.	Interconnection Structure	02
17.	Interprocessor Arbitration : Serial , Parallel and Dynamic arbitrationProcedure	02
18.	Interprocessor Communication and Synchronization	02
19.	Cache Coherence	01
	UNIT 5	
20.	Pipeline processing : Concepts , Arithmetic and Instruction Pipeline	03
21.	Vector and Array processing : vector operation , matrixmultiplication	02
22.	Memory interleaving, Attached array Processor, SIMD ArrayProcessor	02
23.	Comparison of RISC and CISC.	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester I
MA 94108: Advanced Discrete Mathematics

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Formal Logic : Basic preliminaries Sets , functions ,relations(equivalence relations and poset) for logic	02
2.	Symbolic representation and tautologies , Quantifiers	01
3.	Predicates, Propositional and Predicate calculus, Proofs & methodof proofs	02
4.	Algebra of Boolean expression , Logic gates and circuits, Karnaugh maps	03
5.	Lattices, Distributive lattice	01
	UNIT 2	
6.	Graph Theory: Definition of (Undirected) Graphs, Paths, Circuits,Cycles & Subgraphs, Degree of Vertex , Connectivity, Complete regular and bipartite graphs and Complete Bipartite Graphs	01
7.	Kuratowskis Theorem (Statement only) and its uses, planer graphsand their properties	01
8.	Euler's formula for connected Planer Graphs, Graph colorings,Euler's Theorem on the existence of Eulerian paths and circuits	02
9.	Trees and Binary Trees, Spanning Trees, Cut-sets, MinimalSpanning Trees	02
10.	Directed Graphs, Indegree and Outdegree of a vertex, weigted undirected graphs, Matrix representation ofGraph	01
	UNIT 3	
11.	Introduction to languages	01
12.	Grammars	01
13.	FSM & Automata	04
	UNIT 4	
14.	Algebra: Groups:-Review of Basic Concepts, Normal group, Cyclic group, Permutation group	03
15.	Direct product , Conjugacy relation, Normalizer, counting principle(Th.2.4)[7], Sylow's Theorem	02
16.	Rings & Modules:-Some basic concepts, Algebra over fields, ideals, Minimal, Maximal & prime ideals, PID and UFD,Euclidean domain, Polynomial rings, definition of modules	04
17.	Notherian and Artin & Rings:- Hilbert Basis Theorem	02
	UNIT 5	
18.	Vector space:- Review of Basic Concepts, Canonical forms	03
19.	Field:- Extension field, Algebraic & Transcendental Extension field, roots of Polynomial, Finite field	02
20.	Elements of Galios theory, fundamental theorem & Applications.	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester I
MA 94109: Ordinary and Partial Differential Equation

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Initial & boundary value problem, Picard's iteration, Lipschitz condition, Sufficient condition in terms of partial derivatives	03
2.	Example of Lipschitzian and Non- Lipschitzian functions, Picard's theorem for local existence and uniqueness of solutions of an initial value problem	03
3.	Problem of first order which solved for the derivative, examples of problem without solution and of equations where Picard's iteration not converge	02
	UNIT 2	
4.	Existence & Uniqueness for ordinary differential equation, Wornskian	03
5.	Linear independence, Initial value problem for nth order differential equation	03
6.	Linear equation with variable cofficients, Lipschitz condition	02
	UNIT 3	
7.	Fundamental concepts of partial diff. equation, classification of IInd order PDE, Canonical forms of Hyperbolic, Parabolic and Elliptic equation	02
8.	Elliptic differential equation , Laplace and Poisson equation, Dirichlet problem for a rectangle, Neumann problem for a rectangle	02
9.	Parabolic diff. equation: Diffusion equation, Dirac Delta function	02
10.	Hyperbolic diff. equation: Wave equation, Vibrating string Variable separable solution	02
	UNIT 4	
11.	Method of separation of variable, Laplace, Diffusion, and wave equation in Cartesian, cylindrical and spherical polar coordinate	03
12.	Boundary value problem for vibration of string and heat diffusion in a finite rod	03
13.	Classification of integral equation: Fredhlom integral equation, Volterra integral equation	01
14.	Relation between diff. and integral equation	01
	UNIT 5	
15.	Green's function: Definition, example , Green's function for Laplace equation	03
16.	The method of images, the eigen function method	03
17.	Green function for the wave equation- Helmholtz Theorem	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester II
MA 94205: Mathematical Theory Of Computation

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Review of sets, Relations and Functions	03
2.	Review of Graphs and Trees	03
3.	Preposition and Predicate Calculus, Principal of Induction	01
4.	Languages and Grammers-Fundamental Concepts	01
	UNIT 2	
5.	Definition of Automata; Description of finite Automata	01
6.	Deterministic finite Accepters (DFAs), Non Deterministic finite Accepters (NFAs)	02
7.	Regular Grammars and Languages, Properties of Regular Languages, Lemma for Regular Languages. Pumping	04
	UNIT 3	
8.	Context free-grammars and Derivation Trees	02
9.	Parsing and ambiguity	02
10.	Normal form for Context free-grammars -Chomsky and Greibach normal form	03
11.	Pumping Lemma for Context Free languages ,Properties of Context Free languages	03
	UNIT 4	
12.	Basic Definition of Pushdown Automata, Pushdown Automata and Context Free languages	04
13.	Non Deterministic Pushdown Automata and Deterministic Pushdown Automata, Pushdown Automata and Context Free languages	04
	UNIT 5	
14.	Definition of a Turing Machine, Turing Machine as Language,Accepters, Turing's Thesis, Universal Turing Machine	03
15.	Linear Bounded Automata	02
16.	Computational complexity theory- P and NP Problems	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester II
MA 94206: Data Processing and Computation

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Basics concepts, Data Models Categories, Schema, Instances & Database state	03
2.	Database Architecture	01
3.	Data Independence	01
4.	Database language, Role of Database Administrator	02
	UNIT 2	
5.	Entity relationships models	02
6.	Relational Data Models	03
7.	Relational algebra : Basic Relational algebra operations	02
	UNIT 3	
8.	Structured Query languages(SQL) : Data Types, Basic Quires in SQL, insert, delete & update statements in SQL	05
9.	indexing in SQL	01
10.	Sequences in SQL	01
11.	View in SQL	01
	UNIT 4	
12.	Network data models	01
13.	Hierarchical data models	01
14.	Normalization theory	06
	UNIT 5	
15.	Transaction Management : Basic concepts of Transactions	02
16.	Schedule and their types	02
17.	Concurrency Control	03
18.	Database Recovery Concepts and techniques	03

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester II
MA 94207: Operations Research

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Introduction to linear algebra as pre-requisite, linear programming problem: formulation and components. Definitions of decision variables, slack and surplus variables, Mathematical formulation of LPP	02
2.	Solution of LPP: Initial basic feasible solution, graphical method of solution	01
3.	Solution of LPP using Simplex method and Big-M method	04
4.	Duality in linear programming, Dual simplex method, degeneracy	02
	UNIT 2	
5.	Assignment problem, its solution, special cases, unbalanced problem, maximization problem	03
6.	Transportation problem: solution through various methods, unbalanced transportation problem	03
7.	Game theory: two-person zero-sum game, pure and mixed strategies, Min max and max-min principles, solution of the game by algebraic method and dominance rule	03
	UNIT 3	
8.	Sequencing and scheduling: Sequencing problem with n jobs and 2 machines, n jobs, and 2 machines and in general n jobs and m machines using SM Jhonson's rule. Calculation of elapsed and idle times	03
9.	Objectives of CPM & PERT, elements of the network, network rules, constraints, error in the network, Critical Path Analysis, Activity time and floats, optimization through CPM techniques	03
10.	PERT and three estimates, critical path analysis of a PERT network, probability of completion of the project, controlling and monitoring	02
	UNIT 4	
11.	Simple and mathematical definition of Information, basic ideas of information, communication system, Noisy and noiseless channel, Channel matrix	02
12.	Measure of uncertainty and properties of entropy function, Channel capacity, efficiency and redundancy encoding	02
13.	Shannon Fano encoding procedure	02
	UNIT 5	
14.	Dynamic Programming: definition, formation, approaches, Bellman's inequality principle, characteristics of dynamic programming, shortest path/stage coach problems	04
15.	Non-linear programming problems: formulation, Lagrangian method, Kuhn Tucker conditions and Quadratic programming	04

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester II
MA 94208: Real and Complex Analysis

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Measure theory,function of bounded variation, Measurable and non measurable sets	02
2.	Borel sets, measurable function,Lebesgue integral for bounded function over a set of finite measure	03
3.	Lebesgue integral unbounded function,theorem on convergence in measure, Lebsegue class Lp	03
	UNIT 2	
4.	Fourier series, Converfent criteria, Convergent problem	03
5.	Dirichlet's condition, Riemann-Lebesgue theorems and its consequences	03
6.	Fourier analysis	02
	UNIT 3	
7.	Concept of analytic function, C-R equation, Conjugate function, Harmonic Function	02
8.	Poisson's formula, Schwarz's theorem & reflection principle, Conformality	02
9.	Area & closed curves analytic function in region, conformal mapping,length & area	02
10.	Linear transformation, the linear groups,cross-ratio symmetry & oriented circles, use of level surface	02
	UNIT 4	
11.	Complex integration, Line integral Rectifiable arces	03
12.	Cauchy's theorem for rectangle,Cauchy's theorem for circular disk	03
13.	The index of a point with respect to a closed curve, Cauchy's integral formula	02
	UNIT 5	
14.	The general form of Cauchy's theorem & calculus of residue, chain and cycle, simple connectivity	03
15.	Exact differentials in simplyconnectedregions,Residue theorem	03
16.	The argument principle ,Banach points	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester III
MA94303: Functional Analysis And Integral Equations

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Topological space: Open set, Closed set, Neighbourhood, filter	02
2.	Countable Space, Separation Axioms, Continuous mapping	03
3.	Homomorphism, Connectedness, and Compactness	03
	UNIT 2	
4.	Normed linear space: Bnacch space, Quotient space,linear transformation	03
5.	Hahn Banach theorem and its consequences, Conjugate space, separability	03
6.	The Natural imbedding of the normed linear closed graph theorem, The uniform boundedness principle	02
	UNIT 3	
7.	Hilbert spaces and some properties, orthonormal complements, orthonormal sets	03
8.	The projection theorem, Bessel's inequality, Fourier expansion	03
9.	Parseval's equation, Riesz representation theorem	02
	UNIT 4	
10.	Finite dimensional spectral theory,adjoint operator, self adjoint operator	03
11.	Normal and Unitary operators and their properties,projection the spectral theorem	03
12.	Fixed-point theory and its applications	02
	UNIT 5	
13.	Formulation of integral equation and classification, integral differential equation	01
14.	Conversions of ordinary differential equation to integral equation	01
15.	Solutions of integral equation with separable kernals, characteristics number and eigen functions	02
16.	Fredholm determinant method, Construction of Green's function,reduction of B.V problems to integral equation	02
17.	Resolvant kernel of the integral equations, method of successive approximation, convolution type kernals integral transform method	02

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester III
MA 94304: Object Oriented Programming Systems

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Introduction to Object Oriented Programming fundamentals	02
2.	Basic concepts of object oriented programming	02
3.	Merits and demerits of OO methodology	01
4.	Elements of the object model	02
	UNIT 2	
5.	Concepts of objects and classes, attributes and methods, Access modifiers	02
6.	Static member of a class, Instances, Message passing	01
7.	Constructors and Destructor	02
8.	Data abstraction , Encapsulation and data hiding	02
	UNIT 3	
9.	Inheritance: purpose and its types	02
10.	Polymorphism: Introduction, Method of overriding and overloading, compile time and run time polymorphism	04
	UNIT 4	
11.	Introduction to object oriented analysis	03
12.	Object oriented design: Design concepts	03
13.	Class diagrams, State Transition diagrams, object diagrams	03
	UNIT 5	
14.	Rapid prototyping: Overview, method process and techniques	02
15.	Object oriented testing: Concepts, methods	05
16.	UML pattern	04

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester III
MA94353: Regression Analysis For Data Science

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Statistics: Concepts of statistical population and sample	02
2.	Measures of central tendency	03
3.	Measures of dispersion, Kurtosis and Skewness	02
	UNIT 2	
4.	Hypothesis Testing: Introduction-Types of errors	02
5.	Critical region, procedure of testing hypothesis - Large sample tests- Z test for Single proportion	02
6.	Difference of Proportion, mean and difference of means	02
7.	Small sample tests- Student's t- test, F-test and Chi-square test	02
	UNIT 3	
8.	Simple Regression Analysis: correlation, multiple correlation, partial correlation	02
9.	Introduction to linear and non-linear model, ordinary least square methods, fitting a linear trend	02
10.	Simple linear regression, validating simple regression model using t, F and p test, Developing confidence interval	03
	UNIT 4	
11.	Multiple Regression Analysis: Concept of Multiple regression model to describe a linear relationship	02
12.	Assessing the fit of the regression line, inferences from multiple regression analysis	02
13.	Problem of overfitting of a model, comparing two regression model, prediction with multiple regression equation	02
	UNIT 5	
13.	Multivariate Data Analysis: Multivariate data and their diagrammatic representation	02
14.	Exploratory multivariate data analysis, sample mean vector, sample dispersion matrix, sample correlation matrix, graphical representation	02
15.	means, variances, co-variances, correlations of linear transforms, six step approach to multivariate model building	03
16.	Introduction to multivariate linear regression, logistic regression, principal component analysis	02
17.	factor analysis, cluster analysis, canonical analysis and canonical variables, structured equation modeling (SEM)	03

Shri G. S. Institute of Technology and Science
Department of Applied Mathematics and Computational Science
M.Sc. Applied Mathematics Semester III
MA 94371/MA 94370: Mathematical and Statistical Modelling

Total No. of Units: 5 Total No. of Lectures: 40

Lecture Plan

S.No.	Topics	No. of Lectures
	UNIT 1	
1.	Definition of simulation, Advantages and disadvantages of Simulation, Areas of application. Simulation Technique: Monte Carlo Simulation, Advantages and disadvantages and applications of Monte Carlo Simulation Technique	02
2.	Definition of random numbers, Properties of random numbers,Generation of pseudo-random numbers, Techniques for generating random numbers	02
3.	Illustration of examples based on simulation , random numbers generators. Introduction to evolutionary techniques	03
	UNIT 2	
4.	Markov Chain: Probability Vector, Stochastic Matrix, Fixed Point of a Matrix, and Definition of Markov Chain, Transition Matrix, Some Theorems and problems	03
5.	Reliability: Basic Concepts, Failure law, Bath Tub Curve, Evaluation of Reliability of a component from Test Data	02
6.	System Reliability:Components in Series and parallel, Redundancy, Non-Series Parallel System, Markovian approach for Reliability Evaluation and examples illustration	03
	UNIT 3	
7.	Neural Network: Basic Idea, Artificial neural network and its building blocks, Terminologies learning rules	03
8.	back propagation network and its rule, feedback network, Adaline and madaline network	02
9.	Neurons as function of signal monotocity, single and multiplayer neural network, neural dynamical systems and state spaces, neural dynamic, activation models, additive neuronal dynamics	03
	UNIT 4	
10.	Passive membrane decay, Perceptrons LMS Algorithms	03
11.	linear stochastic approximation and back propagation network	03
12.	Functional link network	02
	UNIT 5	
13.	Fuzzy System: Definition of Fuzzy sets and set operations	01
14.	Brief idea of theory of possibility	03
15.	Fuzzy Algebra, Brief idea of fuzzy statistics	02
16.	Brief idea of modeling of system under uncertain environments	02