DEPARTMENT OF APPLIED MATHEMATICS

Proposed Course Structure and Syllabus
Two Year M. Sc. (Mathematics and Computing)

First Semester				
Sl.No.	**Course No.**	**Name of the courses**	**L-T-P**	**Cr. Hrs.**
1	AMC31101	Probability & Statistics	4-0-0	8
2	AMC31102	Ordinary and Partial Differential Equations	4-1-0	9
3	AMC31103	Linear and Advanced Algebra	4-0-0	8
4	AMC31104	Digital Electronics and Computer Organization	3-1-0	7
5	AMC31105	Computer Programming	3-0-0	6
6	AMC31106	Discrete Mathematics (S)	3-0-0	6
7	AMC31201	Statistics Lab	0-0-2	2
8	AMC31204	Digital Electronics and Computer Organization Lab	0-0-2	2
9	AMC31205	Computer Programming Lab	0-0-2	2
		Total	21-2-6=29	**50**
Second Semester				
1.	AMC32101	Complex Analysis and Measure Theory	4-0-0	8
2.	AMC32102	Data Base Management Systems	3-0-0	6
3.	AMC32103	Statistical Inference	3-1-0	7
4.	AMC32104	Data Structures	3-0-0	6
5.	AMC32105	Design and Analysis of Algorithm	3-0-0	6
6	AMC32106	Computer Networks (S)	3-0-0	6
8	AMC32202	Data Base Management Systems Lab	0-0-2	2
9	AMC32203	Statistical Inference Lab	0-0-2	2
10	AMC32204	Data Structures Lab	0-0-2	2
11	AMC32205	Design and Analysis of Algorithm Lab	0-0-2	2
		Composite Viva Voce	0-0-0	4
		Total	19-1-8=28	**51**
Third Semester				
1.	AMC33101	Integral Transform and Integral Equations	3-1-0	7
2.	AMC33102	Functional Analysis	3-1-0	7
3.	AMC33103	Software Engineering	4-1-0	9
4.	AMC33104	Optimization Techniques	4-1-0	9
5		Elective-III	3-1-0	7
6.	AMC33203	Software Engineering Lab	0-0-3	3
7		Seminar on Project	0-0-0	4
		Total	17-5-3=25	**46**
		Fourth Semester		
1.	AMC34101	Operating System	3-1-0	7
2.	AMC34102	Advance Numerical Methods	3-0-0	6
3.	AMC34103	Topology	3-1-0	7

4.		Elective-IV	3-1-0	7
5.		Elective-V	3-1-0	7
6	AMC34201	Operating System Lab	0-0-3	3
7	AMC34202	Advance Numerical Methods Lab	0-0-3	3
8		Seminar on Project	0-0-0	4
9		Project/Dissertation	0-0-0	6
		Total	15-4-6=25	**50**

List of Electives:

Elective I*			
1	AME96101	Stochastic Calculus for Finance	3-1-0
2	AME96102	Combinatorics	3-1-0
3	AME96103	Symbolic Computation	3-1-0
6	AME96104	Pattern Recognition	3-1-0
5	AME96105	Computer Algebra	3-1-0
Elective II*			
1	AME97101	Theory of Compiler Design	3-1-0
2	AME97102	Advanced Algebra	3-1-0
3	AME97103	Machine Learning	3-1-0
4	AME97104	Econometrics	3-1-0
5	AME97105	Statistical Pattern Recognition	3-1-0
Elective III			
1	AME33101	Hydrodynamics	3-1-0
2	AME33102.	Mathematical Modeling	3-1-0
3	AME33103	Celestial Mechanics	3-1-0
4	AME33104	Special Functions	3-1-0
5	AME33105	Sampling Theory	3-1-0
6	AME33106	Artificial Intelligence	3-1-0
7	AME33107	Stochastic Processes	3-1-0
Elective IV			
1	AME34101	Finite Element Method: Theory and Applications	3-1-0
2	AME34102.	Theory of Linear Systems	3-1-0
3	AME34103	Internet Technology	3-1-0
4	AME34104	Data Mining	3-1-0
5	AME34105	Non-Linear Dynamics and Chaos	3-1-0
6	AME34106	Sobolev Spaces	3-1-0
7	AME34107	Time Series Analysis	3-1-0
8	AME34108	Fluid Dynamics	3-1-0
8	AME34109	Industrial Statistics	3-1-0
10	AME34110	Mechanics of Solids	3-1-0
Elective V			
1	AME34111	Computational Fluid Dynamics	3-1-0
2	AME34112	Mathematical Ecology	3-1-0
3	AME34113	Advanced Finite Element Computations	3-1-0
4	AME34114	Software Reliability	3-1-0

5	AME34115	Wavelets: Theory and Applications	3-1-0
6	AME34116	Wave Propagation and Fracture in Solids	3-1-0
7	AME34117	Operator Theory	3-1-0
8	AME34118	Design of Experiments	3-1-0
9	AME34119	Computational Geometry	3-1-0
10	AME34120	Heat and Mass Transfer	3-1-0
11	AME34121	MagnetoHydrodynamics	3-1-0

*Elective I and II are only for M.Sc Integrated (M&C) students.

Syllabus

First Semester

AMC 31101 Probability & Statistics 4-0-0

Concept of a frequency distribution. Probability: Addition, Multiplication, Baye's theorem. Moment generating and Characteristic function. Probability inequalities.
Law of large numbers. Central Limit Theorem. Discrete and Continuous Probability distributions. Chi-square, t and F. Distribution of order statistics and range. Correlation and regression. Multiple and partial correlation. plane of regression, rank correlation and intra class correlation.

AMC 31102 Ordinary and Partial Differential Equations 4-1-0

Section A: Ordinary Differential Equations
Initial value problems, Existence and Uniqueness theorem, Series solution around an ordinary point and a regular singular point, the method of Frobenius, Bessel, Legendre and Hypergeometric equations, Confluent Hypergeometric equation, Self adjoint eigen value problems, Green's functions, Second order boundary value problems, Sturm Liouville problems.

Section B: Partial Differential Equations
Fourier series, Linear and quasi linear equations, Partial Differential Equations of second order with constant and variable coefficients, Classification and reduction of second order equations to canonical form, Cauchy's, Neumann and Dirichlet's problems, Solution of Laplace and Poisson's equations in two and three dimensions by variable separable method, Solution of wave equation and unsteady heat equation in homogeneous, non-homogeneous cases.

AMC 21103 Linear and Advanced Algebra 3-1-0

Section A: Linear Algebra
Fields and linear equations, Vector spaces. Linear transformations and projections, Determinants. Elementary canonical forms and some applications, Inner product spaces, Selfadjoint, Unitary and normal operators, Orthogonal projections. Bilinear forms, Symmetric, Skew-symmetric, Positive and semi-positive forms etc.

Section B: Advanced Algebra

Structure theorem for finitely generated abelian groups, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable groups, Insolvability of S_n for $n \geq 5$, Extension fields, Finite, algebraic, and transcendental extensions, Splitting fields, Simple and normal extensions.

AMC 31104 Digital Electronics and Computer Organization 3-1-0

Basic of Boolean, Algebra and Minimization Techniques; Combinational and sequential circuits; Introduction to finite state machine concept; Basic Digital circuits, Shift Register and Flip-flops and counters; Semiconductor memories; Logic implementation on ROM, PAL, PLA and Gate Array.

Data Representation; Register, Transfer and Microoperations, Basic Computer Organization. Programming the Basic Computer. Microprogmmed Control. CPU, Instruction Cycle / Format, Addressing, Computer Arithmetic, I/O Organization, Memory Organization, Multiprocessors .

AMC 31105 Computer Programming 3-0-0

Introduction, Constants, variables and Data types, Operators and expressions, I/O operations, Control Structures; Arrays, Pointers, The preprocessors, Classes and Objects; Constructors and Destructors, Function overloading; Operator overloading and Type conversions; Inheritance; Polymorphisms, Console oriented I/O operations, File management, Templates; Exception Handling.

AMC 31106 Discrete Mathematics(S) 3-0-0

Permutation, Combination, Use of generating function as enumerator of permutation and combination, Ordering of permutations and combination, Principal of Inclusion and Exclusion. Recurrence Relations and their solutions using generating function, Language and Grammar, Relation, Partial Ordering Relations and Lattices, Introduction to Graph Theory, Introduction to Tree, Spanning Tree, Boolean Algebra, Propositional and Predicate Calculus.

AMC 31201 Statistics Lab 0-0-3

Computation of various measures of central tendency, dispersion, skewness and kurtosis, Fitting of binomial, Poisson, Normal distributions, Computation of correlation coefficient, multiple and partial correlation coefficients, rank correlation and intra-class correlation coefficients, Determination of regression lines and plane of regressions, computation of correlation coefficient for bi-variate data.

AMC 31204 Digital Electronics and Computer organization Lab 0-0-2

Verification of I/C 7400 and implementation of standard gates, Realization of Boolean expressions using only NAND gates, Binary adder, Binary subtractor, BCD adder, Binarycomparator, Cascading of MUX, Latches and Flip-flops using gates and ICs, Counters, Multivibrators using IC 555.

Laboratory design of registers, shift registers, ALU, memory sub-systems, CPU (based on the choice of word size, instruction format, datapath and control unit), Introduction to hardware description languages.

AMC 31205 Computer Programming Lab 0-0-2

Laboratory experiments will be set in consonance with the materials covered in AMC31105. It includes programming assignments for practicing and designing on different programming.

Second Semester

AMC 32101 Complex Analysis and Measure Theory 4-0-0

Section A: Complex Analysis
Functions of a complex variable, their continuity and differentiability, Analytic functions, Complex Integration, Cauchy's theorem and Cauchy's Integral formula, Morera's Theorem, Power series, Taylor's, Laurent's Theorems, Cauchy's inequality, Liouville's theorem, fundamental theorem of algebra, Identity Theorem, Maximum Modulus Principle, Schwarz's Lemma, Calculus of residues, Contour integrals, Argument principle, Rouche's Theorem, Conformal mappings.

Section B: Measure Theory
Field, σ-field, Borel field, Measure, inner and outer measure, Measurable sets and Measurable functions, Measurable and Measure space, Extension of measures, Signed measures, Jordan-Hahn Decomposition Theorem, Lebesgue measure, Lebesgue integral, Monotone Convergence theorem, Fatou's lemma, Dominated Convergence theorem, Absolute continuity, Radon Nikodin theorem, Product measures, Fubini's theorem.

AMC 32102 Data Base Management Systems 3-0-0

Database concepts ,Entity relationship model,, relational network and hierarctial data models.Relational database design, functional and multivalued dependency. Normal form, data description languages, relational algebra and calculus, SQL, query facility and query optimization. Introduction to distributed databases implementation issues. Storage media and storage structure, file and index organization. Heap file, indexed file, B+ tree file , denie index, file with variable length records. Performance and evaluation.

AMC 32103 Statistical Inference 3-0-0

Estimation: Criterions of a good estimator, related theorems and results. Uniformly minimum variance unbiased estimation, Rao-Blackwell theorem, Cramer-Rao inequality, Methods of estimation, Interval estimation. Test of hypotheses: Definition of various terms. Neyman-Pearson's lemma, likelihood ratio test. Tests for mean and variance in normal distribution (one and two population case). Tests for correlation and regression coefficients, paired t-test, chi-square test for goodness of fit, contingency tables, large sample tests through normal

approximations, test of independence. Sequential Analysis, Non-Parametric tests. Analysis of Variance: One-way and two-way classifications.

AMC 32104 Data Structures 3-0-0

Introduction to data structures, Introduction to complexity of algorithms, Linear data structures viz. Array, Stacks, Queues, Linked List, Nonlinear data structures : Trees and Graphs, 2-tree and Height balanced tree, Binary search trees, Searching Algorithms, Sorting Algorithms, Hashing and Hash functions, File organization methods.

AMC 32105 Design and Analysis of Algorithm 3-0-0

Preliminaries: Introduction to algorithms; Analyzing algorithms: space and time complexity; growth of functions; summations; recurrences; sets, etc. Greedy Algorithms: General characteristics; Graphs: minimum spanning tree; Theknapsack problem; scheduling. Divide and Conquer: Binary search; Sorting: sorting by merging, qucksort. Dynamic Programming: Elements of dynamic programming; The principle of optimality; The knapsack problem; Shortest paths; Chained matrix multiplication. Graph Algorithms: Depth-first search; Breadth-first search; Backtracking; Branch-and-bound. Polynomials and FFT: Representation of polynomials; The DFT and FFT; Efficient FFT implementation. Heuristic and Approximate Algorithms: Heuristic algorithms; approximate algorithms; NP-hard approximation problems.

AMC 32106 Computer Networks (S) 3-0-0

Introduction and layered network architecture, circuit switching, packet switching. Data link protocols, stop and wait, sliding window, HDLC, Queuing systems and other Markov systems, Delay analysis in data network. LAN protocols, CSMA/CD, token ring. FDDI, ATM analysis. Network layer-routing, Repeaters, bridges, gateways. TCP/IP. Internet protocols.

AMC 32202 Data Base Management Systems Lab 0-0-2

This will be based on the topics covered in the course AMC 32102, which emphasis on the experiments that supplement Structured Query Language (SQL), PL/SQL, Mini-projects implementation in RDBMS environment.

AMC 32203 Statistical Inference Lab 0-0-2

Computation of estimates based on various properties, computation of interval estimates. Practical based on tests of hypotheses: one population and two population cases, tests of correlation and regression coefficients, paired t-test, contingency tables, Tests of goodness of fit. Practicals based on non-parametric tests and analysis of variance.

AMC 32204 Data Structures Lab 0-0-2

Laboratory experiments will be set in consonance with the materials covered in AMC 32104. This will include problems on arrays, stacks and queues, linked lists (addition, deletion, concatenation, merge), sorting and searching, and traversal techniques of trees and graphs.

AMC32205 Design and Analysis of Algorithm Lab 0-0-2

Laboratory experiments will be set based on the materials covered in AMC 32105. It includes programming assignments for practicing and designing on different algorithm design paradigms.

Third Semester

AMC 33101 Integral Transform and Integral Equations 3-1-0

Section A: Definition of Laplace Transform, Linearity property, condition for existence of Laplace Transform; First & Second Shifting properties, Laplace Transform of derivatives and integrals; Unit step functions, Dirac delta-function. Differentiation and Integration of transforms, Convolution Theorem, Inversion. Periodic functions. Evaluation of integrals by L.T., Solution of boundary value problems. Fourier Integral formula, Fourier Transform, Fourier sine and cosine transforms. Linearity, Scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform. Convolution theorem. Application to boundary value problems.

Section B: Integral Equations: Basic concepts, Volterra integral equations, Relationship between linear differential equations and Volterra equations, Resolvent kernel, Method of successive approximations, Convolution type equations, Volterra equation of first kind, Abel's integral equation, Fredholm integral equations, Fredholm equations of the second kind, the method of Fredholm determinants, Iterated kernels, Integral equations with degenerate kernels, Eigen values and eigen functions of a Fredholm alternative, Construction of Green's function for BVP, Singular integral equations.

AMC 33102 Functional Analysis 3-1-0

Metric spaces, complete metric spaces, Banach contraction mapping theorem. Banach spaces; bounded linear functionals and bounded linear operators, dual spaces, Hahn-Banach theorem, uniform boundedness principle, open mapping and closed graph theorems., weak convergence, Hilbert spaces, orthonormal sets, Riesz representation theorem, bounded linear operators on Hilbert spaces.

AMC 33103 Software Engineering 4-1-0

The software process, computer based system engineering, project management, requirement and specification, software prototyping, software design, software reliability, software reuse, safety critical software, verification and validation, computer aided software testing, software cost estimation, quality management, process improvement, software maintenance, configuration management, software re-engineering.

AMC 33104 Optimization Techniques 3-1-0

Stochastic programming: Chance constrained programming and two-stage programming. Dynamic programming: Single stage and multi-stage programming, forward and backward process, deterministic and probabilistic dynamic programming models. Interior point methods:

Projective and scaling method for linear programming. Network Problems: Spanning Tree Algorithms, PART& CPM, Maximal flow Problem, Goal Programming: Problem formulation, Algorithms and their applications, Simulation Modelling, Monte Carlo Technique.

AMC 25202 Software Engineering Lab 0-0-3

Laboratory experiments will be set to supplement the theory taught in AMC33103, including programming and implementation for software design, testing and verification, Preparation of Test Cases etc. Working with the various CASE Tools like Caliber RM, Together Solo, Star Team etc.

Fourth Semester

AMC 34101 Operating System 4-1-0

Introduction to Operating System, Operating System Structures, Processes, Threads, Process Synchronization, CPU Scheduling, Deadlock, Memory Management, File System Implementation, I/O System.

AMC 34102 Advance Numerical Methods 4-1-0

Solution of tridiagonal system, Complex root of non-linear equation, solution of simultaneous non-linear equations, Numerical evaluation of double and triple integrals with constant and variable limits and its application, Solution of integral equations, Solution of initial-value problem by single and multistep methods, Solution of linear and non-linear boundary-value problems, Solution of Characteristics value problems, Solution of Laplace and Poisson equations in two variables by five point formula, Solution of Laplace equation in two variables by ADI method, Solution of mixed boundary value problem, Algorithm for elliptic equation in three variables, Solution of parabolic partial differential equation in two variables by explicit and implicit methods, Solution of parabolic equation in three variables by ADE and ADI methods, Solution of hyperbolic equation in two variables by explicit and implicit methods and algorithm for hyperbolic equation in three variables, Stability of finite difference schemes for parabolic and hyperbolic equations.

AMC 34103 Topology 3-1-0

Topological spaces, Weak topology, Subspace topology, Product and quotient spaces, Contiuous maps and homeomorphism, Connectedness, Paths, Equivalence classes of paths. Path connected spaces, Separation axioms Compact and locally compact spaces.

AMC 34201 Operating System Lab 0-0-3

It includes experiments that supplement the theory taught in AMC34101.

AMC 34202 Advance Numerical Methods Lab 0-0-3

This will be based on the topics covered in the course AMC34102, which emphasis to write the programs for Numerical Techniques.

Syllabus of Elective Papers

Elective I

AME96101 Stochastic Calculus for Finance 3-1-0

Stochastic processes, filtrations, conditional expectations, martingales and stopping times, Brownian motion and its properties; Ita-integral and its extension to wider classes of integrands, isometry and martingale properties of the integral; Ita-calculus, Ita-formula and its application in calculating stochastic integrals; Stochastic differential equations, existence and uniqueness of solutions; Risk-neutral measure, Girsanov's theorem for change of measure, martingale representation theorems, representation of Brownian martingales, Feynman-Kac formula; Stock prices as geometric Brownian motions, Black-Scholes option pricing, delta hedging, derivation of the Black-Scholes differential equation, the Black-Scholes formula and simple extensions of the model; Application of Girsanov's theorem to Black-Scholes dynamics, self-financing strategies and model completeness, risk neutral measures, the fundamental theorem of asset pricing; The Black-Scholes model, the Black-Scholes option pricing formula and the market price of risk. Continuous time optimal stopping and pricing of American options.

AME96102 Combinatorics 3-1-0

Counting principles, multinomial theorem, set partitions and Striling numbers of the second kind, permutations and Stirling numbers of the first kind, number partitions, Lattice paths, Gaussian coefficients, Aztec diamonds, formal series, infinite sums and products, infinite matrices, inversion of sequences, probability generating functions, generating functions, evaluating sums, the exponential formula, more on number partitions and infinite products, Ramanujan's formula, hypergeometric sums, summation by elimination, infinite sums and closed forms, recurrence for hypergeometric sums, hypergeometric series, Sieve methods, inclusion-exclusion, Mobius inversion, involution principle, Gessel-Viennot lemma, Tutte matrix-tree theorem, enumeration and patterns, Polya-Redfield theorem, cycle index, symmetries on N and R, polyominoes

AME96103 Symbolic Computation 3-1-0

Introduction - Elimination methods for solving system of nonlinear equations - Symbolic techniques in modelling and simulation - Symbolic and parallel adaptive methods for partial differential equations - Symbolic reduction of polynomial systems - Computation of rational function approximation.

AME96104 Pattern Recognition 3-1-0

Introduction, Overview of different approaches, Decision boundaries, Discriminant functions (linear and non-linear), Baysian classification, Training and test sets, Parametric and nonparametric learning, Minimum distance classifiers, k-NN rule, Unsupervised learning, Basic hierarchical andnon-hierarchical clustering algorithms, Dimensionality reduction, Similarity measures, Feature selection criteria and algorithms, Principal component analysis, Some applications.

AME96105 Computer Algebra 3-1-0

Algebraic numbers, Primes and factoring, Trapdoors and public key, Pseudo-random numbers. The finite Fourier transforms. The fast Fourier transform., Polynomial rings in several variables, Complexity with respect to multiplication, Shift registers and coding, Finite Boolean algebras, Equivalence classes of switching functions, Monoids and automata.

Elective II

AME97101 Theory of Compiler Design 3-1-0

Compiler structure, Lexical and syntax analysis, Data structures organization, symbol table management, intermediate code forms, static and dynamic memory allocation, code generation for arithmetic expressions and control structures, subroutine calls and parameter transmission, code optimization.

AME97102 Advanced Algebra 3-1-0

Structure theorem for finitely generated abelian groups, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable groups, Insolvability of S_n for $n \geq 5$, Extension fields, Finite, algebraic, and transcendental extensions, Splitting fields, Simple and normal extensions, Perfect fields, Primitive elements, Algebraically closed fields., Automorphisms of extensions, Galois extensions, Fundamental theorem of Galois theory, Galois group over the rationals.

AME97103 Machine Learning 3-1-0

Introduction, Linear models, Non-linear models, decision trees, instance-based learning, boosting, neural networks, Support vector machines and kernels, Computational learning theory, Experimental methodology, sources of error, Structured models, graphical models, deep belief networks, Unsupervised learning, K-means, expectation maximization, PCA and other dimensionality reduction methods Hidden Markov Models, history-based representations, predictive models, Reinforcement learning.

AME97104 Econometrics 3-1-0

Nature of econometrics. The general linear model (GLM) and its extensions. Ordinary least squares (OLS) estimation and prediction. Use of dummy variables and seasonal adjustment. Generalized least squares (GLS) estimation and prediction. Heteroscedastic disturbances. Pure and mixed estimation. Grouping of observations and of equations. Auto correlation, its consequences and tests. Theil BLUS procedure. Estimation and prediction. Multicollinearity problem, its implications and tools for handling the problem. Ridge regression. Linear regression with stochastic regressors. Instrumental variable estimation. Errors in variables. Autoregressive linear regression. Distributed lag models. Use of principal components, canonical correlations and discriminant analyses in econometrics. Simultaneous linear equations model. Examples. Identification problem. Restrictions on structural parameters - rank and order conditions. Restrictions on variances and covariances. Estimation in simultaneous equations model. Recursive systems. 2 SLS Estimators. Limited information estimators, k-class estimators. 3 SLS estimation. Full information maximum likelihood method. Prediction and simultaneous confidence intervals. Monte Carlo studies and simulation.

AME97105 Statistical Pattern Recognition 3-1-0

Linear classifiers: linear discriminant function (LDF) for minimum squared error, LDF for binary outputs, perception learning algorithm. Nearest neighbour decision rules: description, convergence, finite sample considerations, use of branch and bound methods. Probability of errors: two classes, normal distributions, equal covariance matrix assumptions, Chernoff bounds and Bhattacharya distance, estimation of probability of error. Feature selection and extraction: interclass distance measures, discriminant analysis, probabilistic distance measures, principal components.

Elective III

AME33101 Hydrodynamics 3-1-0

Kinematics-Lagrangian and Eulerian methods, Equation of continuity, Boundary surfaces, Stream lines, Path lines and streak lines, Velocity potential, Irrotational and rotational motion, Vortex lines.

Equations of motion- Lagrange's and Euler's equations of motion, Bernoulli's theorem, Equation of motion by flux method, Equations referred to moving axes, Impulsive actions, Stream function, Irrotational motion in two-dimensions, Complex potential, Sources, sinks, doublets and their images.

Two-dimensional irrotational motion produced by motion of circular and co-axial cylinders in an infinite mass of liquid, Kinetic energy of liquid, Theorem of Blasius, Motion of a sphere through a liquid at rest at infinity, Liquid streaming past a fixed sphere, Equation of motion of a sphere, Stoke's stream function.

AME33102 Mathematical Modeling 3-1-0

Deterministic and stochastic models, tools, techniques, modeling approaches, Models of single and interacting populations, prey-predator, competition, chemostate, AIDS/HIV/ SARS, Epidemic and genetic models, Models for traffic flow, computer data communications, Stock Market, spatio-temporal pattern.

AME33103 Celestial Mechanics 3-1-0

The Two Body Problem: Formulation of the two body problem. Integrals of area, angular momentum and energy. Equation of the relative orbit and its solution. Kepler's equation and its solution. Heliocentric and geocentric co-ordinates, computation of ephemeris. Parabolic and hyperbolic orbits. f and g series. Orbit computation by Laplace and Gauss methods. The Three Body problem: Lagrange's solution for the motion of three bodies. Restricted three body problem . Surfaces of zero relative velocity. Double points. Stability of straight line and equilateral triangle solutions. Tisserand's Criterion for identification of comets: N - Body problem: The ten integrals of motion of the n-body problem. Transfer of origin to one of the particles. The perturbing function. Virial theorem. Numerical integration by Cowell's and Encke's methods.

Elements of Space Dynamics: Motion of a rocket, Step rockets, Minimum energy orbits, Transfer orbits, Parking orbits, Perturbations of artificial satellites due to atmospheric drag and flattening of theearth.

AME33104 Special Functions 3-1-0

Whittaker equation and its solution, Properties of Whittaker functions, Modified Bessel and Associated Legendre functions and their properties, Hermite, Lagurre and Chebyshev polynomials and their properties, Definition of Bessel, Legendre, Hermite Lagurre and Whittaker functions from Hypergeometric function, Asymptotic Expansions of Bessel, Modified Bessel, Legendre and Whittaker functions.

AME33105 Sampling Theory 3-1-0

Finite population sampling: Basic principles of sample surveys, simple random sampling with and without replacement, probability proportional to size sampling, Hurwitz-Thompson estimator, ordered and unordered estimates, stratified random sampling, allocation problems, post-stratification, ratio, regression and product method of estimation, double sampling, cluster sampling, two-stage sampling and systematic sampling. Non-sampling errors, non-response

problems, Warner's randomized response technique for sensitive characteristics, measurement errors in sample surveys.

AME33106 Artificial Intelligence 3-1-0

Problem solving, search techniques, control strategies, game playing (minimax), reasoning, knowledge representation through predicate logic, rule-based systems, semantic nets, frames, conceptual dependency formalism; Planning. Handling uncertainty: Bayesian Networks, Dempster-Shafer theory, certainty factors, Fuzzy logic; Learning through Neural nets -- Back propagation, radial basis functions, Neural computational models - Hopfield Nets, Bolzman machines. PROLOG programming, Applications of Artificial Intelligence.

AME33107 Stochastic Processes 3-1-0

Definition and classification of general stochastic processes. Markov Chains: definition, transition probability matrices, classification of states, limiting properties. Markov Chains with Discrete State Space: Poisson process, birth and death processes. Renewal Process: renewal equation, mean renewal time, stopping time. Markov Process with Continuous State Space: Introduction to Brownian motion, Congestion Process: Queuing Process, M/M/1 Queue.

Elective IV

AME34101 Finite Element Method: Theory and Applications 3-1-0

Variational principles, Euler's equation, Approximations by piece-wise polynomial, Basis function, line element and quadratic elements, natural co-ordinate system of projective geometry and shape function, virtual work, principle of virtual displacement, isoparametric elements, Linear strain triangle, Rayleigh-Ritz method, Galerkin methods and projection methods, triangular elements, element strains and stress, three dimensional tetrahedral element, shape function, stiffness matrix, Boundary value problems, fluid mechanics, heat flow and wave propagation.

AME34102 Theory of Linear Systems 3-1-0

Review of Linear algebra, matrices, decompositions, Fourier transfroms, DFT (time and space) shift invarient, translation invarient, time invarient, convolution, sinsoids, Gabor functions etc. Sinusoids as eigenfunctions of LSI systems, shifting peroperty, convolution,loas pass, band pass filters etc., applications to digital signal and image processing and MATLAB tool applications.

AME34103 Internet Technology 3-1-0

Introduction to Internet: Internet Architecture, Evolution and Internet Network Architecture, OSI Reference Model, TCP/IP; Internet Protocols: Introduction to IPv4 and IPv6, Need of Internet Protocols, Addressing Scheme, Subnet Masking, ICMP

Transport Layer Protocol: TCP, UDP; Internet Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, RARP, BOOTP, DHCP, DNS; Mail Server & E-mail Protocol: SMTP, MIME, POP; Client-Server Approach: Client-Server Models; Voice & Multimedia over IP: Introduction to Real-Time Traffic, VoIP. Mobile IP: Introduction and Need of MIP, Agent Discovery, Registration, Data Transfer, Inefficiency in MIP; HTML Web Tools: Introduction to HTTP, HTTP Transaction, HTTP Request and Response Message, Introduction to WWW, Browser Architecture, HTML Page Creation (Static and Dynamic); JAVA Programming: Introduction to JAVA, Features of JAVA, Difference between Application and Applets, Creation and Compilation of Application and Applets.

AME34104 **Data Mining** **3-1-0**

Introduction : Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective. Data Mining Techniques : A Statistical Perspective on Data Mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms. Classification : Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques. Clustering : Similarity and Distance Measures, Hierarchical Algorithms, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes. Association Rules : Basic Algorithms, Parallel and Distributed Algorithms, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules. Advanced Techniques : Web Mining, Spatial Mining, Temporal Mining.

AME34105 **Non-Linear Dynamics and Chaos** **3-1-0**

Dynamical systems- Central manifold and Normal form, attractors, SIC, 1D map, Logistic map, Poincare' maps, generalized Baker's map, circle map. Bifurcations- Saddle-node, Transcritical, pitchfork, Hopf-bifurcation, Global bifurcations, Melnikov's method for homoclinic orbits. Strange attractors & fractals dimentions. Henon map and Rossler system, Box-counting, pointwise and correlation, hausdorff dimensions. Lyapunov exponent, Horseshoe map and symbolic dynamics, chaotic transitions, intermittency, crisis, quasiperiodicity, controlling & synchronization of chaos.

AME34106 **Sobolev Spaces** **3-1-0**

Distributions–Test function spaces and distributions, convergence distributional derivatives.

Fourier Transform–L^1-Fourier transform. Fourier transform of a Gaussian, L^2-Fourier transform, Inversion formula. L^p –Fourier transform, Convolutions.

Sobolev Spaces–The spaces $W^{l,p}_{\infty}(\Omega)$ and $W^{l,p}(\Omega)$. Their simple characteristic properties, density results. Min and Max of $W^{l,p}$–functions. The space $H^1(\Omega)$ and its properties, density results.

Imbedding Theorems–Continuous and compact imbeddings of Sobolev spaces into Lebesgue spaces. Sobolev Imbedding Theorem. Rellich–Kondrasov Theorem.

Other Sobolev Spaces–Dual Spaces, Fractional Order Sobolev spaces, Trace spaces and trace theory.

Weight Functions-Definition, motivation, examples of practical importance. Special weights of power type. General Weights.

Weighted Spaces–Weighted Lebesgue space $P(\Omega,\sigma)$ weighted Sobolev spaces $W^{k,p}(\Omega,\sigma)$, $Wo^{k,p}(\Omega,\sigma)$, and their properties.

Domains–Methods of local coordinates, the classes C^o, $C^{o,k}$, Holder's condition, Partition of unity, the class $K(x_o)$ including Coneproperty.

Inequalities–Hardy inequality, Jensen's inequality, Young's inequality, Hardy–Littlewood-Sobolev inequality, Sobolev inequality and its various versions.

AME34107 **Time Series Analysis** **3-1-0**

Discrete parameter stochastic processes, strong and weak stationary, autocovariance and autocorrelation. Moving average, autoregressive, autoregressive moving average and

autoregressive integrated moving average processes. Box-Jenkins models. Estimation of the parameters in ARIMA models, forecasting. Periodogram and correlogram analysis

AME34108 Fluid Dynamics 3-1-0

Equations of motion for viscous fluid, similarity of flows, Reynolds number, Flow between parallel flat plates, steady flow in pipes, Flow between two concentric cylinders, Application of parallel flow theory, Unsteady flow over a flat plate, Boundary layer concept, Boundary layer equations in two-dimensional flow, Boundary layer flow along the flat plates: Blasius solution, Shearing stress and Boundary layer thickness, Boundary layer on a surface with pressure gradient, Momentum integral theorems for Boundary layer, The Von Karman integral relation, Application of Momentum integral equation to Boundary layers: Von Karman-Pohlhansen method, Separation of boundary layer flow, Boundary layer control, Methods of Boundary layer control, Introduction to turbulent flow: Origin of turbulence, Reynold's modification of Navier-Stoke's equations for turbulent flow, Semi-emperical theory of turbulence.

AME34109 Industrial Statistics 3-1-0

Control charts for variables and attributes, acceptance sampling by attributes, single, double and sequential sampling plans, OC and ASN functions, AOQL and ATI, acceptance sampling by variables, tolerance limits.

Reliability analysis: Hazard function, distribution with DFR and IFR, series and parallel systems, life testing experiments.

AME34110 Mechanics of Solids 3-1-0

Analysis of stress, principal stresses, principal plances, maximum shearing stresses, Mohr's circle diagram, equations of deformation and strain, strain in form of displacement, compatibility concept, need and physical significance, stress-strain relation, Generalized Hook's Law, different types of symmetry, density function, Airy's stress function, wave propagation in unbounded elastic medium

Elective V

AME34111 Computational Fluid Dynamics 3-1-0

Governing equation of Fluid Dynamics, conservation form, simple CFD techniques, Lax-Wendroff technique, Mac Cormack's techniques, finite volume method, application to Euler equations, upwind difference scheme, viscous flow solutions, staggered grid, SIMPLE Algorithm, SOLA Algorithm, boundary element method and application to potential flows.

AME34112 Mathematical Ecology 3-1-0

Single species models, Exponential, logistic, Gompertz growth, Harvest model, Discrete-time and Delay model, Interacting population model, chemostate, prey-predator, competition & mutualism models, Dynamics of exploited populations, spatially structured models, Age-structured models, sex-structured models, models of spread, two sex models, Leslie matrix.

AME34113 Advanced Finite Element Computations 3-1-0

Taylor – Galerkin, Streamline Upwind FEM, error analysis, SOR techniques for tridiagonal matrices, Meshless techniques, element by element computations, Extended FEM etc.

AME34114 Software Reliability 3-1-0

Basic Concept of Software Engineering, Software Reliability Modeling, Markovian Models, Description of Specific Models, Parameter Estimation, Comparison of Software Reliability Models, Calendar Time Modeling, Failure Adjustment for Evolving Programs, Fault Seeding Model, Nelson's Model

AME34115 Wavelets: Theory and Applications 3-1-0

Fourier Analysis: Fourier and inverse Fourier transforms, Convolution and delta function, Fourier transform of Square integrable functions, Fourier series, Basic Convergence Theory and Poisson's Summation formula.

Wavelet Transforms and Time Frequency Analysis: The Gabor Transform. Short-time Fourier transforms and the uncertainity principle. The integral wavelet transforms Dyadic wavelets and inversions, Frames, Wavelet Series.

Scaling Functions and Wavelets: Multi resolution analysis, scaling functions with finite two scale relations. Direct sum decomposition of $L^2(R)$, Linear phase filtering Compactly supported wavelets, Wavelets and their duals, Orthogonal Wavelets and Wavelet packets, Example of orthogonal Wavelets. Identification of orthogonal two-scale symbols, Construction of Compactly supported orthogonal wavelets, Orthogonal wavelet packets, orthogonal decomposition of wavelet series.

AME34116 Wave Propagation and Fracture in Solids 3-1-0

Section A: ***Wave Propagation***

Study of propagation of waves in elastic, visco-elastic and poro elastic medium, Waves in anisotropic medium, thermo elastic medium, study of surface waves (Raleigh & Love waves) in Elastic and visco-elastic medium including layered medium reflection and refraction of waves in isotropic elastic medium

Section B: Fracture of Solids

Fracture theories (ductile and brittle materials), Von-Misses, Tresca and Griffith fracture criterion, Initiation and Propagation of elastic plastic come, creep and relaxation

AME34117 Operator Theory 3-1-0

Spectral Theory of Linear Operators in Normed Spaces, Spectral Theory in Finite Dimensional Normed Spaces, Basic Concepts, Spectral properties of Bounded Linear Operators, Further Properties of Resolvant and Spectrum, Use of Complex Analysis in Spectral Theory. Banach Algebras, Further properties of Banach Algebra. Gelfard - Naimark theorem.

AME34118 Design of Experiments 3-1-0

Design of experiments: Analysis of variance two-way classified data with m observations per cell, Basic principles of design of experiments, completely randomized design (CRD), randomized block design (RBD) and latin square design (LSD). Estimation of missing observations in RBD and LSD, incomplete block design and balanced incomplete block design (BIBD). Factorial experiments: 2^2, 2^3, 3^2 and 3^3 factorial experiments. Confounding in factorial experiments, Split-plot and simple lattice designs

AME34119 Computational Geometry 3-1-0

Introduction: Historical perspective, Towards Computational Geometry, Data Structures, Geometric Preliminaries. Convex Hulls: Problem statement and lower bounds, Graham's scan, Jarvis's march, Quick hull technique, Divide-and-conquer algorithm, Dynamic convex hull algorithm, Extension and Applications. Point Searching: Point location problems, Location of a point in a planar subdivision, The slab method. Proximity: A collection of problems, Locus

Approach, Voronoi diagram and its construction, Delaunay triangulations, Proximity problems solved by Voronoi diagram. Orthogonal Range Searching: 1-dimensional range searching, Kd-trees, Range trees, Higher-dimensional range trees. Window Searching: Interval Trees, Priority search trees, Segment trees. Polygon Triangulations: Art Gallery Problem, Guarding and triangulations, Triangulating a monotone polygon. Some Applications in VLSI / robotics etc. Sweep Techniques: Trapezoidalization, Intersection of segments, Union of rectangles.

AME34120 Heat and Mass Transfer 3-1-0

Convective Diffusion Transfer: Differential Transfer equations, Thermodynamics of Transfer Processes, Multicomponent Mixtures, Derivation of Transfer Equations from the Kinetic Theory of Gases, Transfer Equation for Asymmetric Fluids, Heat Conduction: Differential Equation of heat Conduction, Heat Consumption Calculation Methods, Methods of Solving Heat-conduction Problems, Steady-State Temperature Field, Solution of Steady-state Problems, One-Dimensional Unsteady-State Field (Plate, Sphere, Cylinder), Convective Heat transfer: Heat and Mass Transfer in a Flow Plate, Heat and Mass Transfer in Pipe Flows, Free Convection, Thermo convective Waves. Conjugate Heat-Transfer Problems, unsteady-State Heat Transfer with Laminar Flow of Incompressible Fluid in Plane and Circular Tubes.

AME34121 MagnetoHydrodynamics 3-1-0

Basic concepts of Magneto-hydrodynamics, Lorentz force, Frame of reference, Electromagnetic Body force, Fundamental equations of MHD, Derivation of magnetic induction equation, Ohm's law for a moving conductor, Hall and Conduction currents, Kinematic aspects of MHD. Electromagnetic Radiation. Magnetic Pressure, Pointing vector, Alfven's theorem, Alfven's wave, Magnetic energy, Dissipative effect, Plane polarized waves, MHD waves in compressible fluid, Electromagnetic boundary conditions, One-dimensional flows: MHD channel Flows, MHD Stokes flow, MHD Rayleigh's Flow, MHD Flow in Rotating Medium, MHD Heat Transfer.