

**DEPARTMENT OF APPLIED MATHEMATICS**

**Course structures and Syllabus  
Five years integrated M. Sc. (Mathematics and Computing)  
(As per BOCS meeting held on 29<sup>th</sup> Feb., 2008)**

**First and Second semesters courses are common with other B. Tech. courses**

<b>CORE COURSE STRUCTURE FOR I &amp; II SEMESTER</b>					
<b>Sl.No.</b>	<b>Course No.</b>	<b>Course Offering Department</b>	<b>Name of the courses</b>	<b>L-T-P</b>	<b>Total Cr. Hrs</b>
1.	AMC-11101	AM	Mathematics–I (Only for 1 <sup>st</sup> Semester)	3 – 1 – 0	7
2.	AMC-12101	AM	Mathematics–II (Only for 2 <sup>nd</sup> Semester)	3 – 1 – 0	7
3.	AP /AC	AP /AC	Physics/ Chemistry	3 – 1 – 0	7
4.	ME / MME	ME / MME	Engineering Graphics/Manufacturing Processes	1 – 3 – 0	5
5.	EE / EAI	EE / EAI	Electrical Technology / Electronics Engineering	3 – 1 – 0	7
6.	MEMME / HSS	MEMME / HSS	Engineering Mechanics /English for Science and Technology	3 – 1 – 0	7
7.	AGL & CME/ FME & CME	AGL & CME/ FME & CME	Earth System Science (S) / Global Energy Scenario & Energy Security of India (S)	3 – 0 – 0	6
8.	HSS / CSE	HSS / CSE	Value Education, Human Right and Legislative Procedure (S) / Computer Programming (S)	3 – 0 – 0	6
9.			*Practical		
10.	AP /AC	AP /AC	Physics/ Chemistry	0 – 0 – 3/2	1.5
11.	EE / EAI	EE / EAI	Electrical Technology / Electronics Engineering	0 – 0 – 3/2	1.5
12.	DSW	DSW	Counseling, Special Classes (Only for 1 <sup>st</sup> Semester)	0 – 0 – 0	(3)
13	DSW	DSW	Co-Curricular Activities (Only for Second semester)	0 - 0 - 0	(3)
			Total	19 – 7 - 3	48+(3)

<b>Third semester</b>				
<b>Sl.No.</b>	<b>Course No.</b>	<b>Name of the courses</b>	<b>L-T-P</b>	<b>Total Cr. Hrs</b>
1.	AMC 31104	Probability & Statistics	4-0-0	8
2.	AMC 31105	Discrete Mathematics	3-0-0	6
3.	APC 93103	Waves and Oscillation	4-0-0	8
4.	EICP 13101	Digital Electronics	3-0-0	6
5.	CSC 13102	Data Structures	3-1-0	7
6.	HSE 13102	HSS (Optional) (S)	3-0-0	6
7.	AMC 31204	Probability & Statistics Lab.	0-0-2/2	1
8.	CSC 13202	Data Structure Lab	0-0-3	3
9.	APC 93201	Physics – III Lab	0-0-3	3
		Total	20-1-7=28	48
<b>Fourth Semester</b>				
1.	AMC 32102	Object Oriented Programming	3-0-0	6
2.	AMC 32104	Statistical Inference	4-0-0	8
3.	HSC 14306	HSS Paper: English for Professional Communication (S)	3-0-0	6
4.	CSC 14101	Computer Organization	3-1-0	7
5.	CSC 14102	Algorithm Design and Analysis	3-1-0	7
6.	MSCP14151	Managerial Economics	3-0-0	6
7.	AMC 32202	Object Oriented Programming Lab.	0-0-2	2
8.	AMC 32204	Statistical Inference Lab	0-0-2/2	1
9.	CSC 14201	Computer Organization Lab	0-0-3	3
10.	CSC 14202	Algorithm Design and Analysis Lab	0-0-3	3
11.	AMC 94501	Composite Viva-voce	0-0-0	4
12.	SWC 94701	CCA	0-0-0	0
		Total	19-2-9=30	53
<b>Fifth Semester</b>				
1.	AMC 95101	Algebra-I	3-1-0	7
2.	AMC 33102	Linear Algebra	3-1-0	7
3.	AMC 95102	Dynamics of a Particle (S)	3-1-0	7
4.	AMC 33103	Integral Transforms and Integral Equations	4-0-0	8
5.	CSC 15102	Operating Systems	3-1-0	7
6.	CSC 15105	Software Engineering	3-1-0	7
7.	CSC 15202	Operating Systems Lab	0-0-3	3
8.	CSC 15205	Software Engineering Lab	0-0-3	3
		Total	19-5-6=30	49

<b>Sixth Semester</b>				
1.	CSC16101	Data Base Management Systems	3-1-0	7
2.	CSC 16102	Computer Networks	3-1-0	7
3.	AMC 96101	Theory of Computation	3-1-0	7
4.	AMC 96102	Real Analysis	3-0-0	6
5.	AMC 96103	Optimization Techniques	3-1-0	7
6.	CSC 16201	Data Base Management Systems Lab	0-0-3	3
7.	CSC 16202	Computer Networks Lab	0-0-3	3
8.	AMC 96502	Composite Viva-voce	0-0-0	4
9.	SWC 96702	CCA	0-0-0	0
		Total	15-4-6=25	44
<b>Seventh Semester</b>				
1.	AMC 97101	Complex Analysis	3-1-0	7
2.	AMC 97102	Number Theory (S)	3-1-0	7
3.	AMC 31103	Ordinary and Partial Differential Equations	4-1-0	9
4.	AMC 33104	Topology	3-1-0	7
5.	CSE	(CSE) Elective - I	3-1-0	7
6.	CSE	(CSE) Elective - II	3-1-0	7
7.	AMC 95602	Industrial/Vocational Training	0-0-0	5
		Total	19-6-0=25	49
<b>Eighth Semester</b>				
1.	AMC 34102	Mathematical Modeling and Calculus of Variations	4-0-0	8
2.	AMC 98101	Measure Theory and Integration(S)	3-1-0	7
3.	AMC 98102	Dynamics of a Rigid Body	3-1-0	7
4.	AMC 98103	Numerical Methods	4-0-0	8
5.	CSC 16104	Language Processor	3-1-0	7
6.	CSE	(CSE) Elective-III	3-1-0	7
7.	CSC 16204	Language Processor Lab	0-0-3	3
8.	AMC 98507	Composite Viva-Voce	0-0-0	4
9.	SWC 98703	CCA	0-0-0	0
10.	AMC 96603	Industrial Visit/Excursion	0-0-0	5
		Total	20-4-3=27	56
<b>Ninth Semester</b>				
1.	AMC 99101	Stochastic Processes	3-1-0	7
2.	AMC 99102	Mathematical Logic	3-1-0	7
3.	CSC 17101	Cryptography & Network Security	3-1-0	7
4.	AME	(Maths)Elective-I	3-1-0	7
5.	AME	(Maths)Elective-II	3-1-0	7
6.	AMC99801	Project	0-0-0(6)	6
7.	AMC 99401	Seminar-1	0-0-0	4
		Total	15-5-6=26	45

<b>Tenth Semester</b>				
1.	AMC34101	Functional Analysis	3-0-0	6
2.	AMC 90102	Applied Graph Theory	3-1-0	7
3	CSC 16103	Computer Graphics	3-1-0	7
4.	AME	(Maths)Elective-III	3-1-0	7
5.	AME	(Maths)Elective-IV	3-1-0	7
6.	AMC 90802	Project	0-0-0(6)	6
7.	AMC 90402	Seminar –II	0-0-0	4
8.	AMC 90504	Viva-voce on Project	0-0-0	4
9	SWC 90704	CCA	0-0-0	0
		Total	15-4-6=25	48

### **Elective (Mathematics)**

#### **Elective-I**

1. AME 33101 Mechanics of Solids
2. AME 33102 Sampling Theory
3. AME 33103 Time Series Analysis
4. AME 33104 Wavelets
5. AME 33105 Differential Geometry

#### **Elective-II**

1. AME 33106 Fluid Dynamics
2. AME 33107 Mathematical Ecology
3. AME 33108 Special Functions
4. AME 33109 Advanced Optimization Techniques
5. AME 90101 Algebra-II

#### **Elective-III**

1. AME 34101 Finite Element Methods
2. AME 34102 Computational Fluid Dynamics
3. AME 34103 Advanced Fluid Dynamics
4. AME 34104 Industrial Statistics
5. AME 34105 Wave Propagation & Fracture in Solids
6. AME 34106 Software Reliability
7. AME 34107 Data Mining: Concepts, Techniques & Applications
8. AME 34108 Operator Theory
9. AGE Geo Statistics

#### **Elective-IV**

1. AME 34109 Magneto Hydrodynamics
2. AME 34110 Non-linear Dynamical Systems and Chaos
3. AME 34111 Design of Experiment
4. AME 34112 Heat & Mass Transfer
5. AME 34113 Analytical Mechanics
6. AME 34114 Fuzzy Set Theory & Application

## **Elective(Computer Science & Engg)**

### **Elective-I & II**

1. CSE 17101 Image Processing
2. CSE 17102 Advanced Algorithms
3. CSE 17103 Functional & Logic Programming
4. CSE 17104 Object Oriented Data Modeling
5. CSE 17106 Multimedia Systems
6. CSE 17107 Pattern Recognition
7. CSE 17108 Advanced Compilers
8. CSE 17109 Data Mining
9. CSE 17110 Computational Geometry
10. CSC 17102 Parallel & Distributed Computing

### **Elective III**

1. CSE 18101 Artificial Intelligence
2. CSE 18102 Soft Computing
3. CSE 18103 Computational Biology
4. CSE 18105 Computational Number Theory
5. CSE 18108 Computer Vision
6. CSE 18109 Internet Technology

**Course Details of 5 Years Integrated M. Sc. (Mathematics & Computing)**

**Detail Syllabus of First and Second Semester**

**AMC 11101**

**Mathematics I**

**[3–1–0]**

**Calculus-I:** Successive differentiation of one variable and Leibnitz theorem, Taylor's and Maclaurin's expansion of functions of single variable, Functions of several variables, partial derivatives, Euler's theorem, derivatives of composite and implicit functions, total derivatives, Jacobian's, Taylor's and Maclaurin's expansion of functions of several variables, Maxima and minima of functions of several variables, Lagrange's method of undetermined multipliers, Curvature and asymptotes, concavity, convexity and point of inflection, Curve tracing.

**Calculus-II:** Improper integrals, convergence of improper integrals, test of convergence, Beta and Gamma functions and its properties, Differentiation under integral sign, differentiation of integrals with constant and variable limits, Leibnitz rule.

Evaluation of double integrals, Change of order of integrations, change of coordinates, evaluation of area using double integrals, Evaluation of triple integrals, change of coordinates, evaluation of volumes of solids and curved surfaces using double and triple integrals. Mass, center of gravity, moment of inertia and product of inertia of two and three-dimensional bodies and principal axes.

**Trigonometry of Complex Number, 3D Geometry and Algebra:** Function of complex arguments, Hyperbolic functions and summation of trigonometrical series.

**3D Geometry:** Cones, cylinders and conicoids, Central conicoids, normals and conjugate diameters.

**Algebra:** Convergency and divergency of Infinite series. Comparison test, D' Alembert's Ratio test, Raabe's test, logarithmic test, Cauchy's root test, Alternating series, Leibnitz test, absolute and conditional convergence, power series, uniform convergence.

**AMC 12101**

**Mathematics II**

**[3–1–0]**

**Vector Calculus and Fourier Series:**

**Vector Calculus:** Scalar and vector fields, Level surfaces, differentiation of vectors, Directional derivatives, gradient, divergence and curl and their physical meaning, vector operators and expansion formulae, Line, surface and volume integrations, Theorems of Green, Stokes and Gauss, Application of vector calculus in engineering problems, orthogonal curvilinear coordinates, expressions of gradient, divergence and curl in curvilinear coordinates.

**Fourier Series:** Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier series, Parseval's formula, complex form of Fourier series.

**Matrix Theory:** Orthogonal, Hermitian, skew- Hermitian and unitary matrices, Elementary row and column transformations, rank and consistency conditions and solution of simultaneous equations, linear dependence and consistency conditions and solution of simultaneous equations, linear dependence and independence of vectors, Linear and orthogonal transformations, Eigen values and Eigen vectors, properties of Eigen values, Cayley-Hamilton theorem, reduction to normal forms, quadratic forms, reduction of quadratic forms to canonical forms, index, signature, Matrix calculus & its applications in solving differential equations.

**Differential Equations:** Differential Equations of first order and higher degree, Linear independence and dependence of functions. Higher order differential equations with constant coefficient, Rules of finding C.F. and P.I., Method of variation of parameter Cauchy and Legendre's linear equations, Simultaneous linear equations with constant coefficients, Linear differential equations of second order with variable coefficients; Removal of first derivative (Normal form), Change of independent variable, Applications of higher order differential equations in solution of engineering problems.

**Partial Differential equations:** Formation of P.D.E, Equations solvable by direct integration, Linear and non-linear equations of first order, Lagrange's equations, and Charpit's method, Homogeneous and non-homogeneous linear P.D.E. with constant coefficients, Rules for finding C.F. & P.I.

**AP**

**Physics**

**[3-1-0]**

**Thermal Physics:**

Concepts of distribution of molecular velocities, Distribution laws and statistics MB, FD and BE, mean free path; Transport phenomena-viscosity, diffusion; thermal conductivity, measurement of thermal conductivity; periodic and a periodic flow of heat; Wiedemann-Franz law.

Heat radiation, black body and black body radiation, Planck's distribution law and its application to classical distribution (Rayleigh-Jeans and Wiens) and total radiation (Stefan-Boltzmann) laws.

**Modern Physics:**

Brief idea of molecular spectra, Rigid rotator, spectra of simple molecules, rotation and rotation-vibration spectra, Brief idea of wave packet and wave function, Shrodinger equation, Particle in a Box, Free electron theory; qualitative idea of band theory of solids and Hall effect, Laser and laser systems (He-Ne and Ruby Lasers).

**Electromagnetics and Electrical Phenomena in Rocks:**

Maxwell's field equation, Equation of electromagnetic field, Propagation of electromagnetic waves in different isotropic media, energy of electromagnetic waves, Poynting's theorem & Poynting's vector, Rocks and minerals as dielectrics, electrical conductivity and electrical phenomena in rocks, Piezo-, ferro-, tribo-, and pyro-electricity.

**AC**

**Chemistry**

**[3–1–0]**

**Cement:** Manufacturing, composition, setting and hardening of cement.

**Glass:** Types of Glasses, Manufacturing & properties of Glasses.

**Polymers:** Classification, structure – property relationship, conductive polymers.

**Solid Fuels:** Structure of coal, classification of coal, Effect of heat on coal, carbonization and pyrolysis. Recovery and purification of by-products obtained from coke ovens; Distillation of coal tar; coal chemicals.

**Liquid Fuels:** Composition of crude oil, processing of crude oil, distillation, sweetening and cracking (basic concepts), octane number, Cetane number, Additives to improve the quality of diesel and petrol, bio-diesel.

**Gaseous Fuels:** Characteristics of good fuel; calorific value, theoretical calculations of calorific value of a fuel, natural gas and hydrogen gas.

**Phase rule and phase equilibrium diagram:** Phase rule; degree of freedom, one and two component systems, temperature and composition diagrams, liquid-liquid and liquid-solid phase diagrams.

**Lubricants:** General characteristics of lubricants, chemistry of lube oil and greases, Reclamation of lubricants.

**Equilibrium:** Electrochemistry: Electric potentials at interfaces, electrodes, batteries, electrochemical cells and their applications.

**Corrosion:** Chemical and electrochemical corrosion, classification, factors affecting corrosion, form of corrosion and general methods of corrosion prevention.

**ME**

**Engineering Graphics**

**[1–3–0]**

Drawing instruments and their uses, Indian standards for drawing, Lettering, Types of lines used in engineering graphics: full lines hidden lines, dimension lines, centerlines, section lines construction lines etc.

Scales: representative fractions, reducing and enlarging scales, plain scales, diagonal scales and vernier scales.

Curves used in engineering practice: conic sections, ellipse, parabola, hyperbola, cycloid, epicycloids, hypocycloid, involutes and spiral.

Orthographic projections: First angle and third angle projections, conventions used, orthographic projections of simple solids; Conversion of three-dimensional views to orthographic views.





Reading, Interpreting and Using Written, and Graphic Information : Using (reading and writing) academic texts, articles in technical journals, instruction manuals/laboratory instruction sheets, safety manuals and regulations, and reports; Using maps, graphs, plan diagrams, flow-charts, sketches, tabulated and statistical data.

*Writing Appropriately in a Range of Rhetorical Styles i.e. Formal and Informal:* Writing instructions, describing objects and processes; defining, narrating, classifying exemplifying, comparing, contrasting, hypothesizing, predicting, concluding, generalizing restating, and reporting; Note making (from books/journals); Writing assignments; summarizing, expanding, paraphrasing; Answering examination questions; Correspondence skills; Interpreting, expressing and negotiating meaning; Creating coherent written tests according to the conventions.

*Receiving and Interpreting the Spoken Word :* Listening to lectures and speeches, listening to discussions and explanations in tutorials; Note taking (from lectures); Interacting orally in academic, professional and social situation; Understanding interlocutor, creating coherent discourse, and taking appropriate turns in conversation; Negotiating meanings with others (in class room, workshop, laboratory, seminar, conference, discussion, interview etc.)

## **AGL & CME**

## **Earth System Science**

**[3–0–0]**

### **AGL ( 2 0 0 )**

Space Science: Solar System, Age of the Earth, Origin Of Solar System. Meteors and Meteorites.

Earth Dynamics : Interior of the Earth, Composition of the Earth, Seismic Waves, Seismograph, Plate Tectonics, Basics of Earthquake, Landslides, Volcanoes.

Geological Oceanography : Sea waves, Tides, Ocean Current, Geological Work of seas and Oceans, Tsunami and its Causes, Warning system and mitigation

Hydrogeology : Water table, Aquifer, Groundwater fluctuation and groundwater composition. Hydrologic cycle.

Glaciology: Glacier types, Different types of glaciers, Landforms formed by glacier.

Geological bodies and their structures: Rock, Mineral, Batholith, Dyke, Sill, Fold, Fault, Joint, Unconformity.

### **CME(1 0 0 )**

Earth's Atmosphere : Structure and composition of atmosphere, Atmospheric circulation, Geological work of wind, Greenhouse effect and Global Warning, Carbon dioxide sequestration. Steps to maintain clean and pollution free atmosphere with governing laws, Precautionary measures against disasters.

Biosphere: Origin of life, Evolution of life through ages, Geological time scale, Biodiversity and its conservation.

Natural Resources: Renewable and non-renewable resources, Mineral and fossils fuel resources

and their geological setting; Mining of minerals and conservation, Effect of mining on surface environment.

## **FME & CME    Global Energy Scenario and Energy Security of India** **[3–0–0]**

Definition of Energy; Primary and Secondary Energy; Difference between Energy, Power and Electricity;  
Renewable and Non-Renewable Sources of Energy; The concept and Significance of Renewability;  
Social, Economic, Political and Environmental Dimension of Energy;  
Major Types and Sources of Energy at the Global and at the National Level;  
Global and Indian Reserves and Resources of Natural Oil and Gas, Coal and Nuclear Minerals;  
Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based Power and Energy: Globally and in India;  
Energy Sources and Power Generation: Thermal, Nuclear, Hydroelectric, Solar, Wind and Wave; General Principles; Relative Merits and Demerits including, Conversion Efficiency, Generation Cost and Environmental Impact: Concepts of Open and Combined Cycles, Co-generation: Clean Coal Initiatives;  
Power Transmission and Distribution: General Principles; Demand Side Management; Social, Political, Economic and Legal Issues Involved in the Generation Transmission Distribution of Power in India:  
Current Scenario and Future Prospects of Carbon Sequestration, Coal Gasification and CBM;  
Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells;  
Energy cum Power Scenario of India vis-à-vis China, South Africa and the USA;  
Global Energy Politics.

## **HSC12305    Value Education, Human Right and Legislative Procedure** **[3–0–0]**

Social Values and Individual Attitudes, Work Ethics, Indian Vision of Humanism, Moral and Non-moral Valuation, Standards and Principles, Value Judgments.

Rural Development in India, Co-operative Movement and Rural Development.

Human Rights, UN declaration, Role of various agencies in protection and promotion of rights.

Indian Constitution, Philosophy of Constitution, Fundamental Rights and Fundamental Duties, Legislature, Executive, and Judiciary: Their Composition, Scope and Activities.

The Legislature: Function of Parliament, Constitution of Parliament, Composition of the Council of the States, Composition of the House of People, Speaker.

Legislative Procedure: Ordinary Bills, Money Bills, Private Member Bills; Drafting Bills; Moving the Bills, Debate, Voting, Approval of the President/Governor.

Vigilance: Lokpal and Functionaries



**EAI**

**Electronics Engineering**

**[0-0-3]**

1. Study of Electronic Equipment & Components.
2. Study of diode characteristics.
3. Study of regulated power supply.
4. Study of BJT characteristics.
5. Study of op-amp characteristics.
6. Implementation of Boolean algebra using Logic gates.
7. Adder Circuits
8. Flip Flops.

**Third Semester**

**AMC 31104**

**Probability & Statistics**

**[4-0-0]**

Concept of a frequency distribution and its construction, probability, concept and definition of addition and multiplication rule, conditional probability, independent events, Bayes' theorem, random variables and distribution functions, probability mass function, probability density function, joint probability distribution, expectation and moments, independent random variables, marginal and conditional distribution, moment generating function, characteristic function, moment inequalities (Chebyshev, Markov, Jensen). Convergence in probability and in distribution, weak and strong laws of large numbers and central limit theorem for independent, identically distributed random variables with finite variance.

Probability distributions: Bernoulli, binomial, multinomial, hypergeometric, Poisson, geometric and negative binomial distributions, uniform, exponential, Cauchy, beta, gamma, normal and bivariate normal distributions, functions of random variables. Sampling distributions, Chi square, t and F distributions, standard errors and large sample distributions, distribution of order statistics and range.

Correlation and regression analysis: Product moment correlation, regression lines, multiple and partial correlations, multiple and partial regressions, plane of regression, rank correlation and intra-class correlation.

**AMC 31105**

**Discrete Mathematics**

**[3-0-0]**

Algebra of sets and duality, Introduction to combinatorics, Counting techniques, The inclusion-exclusion principle, The pigeon-hole principle, Applications. Recurrence relation, Generating function, Mathematical logic, Propositional calculus, Basic logical operation, Truth tables, Notion of interpretation, validity, consistency and completeness, Functions, Composition of function, functions for computer Science, Permutation

function and growth of functions, Relations, Equivalence relation, Diagraphs, Computer representation of relations, Warshall's algorithm. Algebraic structure, Group, semi-group, Cyclic group, Graph theory, Path and Connectivity, Eulerian and Hamiltonian graphs, Isomorphic and Homeomorphic graphs, Representation of graphs in computer memory.

**APC 93103**

**Waves & Oscillation**

**[4-0-0]**

**Waves:**

Waves in a one-dimensional chain of particles, classical wave equation, wave velocity, boundary conditions and normal modes, dispersion relations, dispersive waves, acoustic and optical modes, Waves in continuous media, Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, typical measurements, dispersion in waves, group velocity and phase velocity, their measurements, Superposition of waves, Linear homogeneous equations and the superposition principle, interference in space and energy distribution; beats and combination tones.

**Ultrasonic:** Production, detection and applications of ultrasonic waves.

**Oscillations:**

Free oscillations of simple systems: Equilibrium, concept of potential well, small oscillations, approximate solutions, linear and transverse oscillations of a mass between two springs, diatomic molecule, reduced mass concept, Damped and forced oscillations: Damped oscillations; critical damping, Q of an oscillator. Forced oscillator with one degree of freedom; Transient and steady state oscillations, resonance energy absorption, low and high frequency responses, Free oscillations of system with two degrees of freedom: Two dimensional oscillator; normal modes, longitudinal and transverse oscillation of coupled masses, energy transfer between modes, coupled pendulum, Fourier analysis: Fourier series and Fourier coefficients; simple examples, use of exponential representation for harmonic oscillations, expression for Fourier coefficients. Non-periodic disturbance; representation by Fourier integral, Fourier transform & applications, Case of a wave train of finite length, constancy of  $\Delta x \cdot \Delta k$  (the uncertainty product).

**EICP 13101**

**Digital Electronics**

**[3-0-0]**

Boolean Algebra, logic gates and switching functions, truth tables and switching expressions, Minimization of completely and incompletely specified switching functions- Karnaugh map and Quine-McCluskey method, Decoders, multiplexers, Clocks, Flip-flops, Latches, Counters and shift registers, synthesis of synchronous sequential circuits, Minimization and state assignment, Timing circuits.

**CSC 13102****Data Structures****[3-1-0]**

Basic concepts; Mathematical Background; Arrays: one dimensional, multi-dimensional, Sparse Matrix, Elementary Operations; Stacks: Representation, elementary operations and applications such as infix to postfix, postfix evaluation, parenthesis matching; Queues: Simple queue, circular queue, dequeue, elementary operations and applications; Linked lists: Linear, circular and doubly linked lists, elementary operations and applications such as polynomial manipulation; Trees: Binary tree representation, tree traversal, binary search tree, height balanced trees like AVL tree and 2-3 tree, heap, complete binary tree, other operations and applications of trees; Graphs: representation, Adjacency list, graph traversal, path matrix, connected components, DAG, topological sort, Spanning tree; Sorting: Selection sort, bubble sort, quick sort, merge sort, heap sort, radix sort; Searching: linear and binary search; Hashing: hash tables, hash functions, open addressing, File structures: Introduction, data file types, file organization, file access methods.

**HSE****HSS (Optional)****[3-0-0]****HSE 13301 History of Science and Technology**

Introduction to the History of Science- Emergence and Character of Science, Science in the Ancient world, The Dawn of History: Babylon-China-India, Classical Science. Greek and Romans, Science during the Medieval Age, The Dark Age, The Arabian and the Indian Science, Birth of Modern Science: Renaissance and Scientific Revolution, Eighteen-Century Science, Application of Science, Industrial Revolution, Causes and Consequences, Present Day Science, Impact of Science on Society, Growth of Indian Mineral Industry, including Mining and Petroleum Industry

**HSE13302 Philosophy of Science**

**Introduction:** Rationale for study of Philosophy of Science prevalence of imbalances; General Approach, Nature, Scope and Relation of the subject with Historical Development.; Science and Philosophy vis-à-vis need for Intellectual and Moral Balance. Scientific and Philosophical approaches to knowledge development and Knowledge application (Emphasis on Earth and Mineral Sciences)

**Foundations of Philosophy:** Nature, Concept, Scope, Methodology, Divisions and Implications.

**Concept and Nature of Science:** Origin/Aim, Methodology, Scope and Development: Nature of Scientific Methods; Movements; Scientific Thought; Divisions of Science; Scientific Laws and Scientific Explanations.

**Convergence of Science and Philosophy:** Unified Theory; Space Time Relationship; Patterns of Change; Deeper issues and broad involvements of Science; Status of Scientific Proposition and Concepts of Entities, Epistemic and Ontological aspects.

**Philosophical Analysis and Scientific Practice:** Philosophical Base of Eastern Thought and their parallel in Science; The Essential of Unity between Eastern Thought Pattern and Western Science, Need for harmony between Intuitive Thought and Rational Knowledge;

Philosophers of Science with reference to Western Thought, Philosophers of Science – Western and Eastern.

**Inter-relationship of Science and Culture:** Science and Aesthetics, Science and Human Values, Science in the full tradition, Science vis-à-vis Human Conduct and Social Affairs; Social Significance of Science; Implications of Philosophy of Science for a new peaceful Social Order, Synthesis of Eastern “World View” and Western “Materialism”.

### **HSE13303     Gandhian Studies**

Introduction to Gandhi’s Life and Philosophy; Fundamentals of Gandhian Economics; Gandhi’s Concept of Human Nature, Perfectibility of Man; Ethical Ideas of Gandhi-Truth, *Ahimsa*, *Brahmacharya*, Non-stealing, Non-possession and Voluntary Poverty. Gandhi’s Interpretation of History and Society.

Public Welfare and Sarvodaya Philosophy – *Antyodaya*; *Sarvodaya* Socialism and Capitalism; Nature of *Sarvodaya*’s Economy from Gandhi to Vinobha; Concept of Production and Distribution in *Sarvodaya* Economy and its Utility in our Socio-economic and Scientific/ Technical Development; Non- violent Economy vis-à-vis Centralized Industrial Economy and Rural Economy.

Study of the Current Industrial Problems and Priorities as against the Gandhian Ideology. Gandhian approach to Man-power Management, Prospects, Co-operative Production and Consumption, Rural Entrepreneurship, Finance, Plan changes for helping the disadvantaged sections of the society.

Man and machine- Problems of Automation and Gandhi’s View.

Gandhi’s Political Views: The State as an organ of Violence, Political Sovereignty of the People, Decentralization of Political Power, Concept of Freedom, The Idea of Political Condition- *Ram Rajya*.

Satyagraha: The Importance of Truth Force, Self Suffering, Winning over the opponent by Love.

Relevance of Gandhian Ideas in the contemporary Economic and Political situation.

**Note:** Use of Video Films shall be made to support the classroom teaching.

Oral Communication Skills

### **HSE13304     Oral Communication Skills**

The nature, purpose and characteristics of good conversation, Phonological forms to use in speech, Developing conversation skills with a sense of stress, intonation, and meaning, Use of question tags, Starting, maintaining and finishing conversations, Standard conversational exchange, Spoken language idioms, Effective listening and attention to others, Gestures and body language, Do’s and Don’ts in conversation, Telephonic conversation, Functions of English in conversation: introductions, greetings, clarifications, explanations, interruptions, opinions, Agreement and disagreement, complaints, apologies, Participating in informal discussions and situations, Using information to make some decision, i.e., making social arrangements with friends, Reproducing information in some form (question/answer summarizing, oral reporting, etc.)

## **HSE13305 Oral Presentation Skills**

Characteristics of good presentation, Assessing the audience and its needs, Planning a presentation, Different presentation styles, Using the presentation matrix, The informative presentation, The demonstrative presentation, The persuasive presentation, Presentation structure and design, Materials and logistics, Visual aids and their development and use, Rehearsing and delivering, Using performance techniques, Overcoming anxiety and stress, Opening and closing, Getting and maintaining audience attention, Using language to optimal effect, Body language and gestures, Linguistic aspects: introducing, sequencing, signaling, quoting, clarifying and summarizing, Handling questions

## **HSE13306 Literary Communication**

Exposure to recent literary and creative trends in English and their relation with the values, culture and norms of behaviour; linguistic and cultural process

What and how of literary communication for improvement of proficiency in the use of English language

Analysis and interpretation of five to six recent short stories from different parts of the world to make the sensitive and different intensification of the skills of conceiving the ideas, situations and solutions, and rendering them into appropriate expression on a higher plane of finish.

## **HSE 13307 Present History of India**

**Idea of a Nation:** Defining Nation, Citizenship Duties, Profession, Society, Modern Nation- State as it emerged after 1789, The Socio-Economic context of the new 'Nation'.

**The Modern Individual:** Transition from pre-modern definition and social location of Individuals to the growth of idea of free Individual, Social Contract, The Duties of an Individual, Atomization of Individual and a critique to it.

**Colonial Rule in India:** Colonial redefinition of Nation, Individual, Society in India- a critique of Pre-colonial mode of life by the colonial theorists, The 'Progressive' colonial alternatives, the ambiguity in colonial 'Image' of India.

**Nation and the Nationalists:** The Ideological Contestation of Colonial Images by the Nationalists, Critique of Colonialism by Gandhi, Nehru, Tagore, S.C. Bose, Aurobindo Ghosh, M.N. Roy, J.P. Narayan. Problematizing Colonial Ideas, Impact of Colonialism in India, Problems with the Nationalist Critique of Colonialism. Colonialists and Nationalists on the idea of 'Science', 'Modernity' and 'Development'.

**Re-inscribing Indian Fertility:** Changing Views of Indian Fertility vis-à-vis female Sexuality.

**Threats of Neo-Colonialism:** The Challenges to the Nation, Post Colonial Critique of Colonialism and Nationalism, Individual and Society in a Changing World Order.

**AMC 31204                      Probability & Statistics Lab                      [0-0-2/2]**

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.

**CSC13202                      Data Structures Lab                      [0-0-3]**

Laboratory experiments will be set in consonance with the materials covered in CSC13102. 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.

**APC 93201                      Physics III Lab                      [0-0-3]**

**List of experiments**

- Determination of Wavelength of sodium light by Newton's ring.
- Determination of Wavelength of sodium light by Fresnel's bi-prism.
- Determination of Refractive index of prism by Spectrometer.
- Determination of frequency of tuning fork by Melde's experiment.
- Determination of velocity of sound in the material of the given rod with a Kundt's tube.

**Fourth Semester**

**AMC 32102                      Object Oriented Programming                      [3-0-0]**

OOPs: Basic concepts of OOPs; C++ preliminaries, data types, arrays; Functions; Classes and Objects; Constructors and Destructors, Function overloading; Operator overloading and Type conversions; Inheritance; Pointers; Polymorphisms, Console oriented I/O operations, File management, Templates; Exception Handling.

**JAVA: Introduction to JAVA**

Information Technology: Introduction to Data Base Management System, Foxpro, RDBMS, HRDBMS, Relational Data Base; Introduction to Internet and Intranet Multimedia.

**AMC 32104                      Statistical Inference                      [4-0-0]**

Estimation: Unbiasedness, consistency, efficiency, sufficiency, minimal sufficiency, completeness, factorization theorem, exponential family of distribution and its properties, uniformly minimum variance unbiased (UMVU) estimation, Rao-Blackwell theorem, Cramer Rao inequality, minimum variance bound estimator and its properties, Estimation by methods of moments, maximum likelihood, least squares and minimum chi-square, Interval estimation.

Test of hypotheses: Simple and composite hypotheses, two types of errors, critical region, power function, most powerful and uniformly most powerful tests, Neyman-Pearson's lemma, likelihood ratio tests. Tests for mean and variance in normal distribution: one population and two population cases, Tests for correlation and regression coefficients, paired t-test, chi-square test for goodness of fit, contingency tables, large sample tests through normal approximations and test of independence.

Sequential Analysis: Sequential probability ratio test (SPRT), Operating Characteristic function of SPRT and Average Sample Number (ASN).

Non-Parametric tests: Sign test, run test, median test, Mann-Whitney Wilcoxon test.

Analysis of Variance: One-way and two-way classifications.

## **HSC 14306                      English for Professional Communication                      [3-0-0]**

### **Part I Professional Oral Communication**

#### **Course Introduction**

Professional Communication: Need, principle, channels, forms and barriers; Speaking for professional Purposes: Nature of Oral Communication, Oral Communication Process, and characteristics of Oral Communication

#### **Group Discussion**

Group Discussion(GD): nature, uses and importance; Leadership function in Gd; developing leadership qualities and positive group behaviour; Starting discussions: opening the discussion, stating objectives, suggesting good group procedure (Time management, speaking procedure, etc); Giving opinions, asking for opinions and supporting opinions in GD; Making suggestions and asking for suggestions; Balancing points of view, expressing advantages, disadvantages and consequences; Some pitfalls in discussions, fallacies in argument and rebuttal, concluding and controlling discussions

#### **Job Interview**

Job Interview: The interviewing process, types of interviews and interview formats; Pre-interview preparation techniques, self-analysis, skills assessment, company analysis, job analysis, practice, developing interview file; Projecting success: The beginning, the middle and the end of the interview; Interview Strategies; Upholding the personality and overcoming interviewing hazards

## **Part II Professional Writing**

### **Report Writing**

Report Writing: Characteristics of business reports, reports and other forms of communication, features of good reports; Types of reports (Formal/informal); Structure of formal reports: Front matter, main body and back matter; Style of reports: Readability of reports, choice of words and phrases, construction and length of sentences and paragraphs

### **Business Correspondence**

Official communication: nature and principles of business correspondence; Structure of business letters; Business letter formats; Letter giving instructions; Letters of requests and inquiries; Letters of complaints; Employment letters and applications; CV and resume writing; Business memos: Forms and structure; Writing an effective memo

### **CSC 14101                      Computer Organization                      [3-1-0]**

Number Representation; Memory: Organization, Interfacing with Processors; Processor Organization: CPU, Instruction Cycle / Format, Addressing, Computer Arithmetic, ALU Design, Control Structure, Hardware, Microprogramming, Assembly Programming; I/O Organization: Programmed Controlled, Interrupt Driven, DMA Driven; Computer Peripheral Organization: Key Board, Hard disks, Floppy Disks, Printers; RISC machines.

### **CSC 14102                      Algorithm Design and Analysis                      [3-1-0]**

Performance Analysis: Space and Time Complexity, Asymptotic Analysis, Practical Complexities, Performance Measurement; Divide-and Conquer: Review of quick sort and merge sort, finding max and min, Strassen's matrix multiplication, convex hull; Greedy Approach: Knapsack problem, tree vertex splitting, job sequencing, minimum cost spanning tree; optimal storage on tapes, optimal merge patterns, single-source shortest paths; Dynamic Programming: Multistage graph problem, single-source and all pairs shortest paths, Traveling sales person problem, Longest common subsequence problem, matrix chain multiplication; Back Tracking: 8-queens problem, sum-of-subsets, graph colouring, Hamiltonian cycles; Branch-and-Bound: Least cost search, 15-puzzle problem; Algorithms on Algebraic Problems: Evaluation and Interpolation, Fast Fourier Transform; NP-completeness.

### **MSCP 14151                      Managerial Economics                      [3-0-0]**

Nature, scope and methods of managerial economics, Managerial Economic Concepts – Incremental concept, Opportunity Cost concept, Equi-marginal concept, Discounting concept; Risk & Uncertainty, Law of Diminishing Marginal Utility,

Demand Analysis – Meaning & type, Law of Demand – features, Exceptions, Market Demand Schedule & Curve, Elasticity of Demand – Price elasticity, cross elasticity & income elasticity, Indifference Curve approach and its properties, Supply – its law, elasticity & curve, Types of markets, Pricing under various market conditions – Perfect competition, imperfect competition & monopolistic competition, Profit & Profit measurement, Inflation – meaning, Demand-pull, cost-push inflation, Inflationary gap, Causes and steps to control inflation, National Income – Concepts & methods of measurement, Difficulties in measuring national income.

**AMC 32202                      Object Oriented Programming Lab                      [0-0-2]**

**C++ programming:** Classes and objects, Arrays of objects, Passing objects to member functions. Function overloading, Friend functions, Passing objects to friend functions Member functions/Friend functions returning objects. Pointer: Accessing data members and member functions using pointers. Constructors and Destructors: constructors, parameterized constructors, overloaded constructors, Copy constructors, Dynamic constructors; destructors. Operator Overloading: Overloading of unary operators such as minus, increment operator, decrement operator etc.; Overloading of binary operators such as +, \* etc.; overloading of operators such as >>, << etc. Type Conversions: Basic type to class type, Class type to basic type, one class type to another class type. Inheritance: Single Inheritance, Multiple Inheritance, Hierarchical Inheritance, Multilevel Inheritance and Hybrid inheritance, Constructors in Derived classes, Polymorphism: Run time polymorphism- Virtual functions. Console oriented I/O operations: using ios class functions and flags, Manipulators, User-defined output functions, File Processing: Sequential files, Random Files, Accessing files using class objects, Updating a file Templates: Function Templates, Class Templates, Error Handling.

**JAVA programming:** Simple programs in JAVA

**DBMS:** Development of database using suitable DBMS packages

**AMC 32204                      Statistical Inference Lab                      [0-0-2/2]**

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, Practical based on non-parametric tests and analysis of variance.

**CSC 14201                      Computer Organization Lab                      [0-0-3]**

Laboratory design will be set based on the materials covered in CSC14101. It includes 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 and programming.

**CSC 14202                      Algorithm Design and Analysis Lab                      [0-0-3]**

Laboratory experiments will be set based on the materials covered in CSC14102. It includes programming assignments for practicing and designing on different algorithm design paradigms.

**Fifth Semester**

**AMC 95101    Algebra I    [3-1-0]**

Groups, Subgroups, Cyclic groups, Permutation groups, Groups of Cosets, Normal subgroups and factor groups, Simple group and commutator of the group, Homomorphism and isomorphism, inner automorphisms, Cayley's theorem, The class equation, Cauchy's theorem, Sylow  $p$ -subgroups, The Sylow theorems, Direct product of groups, Rings, Integral domains, The field of quotients of an integral domain, Quotient rings and ideals, Homomorphisms of rings, Rings of Polynomials, Factorization of polynomials over a field, Unique factorization domains, Euclidean domains.

**AMC 33102    Linear Algebra    [3-1-0]**

Vector spaces, Subspaces, Basis and Dimension, Finite dimensional vector spaces, Quotient spaces, linear transformation and their matrix representations, rank and nullity theorem, Change of basis, Dual spaces, Bi-dual spaces and natural isomorphism, System of linear equations, eigen values and eigen vectors, Jordan Canonical form, Cayley-Hamilton's theorem, Diagonalization, Finite dimensional inner product spaces, Cauchy Schwarz inequality, Orthogonality of vectors, Bessel's inequality, Self adjoint, unitary and normal linear operators, Spectral theorem, Bilinear forms.

**AMC 95102    Dynamics of a Particle    [3-1-0]**

Velocities and acceleration along radial, transverse directions, tangential and normal directions, Simple harmonic motion, Elastic strings, Motion on smooth and rough plane curves, Motion in a resisting medium, Motion of particles of varying mass, Central Orbits, Kepler's laws of motion, Motion of a particle in three dimensions, Acceleration in terms of different coordinate systems.

**AMC 33103    Integral Transforms and Integral Equations                      [4-0-0]**

**Section A: Integral Transform**

Laplace Transform, Inversion, Convolution Theorem, Fourier Transform, Inversion, Fourier Sine and Cosine transform, Properties of Fourier Transform, convolution, Parseval's identity, Fourier transforms of derivatives, Application to solve ordinary and partial differential equations.

### **Section B: Integral Equation**

Voltera Integral Equation: Resolvent kernel, polynomial kernel, successive approximation, Integral equation of convolution type, Able's integral equation, Integro-differential equations

Fredholms Integral equation: Fredholm determinant, separable kernels, Homogeneous integral equation, eigen values and its solution, successive approximation, conversion of boundary value problems to integral equation using Green function.

### **CSC 15102**

### **Operating Systems**

**[3-1-0]**

Introduction to Operating System: Introduction, Categories of OS, Computer System Architecture, Interrupts, Storage Structure, Hardware Protection.

Operating System Structures: OS Structure, OS Components, OS Services, System Calls, System Structures, Virtual Machines, System Design Goal, SYSGEN.

Process Management: Process Concept, Process State, PCB, Process Scheduling, Schedulers, Process Creation, Process Termination, Co-operating Process, Producer Consumer Problem, Inter-process Communication, Client Server Communication, Threads, Process Synchronization, Critical Section Problem, Bakery Algorithms, Semaphores, Reader's Writer's Problem, Dining Philosopher's Problem.

CPU Scheduling: CPU Scheduler, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, Priority Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling

Deadlock: Introduction, Deadlock Prevention, Deadlock Avoidance, Resource Allocation Graph Algorithms, Deadlock Detection, Prevention and Recovery

Memory Management: Memory Hierarchy, Memory Types, Main Memory Architecture, Cache Memory, Address Binding, Dynamic Loading, Linking, Overlays, Logical Vs Physical Addresses, Swapping, Contiguous Memory allocation, Fragmentation, Segmentation, Virtual Memory, Paging, Demand Paging, Page Replacement Algorithms, Thrashing

Secondary Storage Structure: Disk Structure, Disk Scheduling, Disk Management

### **CSC15105**

### **Software Engineering**

**[3-1-0]**

Introduction to Software Engineering: Objective and Scope of Software Engineering, Introduction to System, Software Definition, Characteristics of Software, Evolution of Software, Software Quality, Software Problems, Software Engineering Definition, Software Engineering Problem, Software Development Methodologies;

Software Process: Introduction to Software Process, Components of Software Process, Characteristics of Software Process, Software Development Process, Software Development Models, Project Management Process, Software Configuration Management Process, Process Management Process;

Object Oriented Modeling & Design: Object Modeling, Dynamic Modeling, Functional Modeling, Object Oriented Design Methodology;

Software Requirements Analysis: Introduction, Problem Analysis, Data Flow Diagram, Use-Case Diagram, Requirement Specifications, Requirement Validation, Metrics;





## **Seventh Semester**

**AMC 97101**

**Complex Analysis**

**[3-1-0]**

Analytic functions, Cauchy-Riemann Equations, Harmonic Conjugates, Complex Integration, Cauchy's theorem and Cauchy's Integral formula, Morera's Theorem, Conformal mappings, Mobius transformations, 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, Residue Theorem, Argument principle, Rouché's Theorem, Contour integrals, Analytic continuation,

**AMC 97102**

**Number Theory**

**[3-1-0]**

Integers, Well ordering principle, Induction, Fibonacci numbers, Divisibility, Prime numbers, Distribution of primes, Conjectures about primes, Greatest common divisor, Least common multiple, Euclidean Algorithm, Fundamental theorem of arithmetic and applications, Dirichlet progressions, Fermat factorization, Linear Diophantine equations, Perfect numbers, Mersenne numbers, Congruences, Linear congruences, Chinese remainder theorem, Wilson's and Fermat's little theorem, Primality testing and Carmichael numbers, Euler's theorem, Properties of Euler's Phi function, Primitive roots of unity, Mobius inversion formula, Farey sequences.

**AMC 31103**

**Ordinary and Partial Differential Equations [4-1-0]**

### **Section A: Ordinary Differential Equations**

Existence and Uniqueness of solution, Initial value problems, Existence and Uniqueness theorem, Lipschitz condition, Ordinary and singular points, Series solution around an ordinary point and a regular singular point, the method of Frobenius, Bessel, Legendre and Hypergeometric, Bessel and Legendre functions, Confluent Hypergeometric functions, Self adjoint eigen value problems, Green's functions, Second order boundary value problems, Sturm Liouville problems, Perturbation theory for two dimensional linear systems.

### **Section B: Partial Differential Equations**

Euler's formulae, Dirichlet's conditions for Fourier series expansions, Fourier series for even and odd functions, Half range Fourier series, Parseval's formula, Complex form of Fourier series.

Existence and Uniqueness of solutions of PDE, Existence and uniqueness theorem, 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, Neumann and Dirichlet problem for a rectangle, interior and exterior Dirichlet problem for a circle. Solution of wave equation and heat equation in homogeneous, non-homogeneous cases, solution of

Laplace and Poisson's equation in two and three dimensions by variable separable method.

**AMC 33104**

**Topology**

**[3-1-0]**

Definition and examples of topological spaces; Closed sets, Closure, Dense sets, neighborhoods, interior, exterior, and boundary, Accumulation points and derived sets; Bases and sub-bases; Subspaces and relative topology; Kuratowski closure operator; Continuous functions and homeomorphism; First and second countable space; Separable spaces; Connectedness; Compactness, local compactness and One-point compactification; Product and quotient topology; Separation axioms, Urysohn's lemma; Tietz extension theorem.

**Elective-I &II (CSE) Any Two**

**CSE 17101**

**Image Processing**

**[3-1-0]**

Contrast enhancement using histogram equalization, specifications, Smoothing, sharpening, pseudo color enhancement. Image Restoration: constrained and unconstrained; wiener filtering, motion blur removal, geometric/ radiometric corrections. Image compression: Segmentation and edge extraction, run length coding, block coding, contour coding (e.g. DCT, JPEG, MPEG), vector and arithmetic coding, Hoffman code, Fractals and wavelets, shape analysis and practical applications, software exercise on image processing as standard packages like MATLAB.

**CSE 17102**

**Advanced Algorithms**

**[3-1-0]**

Algorithm paradigms, Asymptotic complexity; Graph algorithms, shortest paths, NP-completeness, Randomized algorithms, Linear programming; Geometric algorithms, Range searching, Convex hulls, closest pairs; Numerical algorithms, Matrix and Polynomial multiplication, FFT, Euclid's algorithm, Primality testing, Cryptographic computations; Internet algorithms, text pattern matching, information retrieval, data compression, Web caching.

**CSE 17103**

**Functional & Logic Programming [3-1-0]**

The functional style of programming, paradigms of developments of functional programs. The relationship between logic programming and functional programming. Functional Programming Language LISP- a case study. Propositional logic, First Order Logic: syntax and semantics, deduction, Herbrand interpretation and resolution methods, Syntax and Semantics of Logic Programs, Inference Rules, Unification and SLD- and SLDNF-Resolution, Logic programming language PROLOG - a case study. Basic concepts, Recursive programming, Cuts and negation, Non-deterministic programming, Abstract computational model - Warren's Abstract Machine (WAM), Implementation of Prolog on

WAM. Introduction to Constraint Logic Programming: Constraint logic programming scheme, Constraint satisfaction, constraint propagation, Constraint Logic Programming over the reals, Constraint Logic Programming over finite domains. Introduction to nonclassical logics. Modal logic. Accessibility. Relation and Kripke possible world semantics. The logic of knowledge and belief, Autoepistemic knowledge, Temporal logic.

Introduction to declarative programming paradigms. Logic as a system for declarative programming. . The use of resolution and theorem-proving techniques in logic programming. Logic programming foundations: preliminaries, definite program, Herbrand model, SLD and SLDNF resolution, cut operator. Prolog programming Techniques (Nondeterministic programming Parsing with DCG's) .CASE studies: LISP, PROLOG

**CSE 17104                      Object Oriented Data Modeling                      [3-1-0]**

Review of programming practices and code-reuse; Object model and object-oriented concepts; Object-oriented programming languages and implementation; Object-oriented analyses and design using UML structural, behavioral and architectural modeling; Unified development process, Software reuse design patterns, components and framework; Distributed object computing, interoperability and middleware standards COM/DCOM and CORBA; Object-oriented database system data model, object definition and query language, object-relational system.

**CSE 17106                      Multimedia Systems                      [3-1-0]**

An overview of multimedia system and media streams; Source representation and compression techniques text, speech and audio, still image and video; Graphics and animation; Multi-modal communication; Multimedia communication, video conferencing, video-on-demand broadcasting issues, traffic shaping and networking support; Transcoding; Multimedia OS and middleware; Synchronization and QoS; Multimedia servers, databases and content management; Multimedia information system and applications.

**CSE17107                      Pattern Recognition                      [3-1-0]**

Pattern recognition and machine learning: Definition, goal and overview of different approaches. Pattern recognition: Bayesian classification, Sequential methods including Wald's SPRT, GSPRT, modified SPRT, nearest neighbor classification, linear classification, parametric and non-parametric estimation and supervised learning, clustering techniques, feature selection and extraction, related algorithms, applications. Machine learning: History, Taxonomies of methods and research paradigms, knowledge-level vs symbol-level learning. Major approaches of learning, Formal model of learnability, Learning by observation and discovery, Explanation based learning, Macro operators, explanation generalization, Analogy and case-based reasoning.

**CSE 17108****Advanced Compilers****[3-1-0]**

Introduction to code optimization, efficient code generation and parallelizing compilers. Data-flow analysis: Classical theory, bi-directional flows, unified algorithms, etc. Efficient code generation: Algorithms, register allocation heuristics and automated tools. Parallelism detection: Data dependence, control dependence, various restructuring transformations on loops. Inter-procedural analysis: Constant propagation, data dependence etc., Selected case studies.

**CSE 17109****Data Mining****[3-1-0]**

Introduction to data mining, Data preprocessing and cleaning, Data visualization and exploratory data analysis, Data mining techniques; Performance evaluation, Finding patterns and rules; predictive and descriptive modeling, Issues relating to large data sets; Application to web mining and bio informatics.

**CSE 17110****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.

**CSC17102****Parallel and Distributed Computing****[3-1-0]**

Motivation, Modern scientific method, Parallelism in uniprocessors systems; Computational Models; Interconnection networks; Embedding other networks, Array processors; Parallel algorithm design; Performance and scalability; Algorithms for array processors: sum, prefix computation, matrix multiplication; parallel sorting: odd-even transposition sorting, odd-even merging, enumeration sorting, bitonic sorting, odd-even merging network; Parallel numerical algorithms; Routing algorithms; Communication algorithms: One-to-all, all-to-one, all-to-all, Multiprocessor systems; Multicomputers, Dataflow computers; Systolic algorithms; Reconfigurable processor array. Models of distributed systems; Design issues; Operating systems for distributed computing; Distributed algorithms and applications, Interprocess communication; Clock synchronization algorithms; Distributed memory systems; Message passing

programming; Middleware; Point-to-point communication; Fault Tolerance; Fault tolerant routing.

## **Eighth Semester**

### **AMC 34102 Mathematical Modeling and Calculus of Variations**

[4-0-0]

#### **Section A: Mathematical Modeling**

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.

#### **Section B: Calculus of Variation**

Functionals, Euler's equations, Isoperimetric problems, Functional involving higher order derivatives, Variational problems with fixed and moving boundary, Rayleigh-Ritz method, Galerkin's method, Hamilton's principle, Lagrange's equations.

### **AMC 98101 Measure Theory and Integration**

[3-1-0]

Algebra of sets, ring, sigma-ring, field and sigma field of sets, monotone class, Lebesgue measure and outer measure, measurable sets, measurable functions, Littlewood's three principles, existence of non-measurable set. Lebesgue integral of a bounded function over a set of finite measure, the integral of a non-negative function, general Lebesgue integral, convergence in measure, functions of bounded variation, absolute continuity, differentiation and integration, general measure and integration, signed measure, Hahn-Jordan decomposition, Radon-Nikodym and Lebesgue decomposition theorems, product measures and Fubini's theorem.  $L^p$  spaces, Minkowski and Holder inequalities, convergence and completeness approximation in  $L^p$ , bounded linear functionals on  $L^p$  spaces.

### **AMC 98102 Dynamics of a Rigid Body**

[3-1-0]

Dynamics of Rigid Bodies: Moments and products of inertia, The Momental Ellipsoid, Equipomental Systems, Principal axes, D'Alembert's principle, The general equations of motion of a rigid body, Motion of the Centre of inertia and motion relative to the Centre of inertia, Motion about a fixed axis, The compound pendulum, Centre of percussion, Motion of a rigid body in two dimensions under finite and impulsive forces, Conservation of Momentum and Energy, Lagrange's equations.

### **AMC 98103 Numerical Methods**

[4-0-0]

#### **Section A:**

Solution of algebraic and transcendental equations, Generalized Newton method for multiple roots, Solution of linear simultaneous equation by Gauss Elimination, Gauss Jordan, Crout's triangularization and Gauss-Seidal methods, Finite difference

interpolation and extrapolation, Numerical differentiation and integration, Numerical solution of initial value problems.

**Section B:**

Numerical solution of boundary value problems, Finite differences approximation to partial derivatives, Solution of Laplace and Poisson's equations by explicit method, Solution of Laplace equation by ADI method, Solution of one dimensional parabolic equation by explicit and implicit schemes, Solution of two dimensional parabolic equation by ADE method, Solution of one dimensional wave equation by explicit and scheme.

**CSC 16104                      Language Processor                      [3-1-0]**

Introduction to Compiling: Compilers, analysis of source program, phases and passes of a compiler, tool based approach to compiler construction, Cousins of compilers: loaders and assemblers; Lexical analysis: Role, Input buffering, tokens, regular expressions, transition diagrams, Design of lexical analyzer generator; Syntax analysis: Role, CFGs, ambiguity, top down parsing, bottom up parsing, operator precedence parsing, LR parsers (SLR, LALR, LR), Parser generator; Syntax-Directed Translation (SDT): SDT scheme, Implementation of SDT, postfix notation, SDT to postfix code; Intermediate code generation: Intermediate language, translation of assignment statements, Boolean expressions, case statements; Error Detection and Recovery: Lexical-phase errors, Syntactic-phase errors; Code generation: Issues, target machine, runtime storage management, basic block and flow graphs, next use information, a simple code generator, register allocation, DAG representation of basic blocks, peephole optimization, code generation from DAGs; Code optimization: Sources, optimization of basic blocks, loops in flow graphs.

**Elective-III (CSE) any one**

**CSE 18101                      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

**CSE 18102                      Soft Computing                      [3-1-0]**

Soft Computing concepts, Biological and artificial neuron, Neural networks, Adaline, Perceptron, Madaline and BP (Back Propagation) neural networks, Adaptive feedforward multilayer networks, RBF and RCE neural networks, Topologic organized neural networks, competitive learning, Kohonen maps, Solving optimization problems using



**CSE 18109****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

**CSC 16204****Language Processor Lab****[0-0-3]**

Laboratory experiments are based on the materials covered in CSC16104. It includes programming assignments to build a compiler for a subset of a c-like programming language, using of tools as Lex and Yacc.

**Ninth Semester****AMC 99101****Stochastic Process****[3-1-0]**

Generating functions, properties, Definition and classification of general stochastic processes, Examples, Markov chains, Transition probability matrices, classification of states, recurrence, examples, Basic Limit theorems of markov chains, Renewal Equation (Discrete case), Absorption probabilities, random walk and queueing examples, Continuous time markov chains, pure birth processes, poisson processes, birth and death processes, differential equation of birth and death processes, examples. Renewal processes, renewal equations and elementary renewal theorem, Brownian motion, continuity of paths and the maximum variables, variations and extensions.

**AMC 90102****Mathematical Logic****[3-1-0]**

Propositional calculus, Set theoretic concepts; Truth on algebraic systems; Calculus of predicates; Model theory; Proof theory; Algorithms and recursive functions.

**CSC 17101                      Cryptography & Network Security                      [3-1-0]**

Foundations of Cryptography and Security, Mathematical Tools for Cryptography; Symmetric Encryption Algorithms: Theory of Block Cipher Design, Feistel Cipher Network Structures, DES and Triple DES, Modes of Operation (ECB,CBC, OFB,CFB), Modern Symmetric Encryption Algorithms: IDEA, CAST, Blowfish, RC5, Rijndael (AES), Stream cipher.  
Public Key Cryptography: RSA, Diffie-Hellman, Elliptic Curve Cryptosystems, ElGamal Key Exchange Algorithms.  
Hashes and Message Digests: Message Authentication, MD5, SHA; Digital Signatures, Certificates, User Authentication, Digital Signature Standard (DSS and DSA).

Electronic Mail Security, Pretty Good Privacy (PGP), S/MIME, X.400, (3/27) IP and Web Security, IPsec and Virtual Private Networks, Secure Sockets and Transport Layer (SSL and TLS), Electronic Commerce Security, Electronic Payment Systems, Secure Electronic Transaction (SET), CyberCash, iKey Protocols, Ecash (DigiCash).

**Elective-I (Mathematics) Any one**

**AME 33101                      Mechanics of Solids                      [3-1-0]**

Analysis of stress, principal stresses, principal planes, 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

**AME 33102                      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.

**AME 33103                      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

**AME 33104****Wavelets****[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 uncertainty 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  $L^2(\mathbb{R})$ , 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.

**AME 33105****Differential Geometry****[3-1-0]**

Theory of space curves: Space curves, Planer curves, Serret-Frenet formulae. Osculating circles and spheres. Existence of space curves and evolutes and involutes.

Theory of surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines. Developables, Developable associated with space curves, Developable associated with curves on surfaces. Minimal surfaces.

**Elective-II (Mathematics) Any one****AME 33106****Fluid Dynamics****[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.

**AME 33107**                                      **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.

**AME 33108**                                      **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

**AME 33109**                                      **Advanced Optimization Techniques**                                      **[3-1-0]**

Dynamic programming models for multistage decision situation, PERT and CPM in project scheduling, Meta – Heuristics, Decision Analysis, Goal Programming, Revised Simplex Methods, Queuing models and its application, Inventory theory- Deterministic and Probabilistic models.

**AME 90101**                                      **Algebra-II**                                      **[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.

**Tenth Semester**

**AMC 34101**                                      **Functional Analysis**                                      **[3-0-0]**

Metric spaces, complete metric spaces, Banach contraction mapping theorem. Banach spaces, bounded linear functional 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 90102                      Applied Graph Theory                      [3-1-0]**

Graphs – directed undirected and their representation in a computer walks, connectedness, blocks, cut points, trees, connectivity and traversability, outsets, Planarity, coloring, covering and partitioning of graphs, Miscellaneous applications.

**CSC16103                      Computer Graphics                      [3-1-0]**

Overview of Graphics Hardware; I/O Devices and Hierarchies (PHIGS, GKS etc); 2D and 3D Coordinate Systems; Pixels and Voxels; Line and Circle drawing algorithms; Curves and Spline Techniques and Representation; Clipping Algorithms; 2D and 3D Transformations and Projections; Storage and Retrieval of Objects. Techniques of Interactive Graphics: C++ for GUI, Shading and Rendering, Hidden line removal algorithms.

**Elective-III (Mathematics) Any one**

**AME 34101                      Finite Element Methods                      [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.

**AME 34102                      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.

**AME 34103                      Advanced Fluid Dynamics                      [3-1-0]**

Stress components in a real fluid, Relations between rectangular components of stress, Connection between stresses and gradients of velocity, Navier-Stoke's equations of motion, similarity of flow's, Reynolds number, Viscosity from the point of view of kinetic theory, Flow between parallel flat plates, Plane Poiseuille and Couette flows between two parallel plates, steady flow in pipes, Flow between two concentric cylinders, Application of parallel flow theory, Unsteady flow over a flat plate.

Properties of Navier-Stoke's equations: 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-Pohlhausen 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-empirical theory of turbulence.

**AME 34104                      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.

**AME 34105                      Wave Propagation & 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

**AME 34106                      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

**AME 34107                      Data Mining: Concepts, Techniques Applications                      [3-1-0]**

Introduction: What is data mining, the data mining process and software for data mining.

Methodology: Organization of the data, classification of the data, data matrix, transformation of the data and other data structure.

Exploratory analysis: Univariate exploratory analysis, bivariate exploratory analysis and multivariate exploratory analysis of quantitative data, reduction of dimensionality.

Computational data mining: Measures of distance, cluster analysis, logistic regression, tree models and local model.

Evaluation of data mining method: Criteria based on scoring function Bayesian criteria, computational criteria and criteria based on loss functions.

Application: Market basket analysis, customer relationship management, credit scoring, profiling website visitors and forecasting television audience

## **AME 34108**

## **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 Resolvent and Spectrum, Use of Complex Analysis in Spectral Theory. Banach Algebras, Further properties of Banach Algebra. Gelfand - Naimark theorem.

## **AGL**

## **Geo-statistics**

**[3-1-0]**

Classical Statistics: Universe, Population and Sample; Concept of Random variable; Probability distributions, *viz.* Normal (Gaussian) and Lognormal – properties, characteristics, population moments, confidence limits; Techniques of normal and lognormal probability distribution model fit to observational data – probability graph method, numerical approximations and chi-squared goodness of fit;

Concepts of Geostatistics: Concepts of Support, Autocorrelation, Random Function, Regionalised variable; Schools of Geostatistical thoughts; What, When and Why of Geostatistics; Stationarity and intrinsic hypotheses; Exploratory data analysis.

Semi-variogram: Definition, formulation, properties, mathematical relationship with covariogram, characteristics of an experimental semi-variogram; Calculation of experimental semi-variograms in 1-, 2-, and 3-dimensions with effect of change in support; Mathematical models of semi-variogram; Techniques of model fitting, *viz.* hand fit, non-linear least square, and point kriging cross validation techniques; Practical difficulties associated with semi-variography, *viz.* spatial anisotropy, non-stationarity and proportional effect, regularization, nugget effect, and presence of trend; Other types of semi-variograms, *viz.* accumulation semi-variogram and cross-semivariogram.

Extension and Estimation Variance: Definitions, formulation, and methods of calculation, *viz.* method of discretization and use of auxiliary functions; Dispersion variance – definition, formulation and its calculation.

Kriging: Introduction and definition; Linear kriging – Ordinary kriging and Simple kriging; Solving kriging system of equations for Point and Block Kriged Estimate and Kriging Variance – case with two samples, general case with many samples and in presence of nugget effect. Influence of Nugget effect on kriging weights; Properties of kriging, *viz.* Screen effect; Shadow effect; Volume-variance relationship; Conditional bias in kriging.



**AME 34112****Heat & 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.

**AME 34113****Analytical Mechanics****[3-1-0]**

Dynamical systems, generalized coordinates, degrees of freedom, holonomic and non-holonomic systems, Lagrange's equations for holonomic systems, Lagrange's equation for impulsive forces and for systems involving dissipative forces, conservation theorems, Hamilton's principle and principle of least action, Hamilton's canonical equations, canonical transformation with different generating functions, Lagrange and Poisson brackets and their properties, Hamilton-Jacobi equations, Hamilton-Jacobi theorems and their applications.

**AME 34114****Fuzzy Set Theory & Application****[3-1-0]**

Basic concepts of fuzzy sets and fuzzy logic, Motivation, Fuzzy sets and their representations, Membership functions and their designing, Operations on fuzzy sets, Convex fuzzy sets, Alpha-level cuts, Geometric interpretation of fuzzy sets, Fuzzy numbers and Linguistic variables, Fuzzy rules, Composition of fuzzy relations, Arithmetic operations on fuzzy numbers, Fuzzy reasoning.

Fuzzy mapping rules and fuzzy implication rules, Fuzzy rule-based models for function approximation, Types of fuzzy rule-based models (the Mamdani, TSK, and standard additive models), Fuzzy implications and approximate reasoning.

Fuzzy logic and probability theory, Possibility versus probability, Probability of a fuzzy event, Baye's theorem for fuzzy events, Probabilistic interpretation of fuzzy sets.

Decision making in Fuzzy environment, Fuzzy Decisions, Fuzzy Linear programming, Fuzzy Multi criteria analysis, Multiobjective decision making.