ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Subject Code Format:

A1	A2	B3	C4	C5	C6
School/ Dept. (Offering)		**Level**	**0:** AC	**Serial Number (01 to 99)**	
BH: Basic Sciences and Humanities		**1:** UG/ Int. Msc. **(**1st Year**)**	**1:** PC	01/ 03/…/ 19: Odd Sem. **(**CHEM**)**	
CS: Computer Sciences		**2:** UG/ Int. Msc. **(**2nd Year**)**	**2:** PE	21/ 23/…/ 39: Odd Sem. **(**HUM**)**	
EE: Electrical Sciences		**3:** UG/ Int. Msc. **(**3rd Year**)**	**3:** OE	41/ 43/…/ 59: Odd Sem. **(**MATH**)**	
EI: Electronic Sciences		**4:** UG/ Int. Msc. **(**4th Year**)**	**4:** MC	61/ 63/…/ 79: Odd Sem. **(**PHY**)**	
IP: Infrastructure and Planning		**5:** UG/ Int. Msc. **(**5th Year**)**	**5:** LC	81/ 83/…/ 99: Odd Sem. **()**	
MS: Mechanical Sciences		**6:** PG **(**1st Year**)**	**6:** PR		
BT: Biotechnology		**7:** PG **(**2nd Year**)**	**7:** SE	02/ 04/…/ 20: Even Sem. **(**CHEM**)**	
TE: Textile Engineering		**8:** Ph.D.	**8:**	22/ 24/…/ 40: Even Sem. **(**HUM**)**	
			9:	42/ 44/…/ 60: Even Sem. **(**MATH**)**	
				62/ 64/…/ 80: Even Sem. **(**PHY**)**	
				82/ 84/…/ 98: Even Sem. **()**	

Abbreviation used

I:	Integrated Program	PR:	Project	GE:	Generic Elective/Interdisciplinary
P:	Postgraduate Program	SE:	Seminar	SEC:	Skill Enhancement Course
PC:	Professional Core	AC:	Audit course	DSE:	Discipline Specific Elective
PE:	Professional Elective	PH:	Physics	L:	Lecture
CC:	Core Course	CY:	Chemistry	T:	Tutorial
CE	Core Elective	MH:	Mathematics	P:	Practical
OE:	Open Elective	HS:	Humanities	IA:	Internal Assessment
MC:	Mandatory Course	CS:	Computer Science	EA:	End-Semester Assessment
LC:	Lab Course	AECC:	Ability Enhancement Compulsory Course	PA:	Practical Assessment

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1st SEMESTER

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
AECC-1	BH1431	English For Communication	2	0	0	2	40	60	-	100
AECC-1 Lab	BH1531	English For Communication Laboratory	0	0	2	1	-	-	100	100
SEC-1	CS1481	Fundamentals Of Computers & Programming In C	3	0	0	3	40	60	-	100
SEC Lab-1	CS1581	Programming In C Laboratory	0	0	2	1	-	-	100	100
GE-1	BH1361	Physics-I	3	0	0	3	40	60	-	100
GE Lab-1	BH1571	Physics Laboratory-I	0	0	3	2	-	-	100	100
CC-1	BH1141	Discrete Mathematical Structures	3	1	0	4	40	60	-	100
CC-2	BH1143	Calculus And Analytic Geometry	3	1	0	4	40	60	-	100
CC-3	BH1145	Linear Algebra	3	1	0	4	40	60	-	100
		Total credit	**17**	**3**	**7**	**24**	**240**	**360**	**300**	**900**

2nd SEMESTER

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
AECC-2	BH1432	Communication In Practice	2	0	0	2	40	60	-	100
AECC Lab-2	BH1532	Communication In Practice Laboratory	0	0	2	1	-	-	100	100
GE-2	BH1372	Physics-II	3	0	0	3	40	60	-	100
GE Lab-2	BH1572	Physics Laboratory-II	0	0	2	1	-	-	100	100
CC-4	BH1142	Algebra-I	3	1	0	4	40	60	-	100
CC-5	BH1144	Analysis-I	3	1	0	4	40	60	-	100
CC-6	BH1146	Probability Theory	3	1	0	4	40	60	-	100
GE-3	CS1484	Data Structure Using C	3	1	0	4	40	60	-	100
GE Lab-3	CS1584	Data Structure Using C Laboratory	0	0	3	2	-	-	100	100
		Total credit	**17**	**4**	**7**	**25**	**240**	**360**	**300**	**900**

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3rd SEMESTER

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
GE-4	BH2371	Physics-III	3	0	0	3	40	60	-	100
GE Lab-4	BH2571	Physics Laboratory-III	0	0	2	1	-	-	100	100
GE-5	BH2331	Economics	3	0	0	3	40	60	-	100
CC-7	BH2141	Ordinary Differential Equations	3	1	0	4	40	60	-	100
CC-8	BH2143	Statistics	3	1	0	4	40	60	-	100
CC-9	BH2145	Analysis-II	3	1	0	4	40	60	-	100
DSE-1	CS2281	Design & Analysis Of Algorithms	3	1	0	4	40	60	-	100
DSE Lab-1	CS2581	Design & Analysis Of Algorithms Laboratory	0	0	3	2	-	-	100	100
		Total credit	**18**	**4**	**5**	**25**	**240**	**360**	**200**	**800**

4th SEMESTER

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
AECC-3	BH2402	Environmental Science	2	0	0	2	40	60	-	100
SEC-3	BH2432	Organizational Behavior	2	0	0	2	40	60	-	100
GE-6	BH2362	Physics-IV	3	0	0	3	40	60	-	100
GE Lab-6	BH2572	Physics Laboratory-IV	0	0	2	1	-	-	100	100
CC-10	BH2142	Geometry Of Curves & Surfaces	3	1	0	4	40	60	-	100
CC-11	BH2144	Numerical Methods	3	0	0	3	40	60	-	100
CC-12	BH2146	Mathematical Methods	3	1	0	3	40	60	-	100
CC Lab-1	BH2542	Numerical Analysis Laboratory	0	0	3	2	-	-	100	100
DSE-2	CS2282	Operating System	3	1	0	4	40	60	-	100
DSE Lab-2	CS2582	Operating System Laboratory	0	0	3	2	-	-	100	100
		Total credit	**19**	**3**	**8**	**26**	**280**	**420**	**300**	**1000**

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5th Semester

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
SEC-4	BH3321	Indian Society, Ethics & Culture	3	0	0	2	40	60	-	100
CC-13	BH3141	Advanced Calculus	3	1	0	3	40	60	-	100
CC-14	BH3143	Mathematical Modeling & Simulation	3	0	0	3	40	60	-	100
CC-15	BH3145	Fuzzy And Rough Set Theory	3	1	0	4	40	60	-	100
CC Lab-2	BH3541	Matlab Lab	0	0	3	2	-	-	100	100
DSE-3	CS3281	Relational Database Management System	3	1	0	4	40	60	-	100
DSE Lab-3	CS3581	Relational Database Management System Laboratory	0	0	3	2	-	-	100	100
DSE-4	CS3283	Java Programming	3	1	0	4	40	60	-	100
DSE Lab-4	CS3583	Java Programming Laboratory	0	0	3	2	-	-	100	100
		Total credit	**18**	**4**	**9**	**26**	**240**	**360**	**300**	**900**

6th Semester

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
CC-16	BH3142	Operations Research	3	1	0	4	40	60	-	100
CC-17	BH3144	Complex Analysis	3	1	0	4	40	60	-	100
CC-18	BH3146	Differential Equations-II	3	1	0	4	40	60	-	100
CC-19	BH3148	Computer Network	3	1	0	4	40	60	-	100
CC-20	BH3150	Coding Theory	3	1	0	4	40	60	-	100
CC Lab-3	BH3542	Operations Research Laboratory	0	0	3	2	-	-	100	100
CC Lab-4	BH3544	Statistical Data Analysis Laboratory Using Statistica / Python / R	0	0	3	2	-	-	100	100
		Total credit	**15**	**5**	**6**	**24**	**200**	**300**	**200**	**700**

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7th Semester

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
PC-1	BH4141	Advanced Analysis	3	1	0	4	40	60	-	100
PC-2	BH4143	Advanced Linear Algebra	3	1	0	4	40	60	-	100
PC-3	BH4145	Advanced Differential Equations	3	1	0	3	40	60	-	100
PE-1	BH4241/ BH4243	Graph Theory / Computational Finance	3	0	0	3	40	60	-	100
PE-2	CS4281/ CS4283	Soft Computing / Mobile Computing	3	0	0	3	40	60	-	100
MC-1	CS4481	Software Engineering	3	0	0	3	40	60	-	100
SEMINAR	BH4741	Seminar-I	0	0	3	1	-	-	100	100
		Total credit	**18**	**3**	**3**	**21**	**240**	**360**	**100**	**700**

8th Semester

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
PC-4	BH4142	Topology	3	1	0	3	40	60	-	100
PC-5	BH4144	Probability And Stochastic Processes	3	1	0	4	40	60	-	100
PC-6	BH4146	Advanced Numerical Analysis	3	1	0	3	40	60	-	100
PC-7	BH4148	Abstract Algebra	3	1	0	3	40	60	-	100
MC-2	CS4484	Computer Graphics	3	0	0	3	40	60	-	100
MC-3	CS4482	Data Mining	3	0	0	3	40	60	-	100
MC-3 Lab	CS4582	Data Mining Laboratory Using Matlab	0	0	3	2	-	-	100	100
		Total credit	**18**	**4**	**3**	**21**	**240**	**360**	**100**	**700**

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9th Semester

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
PC-8	BH5141	Functional Analysis	3	1	0	4	40	60	-	100
PC-9	BH5143	Machine Learning	3	1	0	3	40	60	-	100
PC-10	BH5145	Optimization Theory	3	1	0	3	40	60	-	100
PC-11	BH5147	Matrix Computation	3	0	0	3	40	60	-	100
PE-3	BH5241/ BH5243/ BH5245	Multi Variate Analysis / Numerical Optimization / Numerical Solution Of Differential Equation	3	1	0	3	40	60	-	100
PC Lab-1	BH5541	Optimization Lab	0	0	3	2	-	-	100	100
PC Lab-2	BH5543	Matrix Computation & Machine Learning Lab Using R	0	0	3	2	-	-	100	100
		Total credit	**15**	**4**	**6**	**20**	**200**	**300**	**200**	**700**

10th Semester

Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
			L	T	P		IA	EA	PA	Total
PC-12	BH5142	Number Theory And Cryptography	3	1	0	3	40	60	-	100
PC-13	BH5144	Theory Of Computation	3	1	0	3	40	60	-	100
PE-4	CS5282/ CS5284	Image Processing / Fractal And Chaos Theory	3	0	0	2	40	60	-	100
PE-5	BH5242/ BH5244/ BH5246/ BH5248	Finite Element Method / Advanced Machine Learning / Differential Geometry/ Computational Fluid Dynamics	3	1	0	3	40	60	-	100
SEMINAR-2	BH5742	Seminar-II	0	0	2	1	-	-	100	100
PROJECT	BH5642	Project	0	0	6	6	-	-	100	100
		Total credit	**12**	**3**	**8**	**18**	**160**	**240**	**200**	**600**

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Semester-1

Core 1: Discrete Mathematical Structures (BH1141)

Prerequisites: Set theory.

Module-I: (10hrs)

Propositional Logic:Propositions, connectives, well-formed formula, truth tables, logically equivalent formulas, tautology, contradiction, contingency, concept of proof, inference rules and natural deduction, completeness and soundness, predicate logic: existential and universal quantifiers, laws of inference and natural deduction Proof techniques: Introduction to different standard proof techniques such as trivial proofs, Vacuous proofs, Direct proofs, Proof by Contra positive (indirect proof), Proof by Contradiction (indirect proof) , Proof by Cases, Proofs of equivalence, Existence Proofs (Constructive & Non-constructive), Uniqueness Proofs, Mathematical Induction, Recursive definition and structural induction.

Set Theory: Review of Basic Set Operations, representation of set, finite and infinite set, countability and uncountability, countability of rationals, uncountability of reals,.

Module-II: (10hrs)

Relations: Relation and their properties, Partitions, Closure of Relations, Warshall's Algorithm, Equivalence relations, Partial orderings, lattice, topological ordering

Boolean Algebras :Lattices, Principle of Duality, Boolean Lattices, Boolean Algebras, Boolean Functions and Properties .

Module-III: (8hrs)

Counting: sum and product rules, permutations and combinations, number of non-negative integral solutions of a linear equation

Advanced counting techniques: Recurrence relation, Solution to recurrence relation, Generating functions, pigeonhole principle and their applications, Principle of Inclusion and exclusion and its application

Module-IV: (12hrs)

Introduction to graph theory, Graph terminology, Representation of graphs: adjacency matrix, incidence matrix, adjacency list, modeling applications using graphs, graph isomorphism, connectivity, Eulerian graphs and their characterization, Hamiltonian graphs and sufficient conditions for Hamiltonian, Shortest path problems, Planar graph, Graph coloring,

Introduction to trees, various characterizations of trees, Application of trees, Depth first search, breadth first search, testing connectedness and acyclicity, Minimum Spanning tree: Kruskal's Algorithm, Prim's Algorithm.

Text Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Sixth Edition, 2008, Tata McGraw Hill Education, New Delhi. Chapters: 1, 2(2.4), 4, 6(6.1, 6.2, 6.4-6.6), 7, 8, 9
2. C. L. Liu and D. Mohapatra, "Elements of Discrete Mathematics", Third Edition, 2008, Tata McGraw Hill Education, New Delhi Chapters: 10 (10.1- 10.10), 11(11.1 – 11.7)

Reference Books:

1. J. L. Mott, A. Kandel, T. P. Baker, "Discrete mathematics for Computer Scientists & Mathematicians", Second Edition, PHI.
2. Gosset "Discrete Mathematics "Second Edition, Wiley
3. NarsinghDeo, "Graph Theory with applications to engineering and computer science", PHI

4. Douglas B. West, "Introduction to Graph Theory" 2e, PHI
5. B. Kolman, R.C. Busby, S. C. Ross, N. Rehman, "Discrete Mathematical Structures", Pearson.

Course Outcomes: After the successful completion of this course the students will be able to

1. Write an argument using logical notation and determine if the argument is valid or not.
2. Apply counting principles to determine probabilities.
3. Demonstrate an understanding of relations and functions and be able to determine their properties.
4. Model problems in Computer Science using graphs and trees.

Core 2: Calculus and Analytic Geometry (BH1143)

Prerequisites: Understanding ofDifferentiation and Integration of functions.

Module-I: (12hrs)
Asymptotes in Cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates, curvature, radius of curvature for Cartesian curves, polar curves, Newton's method, centre of curvature, circle of curvature, chord of curvature. Cusp, Nodes & conjugate points, Types of cusps, Tracing of curves in Cartesian, Parametric, and Polar coordinates, Trace (Folium of Descartes, Strophoid, Astroid, Cycloid, Cardioids, Lemniscates of Bernoulli)

Module-II: (8hrs)
General equation of the Sphere, intersection of a sphere and a plane, intersection of two spheres, family of spheres, Intersection of a sphere and a line, Tangent plane, condition of tangency, equation of a cone, Enveloping cone of a sphere, cylinder, Enveloping cylinder of a sphere, Right circular cone & cylinder.

Module-III:(8hrs)
Functions of several variables, Limit and Continuity, Partial derivatives, Differentiability, Chain rule, Directional derivatives, Gradient vectors, tangent planes, Extreme values and saddle points, Lagrange multiplier

Module-IV: (12hrs)
Vector differential calculus: vector and scalar functions and fields, Derivatives, Curves, tangents and arc length, double integral, triple integral, gradient, divergence, curl
Vector integral calculus: Line Integrals, Green Theorem, Surface integrals, Gauss theorem and Stokes Theorem

Text Books:

1. Differential Calculus by Shanti Narayan & P K Mittal, S. Chand Publication, Chapters 14 (14.1-14.6), 15, 16, 17
2. Calculus by M.J. Strauss, G.L. Bradley & K.J. Smith, 3rd edition, Pearson,Chapters 10 (10.1-10.2), 11 (11.1-11.8), 12, 13
3. Analytical Geometry of Quadratic Surfaces by B P Acharya & D C Sahu, Kalyani publisher Chapters: 2, 3

Reference Books:

1. Analytical Solid Geometry by Shanti Narayan
2. Calculus and Analytic Geometry by G.B. Thomas and R.L. Finney, 9th edition, Addison-Wesley Publishing Company.
3. Function of Several Variables by N C Bhattacharya

Course outcomes: After the successful completion of this course the students will be able to

1. draw the graph of some curves using curve tracing andlearn the concept of geometrical figures such as sphere, cylinder, cone.
2. compute partial differentiation of various functions and determine their maximum and minimum values
3. apply gradient to solve problems involving steepest ascent and normal vectors to level curves
4. apply Fundamental Theorem of Line Integrals, Green's Theorem, Stokes' Theorem, or Divergence Theorem to evaluate integrals.

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Core 3: Linear Algebra (BH1145)

Prerequisites: Basic ideas of Matrices

Module-I: (12hrs)
Geometric interpretation of solution of system of equations in two and three variables; matrix notation; solution by elimination and back substitution; interpretation in terms of matrices, elimination using matrices; elementary matrices, properties of operations on matrices. Definition and uniqueness; non-existence in general: singular matrices; calculation of inverse using Gauss-Jordan elimination; existence of one sided inverse implies invertibility; decomposition of a matrix as product of upper and lower triangular matrices.

Module-II: (9hrs)
Vector spaces and Subspaces, Solving Ax=0 and Ax=b, Linear Independence, Basis and Dimension, The four fundamental Subspaces, graph and networks, Linear Transformations,Orthogonal Vectors and Subspaces, Cosines and Projections onto Lines, Projections and Least Squares, orthogonal Bases and Gram-Schmidt.

Module-III:(9hrs)
The Faster Fourier Transform, Properties of the determinant, formulas for the determinant, Expansion of determinant of a matrix in Cofactors, Applications of Determinants,Eigen values and eigenvectors, Diagonalisation of a Matrix.

Module-IV: (10hrs)
Difference equations and powers A^k, Markov Matrices, Differential equations and e^{At}, stability of differential equation, complex Matrices, unitary Matrices, similarity transformations, Jordan Form, minima, maxima and saddle points, tests for positive definiteness, Test for positive definiteness, singular value decomposition, minimum principles.

Text Book:
1. Strang, Introduction to Linear Algebra, 4thed., Wellesley Cambridge Press.Chapters-1-5, 6.1,6.2,6.3,6.4.
2. Introduction to linear algebra by V. Krishnamurty.

Reference Books:
1. I.N. Herstein, Topics in algebra, 2nd edition, 1975.
2. M. Artin, Algebra, Prentice-Hall of India.
3. Hoffman and Kunze, Linear Algebra, 2nd ed., PHI.
4. S. Kumaresan, Linear Algebra, a geometric approach, PHI.
5. Dummit : Abstract Algebra , Wiley

Course outcomes: After the successful completion of this course the students will be able to
1. Use Gauss-Jordan elimination to solve systems of linear equations and to compute the inverse of an invertible matrix.
2. Use the basic concepts of vector and matrix algebra, including linear dependence/ independence, basis and dimension of a subspace, rank and nullity, for analysis of matrices and systems of linear equations.
3. Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to diagonalize matrices when this is possible; discriminate between diagonalizable and non-diagonalizable matrices.
4. Orthogonally diagonalize symmetric matrices and quadratic forms.

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GE 1: Physics-I (BH1361)

Module-I: (10 hrs)

Motion of a system of particles: centre of mass, velocity, acceleration, momentum, Equation of motion, Kinetic energy and angular momentum of centre of mass. Conservation of linear momentum and angular momentum for system of particles, moment of inertia, parallel axis theorem perpendicular axis theorem. Moment of inertia of cylinder and sphere. Rotational kinetic energy and power, g by compound pendulum (bar pendulum). Gravitational force, field potential energy and potential, gravitational potential and field at a point due to a thin spherical shell and a solid sphere.

Module-II : (10Hrs)

Central force motion, reduction of two body problems into an equivalent one body problem, general characteristics of central force motion. Derivation of Kepler's laws of planetary motion from gravitational force.

Relation between elastic constants. Torsion of a cylinder, bending of beams, expression for bending moment, equation for bending, depression occurring at the free ends of a light, heavy cantilever.

Viscosity of liquids, laminar flow through a narrow tube and Poisseuille's formula surface tension - pressure difference across curved membrane.

Module-III: (10Hrs)

Oscillation and Waves

Simple harmonic oscillator, damped harmonic oscillator, power loss, Q - factor, overdamped motion, critical damping, forced vibration, resonance, sharpness of resonance. Mathematical description of travelling waves, wave equation. Transverse waves in a stretched string longitudinal waves in a gaseous medium.

Text Books:

1. Classical Mechanics -H Goldstein (Narosa)
2. Mechanics - D. S Mathur (S. Chand)
3. Classical Mechanics -M. Das, P.K Jena (Sri krishna Publication)

Reference Books:

1. Classical Mechanics - Rana AndJoag (TMH)
2. Introduction to Classical Mechanics -Takwale&Purnaik (TMH)
3. Mechanics -K R Simon (Addision Wesley)
4. Properties of matter -Searle and Neaman (Arnold Publication)
5. Classical Mechanics -Kibble

Course Outcomes:

1. State the conservation principles involving momentum, angular momentum and energy and understand that they follow from the fundamental equations of motion
2. Have a deep understanding of Newton's laws, properties of matter.
3. Solve for the solutions and describe the behavior of a damped and driven harmonic oscillator in both time and frequency domains
4. Describe the behavior of waves at interfaces (reflection, transmission, impedance) and their behavior in dissipative media (damping)

AECC-1: English for Communication (BH1431)

Module-I : **(6 Hrs)**
Introduction to Communication:
1.1 Importance of Communication in English
1.2The process of communication and factors that influence the process of communication:
Sender, receiver, channel, code, topic, message, context, feedback, 'noise'.
1.3 Principles of Communication.
1.4 Barriers to Communication & Communication Apprehension
1.5Verbal (Spoken and Written) and non-verbal communication, Body language and its importance in communication.

Module-II : (7 hrs)
Phonetics and Functional Grammar
2.1 Sounds of English: Vowels (Monopthongs and Diphthongs), Consonants
2.2 Syllable division, stress (word, contrastive stress) & intonation
2.3 MTI and problem sounds
2.4Review of Parts of Speech
2.5 Subject and Predicate, Tense, Voice Change
2.6 Idioms and Phrasal Verbs

(Note:This unit should be taught in a simple, non-technical,application oriented manner, avoiding technical terms as far as possible.)

Module-III : (7 hrs)
Reading Literature
Prose:
i) Stephen Leacock: My Financial Career
ii) Mahatma Gandhi: from My Experiments with Truth.
iii) O'Henry: The Last Leaf

Poetry:
i) Nissim Ezekiel: Professor
ii) Jack Prelutsky: Be glad your nose is on your face.
iii) Maya Angelou: Still I rise (Abridged)

Text Books :

1. Paul V. Anderson, Technical Communication, Cengage Learning, 2014.
2. Leech, Geoffrey and Ian Swartik., A Communicative Grammar of English, Longman, 2003.

Reference Books :

1. O'Connor, J.D., Better English Pronunciation, Cambridge University Press, 1980.
2. Wren & Martin, English Grammar and Composition, S. Chand,1995.

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SEC 1: Fundamentals of computers & Programming in C (CS1481)

Module-I: (10 hrs)

Digital Logic Fundamentals: Logic Gates, Introduction to Multiplexer, De-multiplexer, Encoder, Decoder & Flip-Flops.

Introduction to Computer Fundamentals: Basic architecture of computer, Functional units, Operational concepts, Bus structures, Von Neumann Concept

Instruction code, Instruction set, Instruction sequencing, Instruction cycle, Instruction format, addressing modes, Micro instruction, Data path, hardwired controlled unit, Micro programmed controlled unit.

Generation of Programming languages, Compiler, Linker, Loader

Module-II: (10 hrs)

C language fundamentals: Character set, Key words, Identifiers, data types, Constants and variables, Statements, Expressions, Operators, Precedence and associativity of operators, Side effects, Type conversion, Managing input and output

Control structures: Decision making, branching and looping.

Arrays: one dimensional, multidimensional array and their applications, Declaration, storage and manipulation of arrays

Strings: String variable, String handling functions, Array of strings

Functions: Designing structured programs, Functions in C, Formal vs. actual arguments, Function category, Function prototype, Parameter passing, Recursive functions.

Storage classes: Auto, Extern, register and static variables

Module-III: (10 hrs)

Pointers: Pointer variable and its importance, pointer arithmetic and scale factor, Compatibility, Dereferencing, L-value and R-value, Pointers and arrays, Pointer and character strings, Pointers and functions, Array of pointers, pointers to pointers, Dynamic memory allocation

Structure and union: declaration and initialization of structures, Structure as function parameters, Structure pointers, Unions.

File Management: Defining and opening a file, Closing a file, Input/output Operations in files, Random Access to files, Error handling.

Text Books:

1. William Stalling, “Computer Organization and Architecture” Pearson Education
2. Balagurusamy: “C Programming” Tata McGraw - Hill

Reference Books:

1. J. P. Hayes “Computer Architecture and Organization" McGraw Hill Education India.
2. H. Schildt – “C the complete Reference” McGraw - Hill
3. K.R. Venugopal, S.R. Prasad, “Mastering C, McGraw - Hill Education India

Course Outcomes

1.Makes students gain a broad perspective about the uses of computers in engineering industry.
2.Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.
3. Develops the ability to analyze a problem, develop an algorithm to solve it.
4.Develops the use of the C programming language,develop various algorithms using C.

Lab 1(GE Lab 1): Physics Lab-I (BH1571)

List of Experiment

1. Determination of accurate weight of a body using balance by Gauss method.
2. Error analysis using Vernier caliper, screw gauge and spherometer.
3. Determination of velocity of sound by resonance column method.
4. To determine acceleration due to gravity by bar pendulum and study of the effect of amplitude on time period.
5. To determine the acceleration due to gravity by Katter's pendulum.
6. Verification of laws of vibration of string using sonometer.
7. Determination of Young's modulus of wire by Searle's method.
8. Determination of rigidity modulus of rod by static method.
9. Determination of surface tension of water by using capillary rise method.
10. Determination of viscosity of liquid by Poiseuille's method.
11. Determination of specific heat of solid/liquid applying radiation correction.
12. To study the velocity of sound by Kundt's tube.
13. Calculate surface tension of mercury by using capillary rise method.
14. To determine the moment of inertia of a flywheel about its axis of rotation.
15. To determine the Young's modulus of a wire using optical lever method.

Course Outcomes

- The hands-on exercises undergone by the students will help them to apply physics principles.

Lab 2 (AECC-1 Lab): English for Communication Lab(BH1531)

There will be 10 sessions of 2 hours each. Lab sessions will give a platform for the students to indulge in activities based on the first two modules of theory taught in the class room. All the lab classes will be divided in such a manner that all the four aspects of language (LSRW) are covered.

Ist session:
Speaking: Ice-breaking and Introducing each other (1 hour), Writing: Happiest and saddest moment of my life (1 Hour)
IInd session:
Listening: Listening practice (ear-training): News clips, Movie clips, Presentation, Lecture or speech by a speaker (1 Hour), Speaking: Debate (1 Hour)
IIIrd session:
Reading: Reading comprehension (1 Hour), Writing: Creative writing (Short story: Hints to be given by the teacher) (1 Hour)
IVth session:
Reading: Topics of General awareness, Common errors in English usage (1 Hour), Writing: Construction of different types of sentences (1 Hour)
Vth session:
Speaking: Practice of vowel and consonant sounds (1 Hour), Writing: Practice of syllable division (1 Hour)
VIth session:
Speaking: My experience in the college/ or any other topic as per the convenience of the student (1 Hour), Writing: Phonemic transcription practice (1 Hour).
VIIth session:
Listening: Practice of phonetics through ISIL system and also with the help of a dictionary (1Hour), Speaking: Role-play in groups (1 Hour)
VIIIth session:
Speaking: Practice sessions on Stress and Intonation (1Hour), Writing: Practice sessions on Grammar(Tense and voice change)(1 Hour)
IXth session:
Speaking: Extempore, (1 Hour),Writing: Framing sentences using phrasal verbs and idioms (1 Hour).
Xth session:
Watching a short English movie (1 Hour), Writing: Critical analysis of the movie (1 Hour).

REFERENCE BOOKS:

1. Lab Manual Cum Workbook, English Language CommunicationSkills, Cengage Learning, 2014.

Note: 70 marks will be devoted for sessions, 10 marks for record submission, 10 marks for viva-voce and 10 marks for project work.

End term assignment: Students are required to make a project report of at least5 pages on a topic on the following broad streams: Technology, General awareness, Gender, Environment, Cinema, Books and the like. The assignment should involve data collection, analysis and reporting.

Lab 3 (SEC Lab 1): Programming in 'C' Lab (CS1581)
(Minimum 10 programs to be done covering 8 Experiments)

Experiment No. 1

a) Write a C program to find the sum of individual digits of a positive integer.
b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Experiment No. 2

a) Write a C program to calculate the following Sum:
Sum=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!
b) Write a C program to find the roots of a quadratic equation.

Experiment No. 3

a) Write C programs that use both recursive and non-recursive functions
   i) To find the factorial of a given integer.
   ii) To find the GCD (greatest common divisor) of two given integers.
   iii) To solve Towers of Hanoi problem.

Experiment No. 4

a) Write a C program to find both the larges and smallest number in a list of integers.
b) Write a C program that uses functions to perform the following:
   i) Addition of Two Matrices
   ii) Multiplication of Two Matrices

Experiment No. 5

a) Write a C program that uses functions to perform the following operations:
   i) To insert a sub-string in to given main string from a given position.
   ii) To delete n Characters from a given position in a given string.
b) Write a C program to determine if the given string is a palindrome or not

Experiment No. 6

a) Write a C program to construct a pyramid of numbers.
b) Write a C program to count the lines, words and characters in a given text.

Experiment No.7

a) Write a C program that uses functions to perform the following operations:
   i) Reading a complex number
   ii) Writing a complex number
   iii) Addition of two complex numbers
   iv) Multiplication of two complex numbers (Note: represent complex number using a structure.)

Experiment No. 8

a) Write a C program which copies one file to another.
b) Write a C program to reverse the first n characters in a file.

(Note: The file name and n are specified on the command line.)

Course Outcomes

1. Develop a C program.
2. Control the sequence of the program and give logical outputs.
3. Store different data types in the same memory.
4. Manage I/O operations in your C program.

Book: - PVN. Varalakshmi, Project Using C Scitech Publish

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Semester-2

Core 4: Algebra – I (BH1142)

Prerequisites: Set, Relation, Function.

Module-I: (10hrs)

Preliminary Notations, Group Theory: Algebraic structures, Groups, Some Examples of Groups, Subgroups, A Counting Principle, Cosets.

Module-II:(10hrs)

Normal Subgroups and Quotient Groups, Group Homomorphisms, Isomorphisms, Automorphisms, Permutation Groups.

Module-III:(10hrs)

Ring Theory: Definition & Example of Rings, Some Special Classes of Rings. Unique factorization domain, Principal ideal domain, Euclidean domains, polynomial rings over UFD.

Module-IV:(10hrs)

Field, Pigeon Hole Principle, Homomorphisms, Ideals, Quotient Rings., More Ideals and Quotient Rings, The Field of Quotients of an Integral Domain, Euclidean Rings, A particular Euclidean Ring.

Text Books:

1. Topics in Algebra, by I. N. Herstein, Wiley Eastern.
   Ch. 1, Ch. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.10, Ch. 3.1, 3.2, 3.3, 3.4
2. P.B. Bhattacharya, S. K Jain and S.R.Nagpaul: Basic Abstact Algebra, Cambridge University Press. Chapter: 5 (Art 2,3), 7(Art 1,2), 11 (Art 1-4)

Reference Books:

1. Modern Algebra by A. R. Vasishtha, Krishna PrakashanMandir, Meerut.
2. Topics in Algebra by P.N. Arora, Sultan Chand & Sons.

Course outcomes: After the successful completion of this course the students will be able to

1. Use various canonical types of groups (including cyclic groups and groups of permutations) and canonical types of rings (including polynomial rings and modular rings).
2. Analyze and demonstrate examples of groups, subgroups, normal subgroups and quotient groups, ideals and quotient rings.
3. Use the concepts of isomorphism and homomorphism for groups, rings and fields.
4. Produce rigorous proofs of propositions arising in the context of abstract algebra.

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Core 5: Analysis – I (BH1144)

Prerequisites: Set Theory

Module-I: (10hrs)
Bounded and unbounded sets, Infimum and supremum of a set and their properties, Order completeness property of R, Archimedian property of R, Density of rational and irrational numbers in R, Dedekind form of completeness property, Equivalence between order completeness property of R and Dedekind property, Order completeness in R.

Module-II:(10hrs)
Neighbourhood, Open set, Interior of a set, Limit point of a set, Closed set, Countable and uncountable sets, Derived set, closure of a set, Bolzano- Weierstrass theorem for sets,Sequence of real numbers, Bounded sequence, limit points of a sequence, limit interior and limit superior convergent and non-convergent sequences.

Module-III:(10hrs)
Cauchy's sequence, Cauchy's general principle of convergence, Algebra of sequences, Theorems on limits of sequences, Subsequence's, Monotone sequences, Monotone convergence Theorem. Infinite series and its convergence, Test for convergence of positive term series, Comparison test, Ratio test, Cauchy's root test, Raabe's test, Logarithmic test, Integral test, Alternating series, Leibnitz test, Absolute and conditional convergence.

Module-IV:(10hrs)
Continuous and discontinuous functions, Types of discontinuities, Theorems on continuity, Uniform continuity, Relation between continuity and uniform continuity.

Text Books:

1. S.C. Malik and Savita Arora: Mathematical Analysis(4th Edition), New Age International (P) Ltd. Publishers.Ch 1(1.3,1.4),Ch 2,Ch 3,Ch 4(4.1-4.8,4.10),Ch 5

Reference Books:

1. G. Das & S. Pattnaik: Fundamentals of Mathematical Analysis, TMH
2. R. G. Bartle and D.R. Sherbert, Introduction to Real Analysis (4th Edition), Wiley.
3. K. A. Ross, Elementary Analysis: The Theory of Calculus, Under graduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. Sudhir R Ghorpade and Balmohan V. Limaye, A course in Calculus and Real Analysis, Undergraduate Text in Math., Springer (SIE). Indian reprint, 2004.

Course outcomes: After the successful completion of this course the students will be able to

1. Distinguish between a bounded set and unbounded set; determine supremum and infimum of set and obtain fundamental knowledge about open sets, closed sets, countable sets and uncountable sets.
2. Calculate the limit superior, limit inferior, and the limit of a sequence; examine the convergence of a sequence and subsequence and will have basic knowledge of monotonic sequences.
3. Recognize different infinite series like positive term series, alternating series etc. and test their convergence using different methods.
4. Determine if a function is discontinuous, continuous, or uniformly continuous.

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Core 6: Probability Theory (BH1146)

Prerequisites: Permutation & Combination, Set Theory.

Module-I: (10hrs)
Random experiment, trial, sample point and sample space, events, operations of events, concepts of equally likely, mutually exclusive and exhaustive events.
Definition of probability: Classical, relative frequency and axiomatic approaches. Discrete probability space, properties of probability under set theoretic approach. Independence of events.

Module-II: (9hrs)
Conditional probability, total and compound probability theorems, Bayes theorem and its applications, Random variables – discrete and continuous probability distributions, probability function and probability density function (pdf), Cumulative distribution function (cdf).

Module-III: (9hrs)
Joint distribution of two random variables, marginal and conditional distributions. Independence of random variables. Expectation of a random variable, Expectation of sum and product of random variables, conditional expectation. Moment generating functions and its properties, their applications

Module-IV: (12hrs)
Probability distributions: Binomial, Poisson, Hyper geometric, Geometric and Negative Binomial. Uniform (discrete & continuous), Normal, Exponential, Moment generating function (m.g.f.), Normal and Poisson distributions as limiting case of binomial distribution, Weak law of large numbers, Central limit theorem.

Text Books:

1. Fundamentals of Mathematical Statistics by S.C.Gupta&V.K.Kapoor, S Chand & Sons.
2. Probability and Statistics for engineers and scientists, R. E. Walpole, R. H. Myers, mS. L. Myers, K. E. Ye, Pearson.
3. Parzen, E.S.: Modern Probability Theory and its Applications.

Reference Books:

1. StirzekarDavid:ElementryProbability, Cambridge University Press.
2. Mood A.M., Graybill F.A. and BoesD.C.:Introduction to the theory of Statistics, McGraw Hill.
3. Mukhopadhyay, P: Mathematical Statistics, new central book agency.

Course outcomes: After the successful completion of this course the students will be able to
1. demonstrate basic probability axioms and rules of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables,
2. derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions,
3. derive the moments and moment generating function of different distribution to find the mean and variance in an alternative way,
4. translate real-world problems into probability models,read and annotate an outline of a proof and be able to write a logical proof of a statement.

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

GE 2: Physics -II (BH1372)

Module-I: (10 hrs)
Scalar and vector triple product, Differentiation of a vector, The gradient operator, The divergence and curl of vector, Gauss divergence theorem, Strokes theorem. Gauss law in electrostatics and application, Computation of field due to linear spherical and plane charge distribution, Differential form of Gauss law, the energy of a point charge, discrete and continuous distribution, energy density of electrostatic field.

Module-II : (10 hrs)
Magnetic field B, Lorentz force law, The Biot savart law B due to a straight, circular, and solenoidal currents. The vector potential, Ampere circuital law & its differential form. Differential form of electromagnetic induction.

Module-III: (10 hrs)
Maxwell equation and physical significance, Wave equation, Electromagnetic waves, Wave properties, speed, growth and decay current in RC and LR circuits, impedance, Power in ac circuit, power factor, series and parallel resonant circuits, Sharpness of resonance, Bandwidth and Q - factor.

Module-IV : (10 hrs)
Rectifier:
Half wave & full wave rectifier (semiconductor devices) Principle, circuit, operation & theory. Use of L & π filters in rectifier circuits (qualitative idea)
Amplifier:
Classification of amplifier, comparison, Voltage & power gain in CB, CE &CC configuration and characteristics studies, RC coupled amplifier, Class B Push/pull amplifier (principle of amplification circuit description operation, theory and frequency response curve), feedback Amplifier: Basic circuit, operation, advantage of negative feedback.
Oscillator
Necessary of feedback, positive & negative feedback, criteria for sustained oscillation, Hartly and colpitt's oscillator (principle, circuit, operation, theory and use),
Modulation & demodulation:
Principle of modulation, A.M & F.M (Theory and differences between them), Principle of demodulation.

Text Books:
1. Introduction to Electrodynamics -D. J Griffiths (PHI)
2. Electronics -Chattopadhyay &Rakshit (New Age)
3. Electronics - B. B Swain
4. Electricity and magnetism -D. C Tayal
5. Electricity and magnetism -Satyaprakash

Reference Books:
1. Foundation of electromagnetic theory -Ritz and Milford (Narosa)
2. Electricity and magnetism -E. Purcell (Berkely Physics Course)TMH

Course Outcomes:
1. The use of Coulomb's law and Gauss' law for the electrostatic force
2. The relationship between electrostatic field and electrostatic potential
3. The use of the Lorentz force law for the magnetic force
4. The use of Ampere's law to calculate magnetic fields
5. The use of Faraday's law in induction problems
6. The basic laws that underlie the properties of electric circuit elements

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Syllabus (Effective from 2023-24)

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

AECC 2: Communication in Practice (BH1432)

Module - I : (7 hrs)

Basics of Communication in Practice

1.1 Types of Communication in an organization: Formal (internal and external) and Informal (grapevine)
1.2 Communication Channels: Upward, Downward, Diagonal and Horizontal
1.3 Introduction to cross-cultural communication.
1.4 Bias-free communication & use of politically correct language in communication
1.5 Importance of reading and ethics of writing
1.6 Negotiation Skills, Argumentation & Consensus building.

Module-II : (7 hrs)

Business Writing

2.1 Skills of Writing: Coherence, Cohesion, Sentence Linkers, Clarity of Language and stylisticvariation, process of writing.
2.2 Paragraph writing: Topic Sentence, Supporting sentence & Concluding sentence, Logical structuring (Inductive approach and deductive approach)
2.3 Letters, Applications
2.4 Reports and Proposals
2.5 Memos, Notices, Summaries, Abstracts& e-mails
2.6 Writing a CV/Resume': Types of CV
2.7 Writing a Cover letter

Module -III : (6 hrs)

Speaking and Presentation

1.1 Oral Presentation: 4 P's of presentation, PPT
1.2 Group Discussion: Structured and Un-structured, Various types of topics (abstract, absurd, contemporary etc.)
1.3 Types of Interview: Preparing an Interview and techniques
1.4 Grooming and dress code, Personality development

REFERENCE BOOKS:

1. Carol M Lehman, Debbie D Dufrene and Mala Sinha., Business Communication, Cengage Learning. 2nd Edition. 2016.
2. Anderson, Paul.V, Technical Communication, Cengage Learning, 2014.
3. Bovee, Courtland. L. et al., Business Communication Today, Pearson, 2011.
4. Jeff Butterfield, Soft Skills for Everyone, Cengage Learning, 2015

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Syllabus (Effective from 2023-24)

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

GE-3: Data Structure Using C (CS1484)

Prerequisites: C-programming language.

Syllabus:

Module-I : (10 hrs)

Introduction to data structures: storage structure for arrays, sparse matrices, Stacks and Queues: representation and application. Linked lists: Single linked lists, linked list representation of stacks and Queues. Operations on polynomials, Double linked list, circular list.

Module-II : (12 hrs)

Dynamic storage management-garbage collection and compaction, infix to post fix conversion, postfix expression evaluation. Sorting and Searching techniques – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort, Heap sort, Radix sort. Linear and binary search methods, Hashing techniques and hash functions.

Module-III : (10 hrs)

Graphs: Graph terminology, Representation of graphs, path matrix, BFS (breadth first search), DFS (depth first search), topological sorting, Warshall's algorithm (shortest path algorithm.)

Module-IV : (8 hrs)

Trees: Tree terminology, Binary tree, Binary search tree, General tree, B+ tree, AVL Tree, Complete Binary Tree representation, Tree traversals, operation on Binary tree-expression Manipulation.

Text Books:

1. Gilberg and Forouzan: "Data Structure- A Pseudo code approach with C" by Thomson publication
2. "Data structure in C" by Tanenbaum, PHI publication / Pearson publication.
3. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms", Tata McGraw Hill.

Reference Books:

1. "Fundamentals of data structure in C" Horowitz, Sahani& Freed, Computer Science Press.
2. "Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill.

Course Outcomes: After the successful completion of this course the students will be able to

1. Choose appropriate data structure as applied to specified problem definition.
2. Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
3. Apply the conceptof data structure on various domains like DBMS, compiler construction etc.
4. Learn both linear and non-linear data structures like stacks, queues, linked list etc.

Lab 4 (GE Lab 2): Physics Lab II (BH1572)

Experiment Lists:

1. Determination of reduction factor of tangent Galvanometer.
2. Determination of figure of merit of a moving coil Galvanometer.
3. Measurement of high resistance with a Galvanometer.
4. Study the charging and discharging process of a capacitor through resistor.
5. Calibration of CRO.
6. Determination of the unknown resistance of a wire using Meter Bridge (applying end correction method).
7. Comparison of emfs of cellsby stretched wire potentiometer.
8. LCR impedance apparatus.
9. Carry Foster's bridge.
10. To determine self-inductance of a coil by Rayleigh's method.
11. To determine the mutual inductance of two coils by absolute method.
12. To determine self-inductance of a coil by Anderson's bridge.
13. Conversion of voltmeter to ammeter and vice-versa.
14. To study the force experienced by a current carrying conductor placed in a magnetic field (Lorentz's force) using a mechanical balance.

Course Outcomes

- The hands-on exercises undergone by the students will help them to apply physics principles.

Lab 5 (AECC-2 Lab): Communication in Practice Lab (BH1532)

There will be 10 lab sessions of 2 hours each. Lab sessions will be used to give the students an in-hand experience of communication taking place in an organization. This will help the students to understand the requirement of communication in the workplace. Students will be encouraged to brush-up themselves in activities based on all the modules of theory taught in the class room. Special emphasis will be given to speaking and writing business correspondences.

Ist session:
Speaking: Greeting an acquaintance/ friend, introducing oneself, introducing a third person to a friend, breaking off a conversation politely, leave-taking, Describing people, objects, places, processes etc. (1 Hour), Writing an application (1 Hour)
IInd session:
Speaking: making and responding to inquiries; expressing an opinion; expressing agreement/ disagreement, contradicting/ refuting an argument; expressing pleasure, sorrow, regret, anger, surprise, wonder, admiration, disappointment etc (1 Hour), Writing an informal letter/Business Letter (1 Hour)
IIIrd session:
Speaking: Narrating or reporting an event (1 Hour), Writing a Report (1 Hour)
IVth session:
Speaking: Ordering / directing someone to do something, Making requests; accepting / refusing a request, Expressing gratitude; responding to expressions of gratitude, Asking for or offering help; responding to a request for help, Asking for directions (e.g. how to reach a place, how to operate a device etc.) and giving directions, Speaking: asking for and granting/ refusing permission, prohibiting someone from doing something, suggesting, advising, persuading, dissuading, making a proposal, praising, complimenting, felicitating, expressing sympathy (e.g. condolence etc.), Complaining, criticizing, reprimanding etc., (1 Hour), Writing a proposal (1 Hour)
Vth Session:
Speaking:Understanding and interpreting graphs, flowcharts, pictograms, pictures, curves etc., (1 Hour), Writing: Describing, explaining and interpreting graphs, flowcharts, pictograms, pictures, curves etc.
VIth session:
Speaking: Group discussion (1 Hour), Writing a memo, notice and circular (1 Hour)
VIIth session:
Speaking: In-house communication on work-related situations (1 Hour), Writing a CV (1 Hour)
VIIIth session:
Presentation 1 (Students will make and present a topic in power point on a pre-assigned topic) (1 Hour),Writing an e-mail (1 Hour)
IXth session:
Presentation 2 (Students will make and present a topic in power point on a pre-assigned topic) (1 Hour), Writing an abstract (1 Hour)
Xth session:
Presentation 3 (Students will make and present a topic in power point on a pre-assigned topic) (1 Hour), Writing a summary (1 Hour)

REFERENCE BOOKS:

1. Kumar, Sanjay &Lata, Pushp, Communication Skills A Workbook, OUP,2018

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Lab 6 (GE-3 Lab): Data Structure Using C Lab (CS1584)
(Minimum 10 experiments to be done)

Experiment No.1: Write a C program to perform matrix multiplication using array.

Experiment No.2

(a) Write a C program to create a stack using an array and perform
  (i) push operation
  (ii) pop operation

(b) Write a C program to create a queue and perform
  i) Push
  ii) pop
  iii) Traversal

Experiment No. 3: Write a C program that uses Stack operations to perform the following:
i) Converting infix expression into postfix expression
ii) Evaluating the postfix expression

Experiment No. 4

Write a C program that uses functions to perform the following operations on Single linked list:
i) Creation
ii) Insertion
iii) Deletion
iv) Traversal in both ways

Experiment No. 5

Write a C program that uses functions to perform the following operations on Double linked list:
i) Creation
ii) Insertion
iii) Deletion

Experiment No. 6

Write a C program that uses functions to perform the following operations on Binary Tree:
i) Creation
ii) Insertion
iii) Deletion

Experiment No. 7

Write C programs that use both recursive and non recursive functions to perform the Linear search operation for a Key value in a given list of integers: Linear search

Experiment No. 8

Write C program that use both recursive and non recursive functions to perform the Binary search operation for a Key value in a given list of integers:

Experiment No.9

Write a C program that implement Bubble Sort method to sort a given list of integers in descending order.

Experiment No.10

Write a C program that implement Quick Sort method to sort a given list of integers in ascending order:

Course Outcomes

1. Identifying successful troubleshooting strategies for common hardware and software issues.
2. Understanding transferrable functions between different types of software.
3. Differentiating between software types and common use cases.
4. Applying computer fundamentals knowledge to other technology, including mobile devices.

Book:- "Data structure using C" by Sudipta Mukherjee, TMH Publication

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Semester-3

Core 7: Ordinary Differential Equations (BH2141)

Prerequisites: Differentiation and Integration.

Module-I: (10hrs)
Basic Concepts of Differential Equation: Origin and Classification of Differential equation, Solution of Differential Equation, Kinds of solution, Initial and Boundary value problem, Existence and uniqueness of solution, Formation of Differential equation. First Order First Degree Equation: Variable separable, Homogenous Equation, Exact Differential equation, Integrating Factors, Linear equations, Equation reducible to linear form.

Module-II: (12hrs)
Equations of First order but of Higher Degree: Equations solvable for p, Equation solvable for y, Equation solvable for x,
Linear Equations with Constant coefficient: Linear differential equation of nth order, Homogenous Linear equation with constant coefficient, Non- Homogenous Linear equation with constant coefficient, Operators and its use to solve linear differential equations with constant coefficient, Method of Variation of Parameter, Linear Differential Equation with variable coefficient: Method of reduction of order, method based on the removal of the first derivatives.

Module-III: (10hrs)
Existence and Uniqueness of solution: Picard's method of successive Approximation, Existence and uniqueness Theorem.
Series Solution and special function: Power series, Radius of convergence of power series, Ordinary point, singular point and regular singular point (only definition), Series solution about an ordinary point.

Module-IV: (8hrs)
Legendre equation and Legendre polynomial, Orthogonality, Power series method about singular point, Bessel's equation and Bessel's function, Orthogonality in Bessel function. Boundary value problem for Ordinary Differential Equation; Sturm –Liouville Problems.

Text Books:
1. A Course on Ordinary and Partial Differential Equation by J. Sinha Roy, S Padhy, Kalyani Publisher.Chapters: 1(1.1-1.4), 2(2.1-2.7), 3(3.1-3.4), 4(4.1-4.6), 6(6.1,-6.3), 7(7.1,7.2,7.3.1,7.4.1)), 10 (10.1,10.2).

Reference Books:
1. Ordinary Differential Equation by P C Biswal (Pub- PHI).

Course Outcomes: After the successful completion of this course the students will be able to
1. know different kinds of ordinary differential equations of first order and first degree, first order and higher degree and find their solutions using the methods discussed.
2. recognize linear differential equations of higher order with constant coefficients and variable coefficients and solve the problems using the methods provided.
3. have knowledge on existence and uniqueness of solutions of an initial value problem; learn series solution of differential equations about regular points and singular points.
4. have knowledge on specific polynomials and functions (Legendre's polynomial and Bessel's function) and their properties; know how to solve Strum-Liouville problems.

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Core 8: Statistics (BH2143)

Prerequisites: Probability theory.

Module-I : (10hrs)
Primary and Secondary Data, Univariate data, Frequency distribution, Diagrammatic representation, graphical representation and Tabulation of data. Measures of central tendency, dispersion, skewness and kurtosis for data. Moments and quartiles.

Module-II : (10hrs)
SAMPLING AND SAMPLE DESIGNS: Theoretical Basis of sampling, Methods of sampling, Restricted and unrestricted random sampling, Stratified sampling Systematic sampling,Cluster sampling, Selection of appropriate method of sampling,Size of sample, merits and limitation of sampling, Sampling and Non Sampling errors, Reliability of sampling.

Module-III : (10hrs)
Theory of estimation: Consistency, efficiency, unbiasedness, sufficiency. Correlation and regression analysis, Bivariate frequency distributions.

Module-IV: (10hrs)
t, F, and χ^2 – distributions, their derivation and properties. Testing of hypothesis on t, F, and χ^2 – distributions, Acceptance sampling, Estimation of Parameters, Confidence Intervals.

Text Books:
1. Elementary Statistical Methods, S.P. Gupta, Sultan Chand & Sons.
2. Fundamentals of Mathematical Statistics, S C Gupta, V K Kapoor, S Chand and sons

Reference Books:
1. An Introduction to Probability and Statistics, V. K. Rohatgi, A.K. Md. E. Saleh, Wiley Publication.
2. Fundamentals of Statistics:A.M. Gun, M.K. Gupta and B. Dasgupta.
3. Probability and Statistics for Engineers and Scientists 9th edition, Ronald E. Walpole, Raymond H. Myers et. al, Pearson

Course outcomes: After the successful completion of this course the students will be able to
1. Utilize a comprehensive set of descriptive statistical methods in order to organize, summarize, and display data in a meaningful way;
2. Apply discrete and continuous probability distributions in order to evaluate the probability of real- world events;
3. Construct confidence interval estimates for population parameters, for single and multiple populations, based on sample data,Perform Correlation & Regression analysis, in order to estimate the linear relationship & nature of the strength of the linear relationship exist between two variables of interest.
4. Conduct hypotheses tests concerning population parameters, for single and multiple populations, based on sample data;

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Core 9: Analysis II (BH2145)

Prerequisites: Set Theory, Sequence, Series, Function, Limit, Continuity.

Module-I: (10hrs)
Derivative of a function, Relation between continuity and differentiability, Increasing and decreasing functions, Darboux theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's theorem with Cauchy's and Lagrange's form of remainders.

Module-II: (10hrs)
Definition, existence and properties of Riemann integral of a bounded function, Darboux theorem, Condition of integrability, Riemann integrability for continuous functions, bounded functions, monotonic function and functions with finite or infinite number of discontinuities (without proof). The integral as the limit of the sums, Properties of Riemann integral,

Module-III: (10hrs)
Fundamental theorem of calculus, First Mean value theorems, change of variables, Second mean value theorem, Generalized mean value Theorems,
Definition of improper integrals, Convergence of improper integrals, Test for convergence of improper integrals Comparison test, Cauchy's test for convergence, Absolute convergence, Abel's Test, Dirichlet's Test,

Module-IV: (10hrs)
Beta and Gamma functions and their properties and relations. Definition of pointwise and uniform convergence of sequences and series of functions, Cauchy's criterion for uniform convergence, Weierstrass M-test, Uniform convergence and continuity, Uniform convergence and differentiation, Uniform convergence and integration.

Text Books:

1. G Das and S Pattanaik: Fundamentals of Mathematical Analysis TataMcGraw-HillPublishing Company Limited.

Reference Books:

1. S.C. Malik and Savita Arora: Mathematical Analysis, New Age International (P) Ltd. Publishers, 1996.
2. R. G. Bartle and D.R. Sherbert, Introduction to Real Analysis (4th Edition), Wiley
3. K. A. Ross, Elementary Analysis: The Theory of Calculus, Under graduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. Sudhir R Ghorpade and Balmohan V. Limaye, a course in Calculus and Real Analysis, Undergraduate Text in Math., Springer (SIE). Indian reprint, 2004.

Course Outcomes: After the successful completion of this course the students will be able to

1. Check differentiability of functions using mean value theorems.,
2. Know Riemann Integration and solve integrals of different functions.
3. Know and solve Improper integrals.
4. Check the convergence of sequence and series of functions.

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

GE 5: Economics(BH2331)

Module-I: (10 hrs)

Engineering Economics- Nature and Scope, General concepts on micro & macro economics. The theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Theory of production, Law of variable proportion, Law of returns to scale.

Module-II : (10 hrs)

Time value of money- Simple and compound Interest, Cash flow diagram, Principle of Economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method , Annual worth method , internal rate of return method, Cost-benefit analysis in public projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, straight line method and declining balance method.

Module-III : (10 hrs)

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)

Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system.

Text Books:

1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
2. M.D.Mithani, Principles of Economics.

Reference Books:

1. Sasmita Mishra, “Engineering Economics & Costing “, PHI
2. Sullivan and Wicks, “Engineering Economy”, Person
3. R. PaneerSelvam, “Engineering Economics”, PHI
4. Gupta,” Managerial Economics”, TMH
5. Lal and Srivastav, “Coast Accounting”,TMH

Course outcomes

1. The students developed the knowledge of basic economic problems and the relationship between engineeringtechnology and economics.
2. The students has an understanding of a demand determinants and the methods of demand forecasting of a product.
3. Senmsitizing the students to the changing environments of banking scenario and to understand the finctions of RBI.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

DSE-1 Design & Analysis of Algorithms (CS2281)

Prerequisites: Discrete Mathematics. Data Structure.

Module- I: (12 hrs)
Introduction to design and analysis of algorithms, Growth of Functions (Asymptotic notations, standard notations and common functions), Recurrences, solution of recurrences by substitution, recursion tree and Master methods, worst case analysis of Merge sort, Quick sort and Binary search, Design & Analysis of Divide and conquer algorithms. Heapsort: Heaps, Building a heap, The heapsort algorithm, Priority Queue, Lower bounds for sorting.

Module –II: (8 hrs)
Dynamic programming algorithms (Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence). Greedy Algorithms - (Assembly-line scheduling, Achivity- selection Problem, Elements of Greedy strategy, Fractional knapsac problem, Huffman codes). Data structure for disjoint sets:- Disjoint set operations, Linked list representation, Disjoint set forests.

Module –III: (8 hrs)
Graph Algorithms: Breadth first and depth-first search, Minimum Spanning Trees, Kruskal and Prim's algorithms, single- source shortest paths (Bellman-ford and Dijkstra's algorithms), All- pairs shortest paths (Floyd – Warshall Algorithm). Back tracking, Branch and Bound.

Module –III : (12 hrs)
Fast Fourier Transform, string matching (Rabin-Karp algorithm), NP - Completeness (Polynomial time, Polynomial time verification, NP - Completeness and reducibility, NP-Complete problems (without Proofs), Approximation algorithms (Vertex-Cover Problem, Traveling Salesman Problem).

Text Book:
1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, C.Stein : Introduction to algorithms -2nd edition, PHI,2002. Chapters: 1,2,3,4 (excluding 4.4), 6, 7, (7.4.1), 8 (8.1) 15 (15.1 to 15.4), 16 (16.1, 16.2, 16.3), 21 (21.1,21.2,21.3), 22(22.2,22.3), 23, 24(24.1,24.2,24.3), 25 (25.2), 30,32 (32.1, 32.2) 34, 35(35.1, 35.2)

Reference Books:
1. Algorithms – Berman, Cengage Learning
2. Computer Algorithms: Introduction to Design & Analysis, 3rd edition-by Sara Baase, Allen Van Gelder, Pearson Education
3. Fundamentals of Algorithm-by Horowitz &Sahani, 2nd Edition, Universities Press.
4. Algorithms By Sanjay Dasgupta, UmeshVazirani – McGraw-Hill Education
5. Algorithm Design – Goodrich, Tamassia, Wiley India.

Course outcomes
1. Understanding critical concepts of algorithm.
2. Application and implementation of algorithm in an organized manner .
3. Essential algorithm to enhance the efficiency
4. Learn to solve a problem efficiently, and algorithm analysis helps in predicting the performance of an algorithm

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

GE 4: Physics-III (BH2361)

Module – I : (10 hrs)

Fermat's principle, reflection and refraction at plane interference, cardinal points of a coaxial optical system, cardinal points of combination of two thin lenses, elementary ideas of monochromaticaberrations and remedies, chromatic aberration, achromatic combination, Ramsden's and Huygens's eyepieces,

Module – II : (10 hrs)

Wave theory of light, Huygen's principle, condition of interference, division of wave front, biprism, colour of thin films, Newton's ring, and determination of wave length of monochromaticlight by Newton's ring.

Diffraction of light, Fresnel and Fraunhoffer diffraction, Fresnel's half period zones, Zone plate act as a convex lens.Fraunhoffer diffraction by a single slit,

Electromagnetic nature of light, Polarized and unpolarized light. Plane polarized, circularly polarized and elliptically polarized light. Polarization by reflection and refraction, Brewster's law, Malus's law. Double refraction, ordinary and extraordinary rays, construction, working and uses of Nicol prism. Half wave plate and quarter wave plate.

Module– III : (10 hrs)

Inadequacy of classical physics: review of black body radiation. Particle nature of wave, photoelectric effect, Compton effect, dual nature of radiation. Wave nature of particle – De Broglie hypothesis and wave - particle duality. Superposition of two waves, group velocity and phase velocity, wave packet. Experimental confirmation of matter waves (Davisson – Germerexperiment). Heisenberg's uncertainty principle and applications (Ground state energy of harmonic oscillator, Time dependent Schrodinger equation in one and three dimensions.The wave function, equation of continuity, probability current density and probability density. Normalization of the wave function, Expectation value of an observable

Text Books:

1. optics -A.K. Ghatak
2. Introduction to Quantum mechanics – M. Das, P.K.Jena (SrikrishnaPrakashan)

Reference Books :

1. Principle of optics – B.K.Mathur

Course Outcome:

1. Fermat's Principle can be used to establish laws of reflection and refraction at spherical surfaces.
2. The interference chapter gives the concept of light wave and its equation, meaning of coherence, interference fringes etc.
3. The diffraction chapter explains various types of diffractions in detail, knowledge of grating and its resolving power.
4. To study time-dependent and independent Schrodinger's equations with solutions in simple potentials

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Lab 7 (GE-4 Lab): Physics Lab-III (BH2571)

List of Experiments:

1. Angle of minimum deviation (I-D curve) using spectrometer.
2. Determination of resolving power of a telescope
3. Optical rotation of sugar solution by polarimeter.
4. Refractive index of glass slab using travelling microscope.
5. Refractive index of water using travelling microscope.
6. Determination of radius of curvature of a spherical mirror by Kohlrausch's method.
7. Determination of dispersive power of the material of the prism.
8. To measure voltage and Frequency of a sinusoidal wave form using a CRO and to find unknown frequency by producing Lissajous figure.
9. To study parallel resonant LCR circuit.
10. To study series resonant LCR circuit.

Course Outcome:

1. To know and handle optical instruments: spectrometer, telescope, traveling microscope etc.
2. To find electrical parameters using electrical circuits.

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Lab 8 (DSE-1 Lab): Design & Analysis Algorithms Lab (CS2581)

List of Experiments:

1. Using a stack of characters, convert an infix string to postfix string.(1 class)
2. Implement insertion, deletion, searching of a BST. (1 class)
3. (a) Implement binary search and linear search in a program (b) Implement a heap sort using a max heap.
4. (a) Implement DFS/ BFS for a connected graph. (b) Implement Dijkstra's shortest path algorithm using BFS.
5. (a) Write a program to implement Huffman's algorithm.(b) Implement MST using Kruskal/Prim algorithm.
6. (a) Write a program on Quick sort algorithm.(b) Write a program on merge sort algorithm. Take different input instances for both the algorithm and show the running time.
7. Implement Strassen's matrix multiplication algorithm.
8. Write down a program to find out a solution for 0 / 1 Knapsack problem.
9. Using dynamic programming implement LCS.
10. (a) Find out the solution to the N-Queen problem.(b) Implement back tracking using game trees.

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Duration: 5 years (Ten Semesters)

Semester-4

Core 10: Geometry of Curves & Surfaces (BH2142)

Prerequisites: Differential Calculus

Module I: (10hrs)
Curves in two and three dimensions: Tangent, Principal normal, Binormal, Curvature, Torsion, Serret-Frenet formula, unique determination of curve, Helices, Involute, Evolute,

Module II: (10hrs)
Surfaces,Tangent plane, normal, One parameter family of surfaces: Envelope, characteristics, Edge of regression, Developable surface

Module III: (10hrs)
Curvilinear coordinates on a surface, First order magnitudes, Directions on a surface, Normal, Second order magnitudes, Derivatives of normal, Curvature of normal section, Meunier's theorem.

Module IV: (10hrs)
Curves on a surface, Lines of curvature, Principal Directions, First and second curvature, Euler's theorem, Surface of revolution, Conjugate directions

Text Books:
1. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press.

Reference Books:
1. A.N. Presley, Elementary Differential Geometry, Springer
2. DoCarmo, Differential Geometry, Academic Press

Course outcomes: After the successful completion of this course the students will be able to:
1. Compute quantities of geometric interest such as curvature, as well as develop a facility to compute in various specialized systems, such as semi geodesic coordinates or ones representing asymptotic lines or principal curvatures.
2. Introduced to the method of the moving frame and overdetermined systems of differential equations as they arise in surface theory.
3. Develop the ideas of edge of regression and its characteristics.
4. Develop arguments in the geometric description of curves and surfaces in order to establish basic properties of geodesics, parallel transport, evolutes, minimal surfaces and consequences of the index theory.

Core 11: Numerical Methods (BH2144)

Prerequisites: Differentiation, Integration.

Module-I: (10 hrs)
Errors, Algorithms and Convergence, Transcendental and polynomial equations: Introduction, Bisection method, Regula-falsi method, Secant method, Fixed Point iteration, Newton-Raphson method, Rate of convergence. Error Analysis for iterative methods,
System of Linear Algebraic Equations: Pivoting Strategies, Matrix inversion, LU-Decomposition, Gauss Jacobi, Gauss –Seidel Method, Relaxation Techniques.

Module-II:(10 hrs)
Interpolation and Approximations: Introduction, Lagranges and Newton Interpolation, Finite Difference Operators, Interpolating Polynomials using Finite Differences (Forward & Backward) Least Square Approximation, Uniform Approximation. Differentiation.

Module-III:(10 hrs)
Numerical Integration: Newton Cotes Algorithm, Trapezoidal rule, Simpson's rule, Gauss – Legendre Integration Method, Ordinary Differential Equations: Euler's Method, Euler Modified Method, Runge -kutta Method.

Text Books:

1. Numerical Methods for Scientific and Engineering Computation; M.K. Jain, S. R. K. Iyengar, R.K. Jain, New Age International Pvt. Ltd.(Sixth edition).

Reference Books:

1.Numerical Mathematics and Computing: by W. Cheney, David Kincaid, Cengage publication.
2. Numerical Methods by B.P. Acharya & R.N. Das.
3. An Introduction to Numerical Analysis by K. Atkinson,Wiley.

Course outcomes: After the successful completion of this course the students will be able to

1. Apply some methods and algorithms to solve Transcendental/polynomial equations; gain knowledge on convergence of those methods analyze the errors in the iterative methods.
2. Solve systems of linear algebraic equations by the methods discussed.
3. Use methods of approximation of functions and interpolation to construct new data points based on the range of a discrete set of known data points; predict the unknown values for any geographical related data points such as noise level, rain fall and elevation etc.
4. Estimate derivatives and integrals for functions that are only known at isolated points; find numerical approximations to the solutions of ordinary differential equations which frequently arise in Physics, Chemistry, Biology and Economics etc.

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Duration: 5 years (Ten Semesters)

Core 12: Mathematical Methods (BH2146)

Prerequisites: Differentiation, Integration, Differential equation.

Syllabus:

Module-I: (14hrs)

Laplace Transform: Definition, Notation, Some simple transform, existence of Laplace transforms, Inverse Laplace Transform. Laplace transform of Derivatives, Transform of integrals, solution of differential equation using Laplace transforms, solution of simultaneous differential equation using Laplace transforms. Unit step function and its LT, Heaviside step function, 1st shifting theorem and 2nd shifting theorem, impulse function and its LT. Convolution

Module-II: (13hrs)

Z Transform: Definition and Notation, Linearity property of z transform, 1st shift property, 2nd shift property, Inverse z transform. Difference equation, Solution of Difference equation using Z transforms. Z transform function, Impulse response, Stability, convolution, Relation between Laplace transform and Z transform.

Module-III: (13hrs)

Fourier transform: Fourier integral, Fourier Transform, Linearity property, Differentiation, Time Shift Frequency shift and symmetry property of Fourier Transform, Relation between LT and FT

Fourier transform of step and impulse function, Convolution. Fourier transform of sequence, discrete FT, Estimation of the continuous FT, The fast Fourier Transform.

Text Books:

1. Advanced Modern Engineering Mathematics (3rd Edition) By Glyn James,(Pearson Education)
   Chapter 2.1,Ch-2.2.1 to 2.2.9, Ch-2.3.1 to 2.3.4, Ch-2.5.1 to2.5.4, 2.5.8 to 2.5.10, Chapter-3.1, Ch-3.2.1 to 3.2.3, Ch-3.3.1 to 3.3.5, Ch-3.4.1, ch-3.5.1 to 3.5.3, Ch-3.6.1 to 3.6.5, ch-3.7
   Chapter 5.1, Ch-5.2.1 to 5.2.4, Ch-5.3.1 to 5.3.6, Ch-5.4.1 to 5.4.3, Ch-5.5.1 to 5.5.3, Ch-5.6.1 to 5.6.6

Reference Books:

1. Advanced Engineering Mathematics (10th Edition) By Erwin Kreszig(Willey)
2. Mathematical Methods by E RukmangadaCharu (Pearson)

Course outcomes: After the successful completion of this course the students will be able to

1. Implement basic operations in Fourier series and Laplace transforms and Z transform.
2. Apply mathematical and computational methods to a range of problems in science and engineering
3. Solve differential equations and integral equations,
4. Solve problems of mechanics using Laplace, Fourier and Z transforms

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

GE 6: Physics IV (BH2362)

Module – I : (12 hrs)

Thermodynamic system and thermodynamic equilibrium, Reversible and irreversible process, internal energy, first law of thermodynamics, difference between molar specific heat of an ideal gas, Derivation of relation 〖PV〗^γ=constant for adiabatic process, work done in isothermal and adiabatic process. Entropy changes in various processes.T - S diagram, Carnot cycle, Carnot engine and its efficiency, Carnot theorem, second law of thermodynamics - Kelvin plank and Clausius formulation, their equivalence, thermodynamic scale of temperature.

Thermodynamic coordinates P.V.T and1st Tds equation, 2nd Tds equation. Clausius -Clapeyron equation, effect of pressure on melting point and boiling point, thermal conductivity, differential equation of heat flow in one-dimension, experimental determination of thermal conductivity by Ingen - Haus and Searl'smethod.Vandewall's equation of statefor real gases, critical constants, reduced equation of state.

Module – II : (10 hrs)

Black body radiation, Stefan's law, energy distribution in the blackbody spectrum. Wien' displacement law, Wein's formula and Rayleigh –jeans formula (only statement and discussion).Planck' radiation formula, derivative of Rayleigh - jeans formula.Wein's formula and Stefan Boltzmann law using Planck's formula.

Rutherford's atomic model and its short coming, Bohr's theory of hydrogen atom. Energy levels, explanation of spectra, correction for nuclear motion, Bohr's correspondence principal.Frank - Hertz experiment, critical potential.

Module– III : (8 hrs)

The atomic nucleus:its size, mass, charge, spin, magnetic moment, Mass defect, binding energy, stability of nuclear force - its characteristics, Radioactive decay law, activity decay law, activity, half - life, average life, elementary idea of nuclear fission and fusion. Linear accelerator, cyclotron.

Text Books:

1. Heat and Thermodynamics - A.B.Gupta& H.B. Ray (New Central)
2. Physics for degree students - vol - I, II, M.Das
3. Modern Physics - R.Murugeshan
4. Atomic and nuclear physics - Satyapraksh

Reference Books :

1. Sound - M.Ghosh (S.Chand)
2. Introductionto Modern physics - H.S. Mani, G.K. Mehta (Affiliated East West)
3. Atomic physics - G.P.Harnwerll& W.E. Stephens.McGraw - HILL Book company, Inc.
4. Atomic and nuclear physics - Shatendra Sharma (Pearson publication)
5. Atomic and nuclear physics –GuptaGhosha

Course Outcome:

1. To analyze the thermodynamic function and their relations.
2. To visualize the emission spectra associated with particular temperatures.
3. understand how Planck's law can be used to plot blackbody curves of objects with different temperatures.
4. To learn the fundamentals of atomic structure

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Duration: 5 years (Ten Semesters)

SEC 3: Organizational Behaviour(BH2432)

Module-I : (10 hrs)

The study of Organizational Behaviour: Definition, Meaning, Why study OB; Learning – Principles of learning and learning theories; Personality- Meaning, Determinants, Types, Personality and OB; Perception- Perceptual Process, perceptual errors, Importance of perception in organizations; Motivation-Nature and Importance, Theories of motivation (Herzberg, Maslow, McGregor).

Module-II : (10 hrs)

Group level:

Groups in Organizations –Nature, Types, Reasons behind forming groups, Determinants, factors contributing to Group Cohesiveness, Group Decision Making- Process, advantages and disadvantages; Team- Effective Team Building; Types of Leadership- Effective Leadership, Styles of leadership, Leadership Theories-Trait Theory and Contingency Theory, Leadership and Followership; Conflict- Healthy Vs Unhealthy conflict, Conflict Resolution Techniques

Module- III : (10 hrs)

Structural level:

Organizational Culture: culture and organizational effectiveness; Organizational Change: Types of change, Reasons to change, Resistance to change and to manage resistance. Introduction to organizational development.

Text Books:

1. Stephens P Robbins, OrganisationalBehaviour, PHI
2. K. Aswatthappa, OrganisationalBehaviour, HPH

Reference Books:

1. Kavita Singh, OrganisationalBehaviour, Pearson
2. D.K.Bhattacharya, OrganisationalBehaviour, OUP
3. PradeepKhandelwal, OrganisationalBehaviour, TMH
4. Keith Davis, OrganisationalBehaviour, McGrawHillNelson Quick, ORGB, Cengage Learning

Course Outcomes :

1. able to analyse and compare different models used to explain individual behaviour related to motivation.
2. Understanding how individual, groups and structure have impacts on the organisational effectiveness.
3. Learning the basic concepts of Organisational Behaviour and its application in c contemporary organizations.
4. Learning and appreciating the different cultures and diversity in the work place andLearn basic concurrent programming in C and assembly code.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

DSE 2: Operating System (CS2282)

Module-I : (12 hrs)

Overview Operating System, Simple Batch Processing Systems, Multiprogramming and Time Sharing systems. Personal Computer Systems, Parallel Systems, Distributed Systems and Real- time Systems.

Operating System Structures: Operating System Services, System components, Protection system, Operating System Services, system calls, Process Concept, Process Scheduling, Operation on Processes, Inter-process communication, Examples of IPC Systems, Multithreading Models, Threading Issues, Process Scheduling Basic concepts, scheduling criteria, scheduling algorithms, Thread Scheduling.

Module-II : (8 hrs)

Process Coordination, Synchronization, Critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Monitors. Deadlocks, System model, Deadlock Characterization, Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, recovery from Deadlock.

Module-III : (10 hrs)

Memory Management strategies, Logical versus Physical Address space, swapping, contiguous Allocation, Paging, Segmentation. Virtual Memory: Background, Demand paging, performance of Demand paging, Page Replacement, Page Replacement Algorithms. Allocation of frames, Thrashing, Demand Segmentation.

Module-IV : (10 hrs)

Recovery, Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, I/O System Overview, I/O Hardware.

File system, file structure, Directory Structure, Allocation Methods, Basic concepts of Linux system, administration requirements, VM ware and Hypervisor concepts.

Text Book:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Concepts,8th edition, Wiley-India, 2009.
2. Naresh Chouhan: Principles of Operating System, Oxford University Press.
3. Dhamdhare: Operating Systems: A Concept, 3rd Edition, Tata McGraw Hill Education, India

Reference Book:

1. William Stallings: Operating Systems, PHI Learning Pvt. Ltd.
2. H.M. Deitel, P. J. Deitel, D. R. Choffnes: Operating Systems, 3rdEdition, Pearson Education.
3. Andrew S. Tanenbaum: Mordern Operating Systems, 3rdEdition, PHI Learning Pvt. Ltd.

Course Outcomes :

1. Know basic components of an operating system.
2. Comprehend how an operating system virtualises CPU and memory.
3. Discuss various scheduling and swapping policies.
4. Learn basic concurrent programming in C and assembly code.

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Lab 9 (GE-6 Lab): Physics Lab–IV (BH2572)

List of Experiments:

Properties of Matter and Heat Laboratory

1. To determine the coefficient of viscosity by viscometer.
2. Determination of rigidity modulus of a wire by dynamic method.
3. Determination of surface tension of soap solution.
4. Determination of Young's modulus, modulus of rigidity, and poissions ratio of material of a wire using Searles method.
5. Calculation of Mechanical equivalent of heat by Joule's calorimeter.
6. To find Specific heat of a liquid by method of cooling.
7. To determine the specific resistance of a given wire using Carey-Foster bridge.
8. Calculate thermal conductivity of a bad conductor by lee's method.
9. Calculation of velocity of sound by resonance column method.
10. Determine Young's modulus by bending of beam by cantilever.
11. Determination of thermal conductivity of metal by Searle's apparatus.
12. Determination of latent heat of fusion of ice by applying radiation correction.
13. Determination of vapour density of a volatile liquid by Victor Meyer's method.
14. To determine coefficient of viscosity of air by Rankin's Method.

Course Outcome:

1. To learn about properties of liquid like viscosity, surface tension etc.
2. To find physical properties of solids such as modulus of elasticity, thermal conductivity, latent heat etc.

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Lab 10 (DSE-2 Lab): Operating System Lab (CS2582)

List of Experiments:

1. Basic UNIX Commands.
2. Linux Administrative commands.
3. UNIX Shell Programming.
4. Programs on process creation and synchronization, inter process communication including shared memory, pipes and messages.(Dinning Philosopher problem / Cigarette Smoker problem / Sleeping barber problem)
5. Programs on UNIX System calls.
6. Simulation of CPU Scheduling Algorithms. (FCFS, RR, SJF, Priority, Multilevel Queuing)
7. Simulation of Banker's Algorithm for Deadlock Avoidance, Prevention
8. Program for FIFO, LRU, and OPTIMAL page replacement algorithm.
9. Android Programming for mobile application.

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Duration: 5 years (Ten Semesters)

Lab 11 (CC LAB-1) :Numerical Analysis Lab (BH2542)

List of Experiments:

1. Write a computer-oriented algorithm & the corresponding C Program to fit a st. line of the form y = a x + b, for a given data, using the method of least square.
2. Write a computer oriented algorithm & the corresponding C Program to find the smallest positive root using fixed point iteration method.
3. Write a computer oriented algorithm & the corresponding C Program to find the smallest positive root using Newton- Raphson method.
4. Write a computer oriented algorithm & the corresponding C Program to find the solution of the system of linear equations using Gauss Seidel Method.
5. Write a computer oriented algorithm & the corresponding C Program to interpolate y using the given pair of values of x and y by Lagrange's interpolation.
6. Write a computer oriented algorithm & the corresponding C Program to find the derivative at the initial point using Newton 's Forward DifferenceMethod.
7. Write a computer oriented algorithm & the corresponding C Program to find the derivative at the final point using Newton 's Backward DifferenceMethod.
8. Write a computer oriented algorithm & the corresponding C Program to integrate Numerically using Trapezoidal & Simpson's Rule.
9. Write a computer oriented algorithm & the corresponding C Program to integrate Numerically using Gauss Quadrature Rule.
10. Write a computer oriented algorithm & the corresponding C Program to solve the Differential Equation. $\frac{dy}{dx} = f(x, y),\ y(x_0) = y_0$ at the specified pivotal points by using the Runge-Kutta Method of 4^{th} order.

AECC-3: Environmental Science (BH2402)

Module-I : (10 hrs)

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle, carbon cycle, Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced oxidation process.

Module-II : (10 hrs)

(a) Waste Water Treatment: COD and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

(b) Air Pollution: Air pollution and pollutants, criteria of pollutants, Acid deposition, Global climate change – greenhouse gases, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.

(c) Solid waste, Hazardous waste management including Nuclear solid wastes. Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, zero waste management, Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators,super critical liquids, Inorganic waste treatment. E.I.A., Environmental auditing,

Module-III : (10 hrs)

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error and Hazard Analysis. Hazard Control Measures in integrated steel industry, Petroleum Refinery, L.P.G. Bottling, Pharmaceutical industry. Fire Prevention – Detection, Extinguishing Fire, Electrical Safety, Product Safety. Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Gas Cylinders, Hydro Carbons and Wastes. Personal Protective Equipment.

Text Book :

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

Reference Books :

1. Chemistry for Environmental Engineering and Science, Clair N. Sawyer, Perry L. Mc Carty and Gene F. Parkin, 5th edition, Mc GrawHill
2. Environmental Engineering by Arcadio P. Sincero&Gergoria A. Sincero PHI Publication
3. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
4. Environmental Science, Curringham&Saigo, TMH,
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.
6. Industrial Safety Management and Technology, Colling. D A – Prentice Hall, New Delhi.

Course Outcomes: Students will be able to:

1. Realise the importance of ecological balance.
2. Know how to minimize waste for a better environment.
3. Follow proper procedure for waste treatment
4. Take safety measures in their house, workplace etc.

Semester-5

Core 13: Advanced Calculus (BH3141)

Prerequisites: Differentiation, Partial Differentiation, Integration, Differential Equation.

Module –I: (14hrs)
Special Function: Some special functions: Bessel's function, Legendre polynomial (function), Gamma, Beta, error functions;
Integral transforms: Fourier transform, Z-transform

Module –II: (14hrs)
Calculus of variation: Variation of a functional, Euler-Lagrange equation. Variational problems with fixed boundaries,variational problem with Moving boundaries,sufficient conditions for an extremum,direct methods in variational problem. Variational methods for boundary value problems in ordinary and partial differential equations.

Module –III: (12hrs)
Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Text Books:
1. Linear Integral Equation by Santi Swarup; Krishna publications
2. Calculus of variation by A.S. Gupta;PHI, Chapter-1(1.1-1.6),2(2.1-2.3),3(3.1-3.6),4(4.1-4.2),6(6.1-6.3)

Reference Book:
1. Calculus of variations: I.M. Gelfand, S.V. Fomin, Prentice Hall.

Course outcomes: After the successful completion of this course the students will be able to
1. Develop ability to solve problems in the geometry and analysis using in differential forms.
2. Develop capacity to both prove results and solve problems and find the extremum value of functional.
3. Recognize the place of differential calculus in mathematics and development of scientific thought.
4. Develop facility in reading and analyzing mathematical problems.

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Core 14: Mathematical Modelling and Simulation (BH3143)

Prerequisites: Differential Equation, Probability, Graph Theory.

Module-I: (10hrs)

***What is Modeling*-**Model and reality ,Properties of Models ,Building a Model, Elementary Methods-Arguments from scales ,Dimension Analysis, Graphical methods –Mathematical Modeling through Graphs: Solutions that can be Modeled Through Graphs – Mathematical Modeling in Terms ofDirected Graphs, Signed Graphs, Weighted Digraphs and Un-oriented Graphs.

Module-II: (10hrs)

Mathematical Modeling through Ordinary Differential Equations of First order: Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Dynamic problems – Geometrical problems.

Mathematical Modeling through Ordinary Differential Equations of Second Order: Planetary Motions – Circular Motion and Motion of Satellites – Mathematical Modeling through Linear Differential Equations of Second Order – Miscellaneous Mathematical Models

Module-III: (10hrs)

Mathematical Modeling through Difference Equations: Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics – Probability Theory.

Text Books:

1. J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi,Edward A. Bender.. An Introduction to Mathematical Modeling, S.M. Ross .Simulation, India Elsevier Publication.

Reference Books:

1. A. C. Fowler, Mathematical Models in Applied Sciences, Cambridge University Press.
2. A.M.Law and W.D.Kelton , Simulation Modeling and Analysis, T.M.H. Edition.
3. SankarSengupta, System Simulation and Modeling , Pearson

Course outcomes: After the successful completion of this course the students will be able to

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply the engineering design process to produce solutions that meet specified needs with consideration public health and safety and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.
3. Model physical problems and solve them.
4. Solve some mathematical problems without using derivatives and integrations.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

SEC-4: Indian Society, Ethics & Culture (BH3321)

Module I : (10 hrs)

Introduction to Ethics

1.1 Basic Terms-Morality, Ethics, Emotional Intelligence, Ethical Dilemma
1.2 View on ethics by Aristotle, Gandhian Principle
1.3 Moral development Theory by Kohlberg
1.4 Indian society's origin and Composition
1.5 Secularisation and Democratisation.

Module II : (10 hrs)

Ethics and religion-

2.1 Personal Ethics, Governing factors of an Individual's value system, utilitarianism, Deontology, Moral Absolutism
2.2 Protestant Religious movements in the 6th century B C - Gautama Buddha and Buddhism, Mahavir Jain and Jainism
2.3 Cultural attainment with reference to the Gupta Golden age
2.4 Ethical Issues-IPR, CSR, Bioethics, Media Ethics.

Module III : (10 hrs)

Roots of Indian Culture

3.1 Harappan Culture and Vedic culture
3.2 Cultural Expansion
3.3 Impact of Islam on Indian life
3.4 Socio-religious Reform Movements- Bhakti movement, BrahmoSamaj and Arya Samaj.

Text Books:

1. Indian Society and Culture- P.C Das, B.C Das, S.S Das-Kalyani Publisher.
2. Professional Ethics- R. Subramanian-Oxford university Press

Reference Books:

1. Business Ethics-Manuel Velasquez-Pearson Education
2. Ethics & Conduct of Business- John R Boatright, B. P. Patra- PEARSON Publication

Course Outcome:

1. Students will develop an insight of human values and its significance in personal and professional life.
2. Students will develop sensitivity towards human rights and practices of democracy.
3. Students will develop a sense of respect towards Indian cultural values and its various aspects.
4. Students will develop the practice of ethical behavior and humanistic approach.

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Duration: 5 years (Ten Semesters)

Core 15: Fuzzy and Rough Set Theory (BH3145)

Prerequisites: Set theory.

Module-I: (10hrs)
Crisp sets and Fuzzy sets: Introduction – crisp sets an overview – the notion of fuzzy sets –basic concepts of fuzzy sets – membership functions – methods of generating membership functions – defuzzification methods- operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersection – combinations of operations – General aggregation operations.

Module-II:(10hrs)
Fuzzy arithmetic and Fuzzy relations: Fuzzy numbers- arithmetic operations on intervals- arithmetic operations on fuzzy numbers- fuzzy equations- crisp and fuzzy relations – binary relations – binary relations on a single set – equivalence and similarity relations – compatibility or tolerance relations.
Fuzzy measures – belief and plausibility measures – probability measures – possibility and necessity measures – possibility distribution - relationship among classes of fuzzy measures.

Module-III:(10hrs)
Fuzzy Logic and Applications: Classical logic: an overview – fuzzy logic – approximate reasoning - other forms of implication operations - other forms of the composition operations – fuzzy decision making –fuzzy logic in database and information systems - fuzzy pattern recognition – fuzzy control systems.

Module-IV:(10hrs)
Basic concept of rough sets: Approximation space and set approximation, rough membership function
Rough set in data analysis: Information system, Indiscernibility relation, Set approximation, rough sets and membership function, Dependency of attributes, Reduction of attributes, Reducts and core, Discernibility matrices and functions, Decision rule synthesis.

Text Book:
1. George J Klir and Tina A Folger, Fuzzy sets, Uncertainty and Information, Prentice Hall of India, 1988.
2. An introduction to rough set theory and application: A tutorial, by Z. Suraj
3. Rough sets: Mathematical Foundation by L. Polkowski, Spinger-Verlag, Berlin
4. H.J. Zimmerman, Fuzzy Set theory and its Applications, 4th Edition, Kluwer Academic Publishers, 2001.

Reference Book:
1. George J Klir and Bo Yuan, Fuzzy sets and Fuzzy logic: Theory and Applications. Prentice Hall of India, 1997.
2. Hung T Nguyen and Elbert A Walker, First Course in Fuzzy Logic, 2nd Edition, Chapman & Hall/CRC, 1999.
3. Jerry M Mendel, Uncertain Rule – Based Fuzzy Logic Systems; Introduction and New Directions, PH PTR, 2000.
4. John Yen and Reza Langari, Fuzzy Logic: Intelligence Control and Information, Pearson Education, 1999.
5. Timothy J Ross, Fuzzy Logic with Engineering Applications, McGraw Hill International Editions, 1997.

Course Outcomes: After successful completion of the course, students will be able to:
1. decide the difference between crips set and fuzzy set theory
2. make calculation on fuzy set theory and gain the methods of fuzzy logic
3. recognize fuzzy logic membership function
4. recognize fuzzy logic fuzzy inference systems make applications on Fuzzy logic membership function and fuzzy inference systems.

School/ Department: School of Basic Sciences & Humanities
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Duration: 5 years (Ten Semesters)

DSE 3: Relational Database Management System CS3281)

Module I:(10 hrs)
Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.

Module II:(10 hrs)
Entity relationship model, Components of ER model, Mapping E-R model to Relational schema, Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, RAID

Module III:(10 hrs)
Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL and QBE. Database Design:-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation.

Module IV:(10 hrs)
Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes. Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques. Fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, Data warehousing & Data Mining and Big data and NoSQL.

Text Books:

1. Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education.

References Books:

1. Elmasari&Navathe: Fundamentals of Database System, Pearson Education.
2. Ramakrishnan: Database Management Systems, McGraw-Hill Education.
3. Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education.
4. Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition, O'Reilly Media

Course Outcomes:

1. Efficient data set management
2. Normalization of a large data base of uniform domain
3. Expert in optimizing the query
4. Handling vague and raw data for data analysis

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DSE 4: Java Programming (CS3283)

Module I : (10 hrs)

Features of Java, Data types, operators & expressions, control structures, arrays, Classes, objects & methods, constructors, garbage collection, access qualifiers, Overloading, String Handling – string operations, character extraction, string comparison, searching and modifying strings, String Buffer, String Builder, Packages, Interfaces, Wrapper classes, Static variables and methods.

Module II : (10 hrs)

Inheritance: single and multilevel inheritance, method overriding, abstract class, use of super and final keywords. Exception Handling: Exception types, uncaught exceptions, multiple catch clauses, nested try statements, built-in exceptions, creating your own exceptions. Multithreading: Java thread model, creating multiple threads, thread priorities, synchronization, inter-thread communication, suspending, resuming and stopping threads; Familiarity with Java Collection Framework.

I/O Streams: Console I/O, Files I/O – Byte Streams, Character Streams, Object Serialization; Socket Programming: TCP Socket, Datagram Socket.

Module III : (10 hrs)

DBC programming: JDBC Drivers, Creating connection, executing queries and stored procedures, handling database transactions.

GUI Development: AWT Classes, Window fundamentals, working with graphics, working with color& fonts. Event handling in Java, Delegation Event Model, Swing Package: JFrame, JPanel, swing GUI controls, layout managers, working with menus, Introduction to JavaFX

Text Books:

1. Liang Y. Daniel, Introduction to Java Programming, Pearson Education.
2. Herbert Schildt, The Complete Reference Java 2, Tata McGraw Hill

Reference Books:

1. E. Balaguruswami, Programming with Java, Tata McGraw Hill.
2. Mughal K.A., Rasmussen R.W., A Programmer's Guide to Java Certification, Addison-Wesley

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Develop skills to write Java programs to solve a variety of real-world problems.
2. Write programs using object oriented approach and standard Java
3. Develop client server applications using network sockets
4. Develop skills to write Desktop Applications involving GUI and Databases.

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Lab 12 (DSE Lab 3): Relational Database Management System Lab (CS3581)

List of Experiments:

1. Use of SQL syntax: insertion, deletion, join, updation using SQL.
2. Programs on join statements and SQL queries including where clause.
3. Programs on procedures and functions.
4. Programs on database triggers.
5. Programs on packages.
6. Programs on data recovery using check point technique.
7. Concurrency control problem using lock operations.
8. Programs on ODBC using either VB or VC++.
9. Programs on JDBC.
10. Programs on embedded SQL using C / C++ as host language.

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Lab 13 (CC LAB-2) MAT LAB - (BH3541)

List of Experiments:

1. Use of commands in Matlab
2. Create Arrays in Matlab.
3. Use Mathematical operations with Arrays.
4. Study Two Dimensional plots in Matlab..
5. Use Defined functions and function files in Matlab.
6. Use Programming in Matlab.
7. Study polynomials, curve fitting in Matlab.
8. Use Interpolation in Matlab.
9. Use differentiation in Matlab.
10. Use Integration in Matlab.

Lab 14 (DSE Lab 4): Java Programming Lab (CS3583)

Note: This course shares the objectives and outcomes of its associated theory course PPCCA202. Suitable IDE will be used to carry out laboratory exercises. The programs will follow proper object-oriented modeling. The exercises suggested below are illustrative in nature. Additionally, suitable exercises may be suggested by the faculty concerned to meet the course objectives.

List of Exercises:

1. Develop an Object Oriented Program to find the area and perimeter of a circle.
2. Develop an interest calculator program to find simple interest payable monthly, compound interest payable annually compounded quarterly. Use keyboard inputs for interest rate and principal amount.
3. Define a class to calculate professional tax on a salary amount based on the following tax rate. Use if and switch control structures.

Salary Slab	Tax Rate
Up to Rs. 10000.00	Nil
Between Rs. 10001.00 – Rs. 25000.00	Rs. 100.00
Between Rs. 25001.00 – Rs. 50000.00	Rs. 200.00
Between Rs. 50001.00 – Rs. 75000.00	Rs. 300.00
Between Rs. 75001.00 – Rs. 100000.00	Rs. 450.00
Above Rs. 100000.00	Rs.650.00

4. Develop a text-menu based program to compute area and perimeter of a circle, rectangle, square and a right angle triangle.
5. Develop a menu based program to perform operations in a bank account.
6. Develop a program to find the sum of even numbers and sum of odd numbers in a set of numbers. Define a class with suitable methods to carry out the operations. Use array to store numbers.
7. Modify the class defined in sl-6 to find largest and smallest numbers in a set of numbers.
8. A student scores marks in subjects in a semester. A semester has 5 or 6 subjects depending of MCA course. Define a class called Score that contains subject code, name and marks in that subject. Define a class called Student having an array of objects of Score class in it following object composition. Process result of students in different semesters.
9. Define a class called SimpleMath with overloaded methods to carryout arithmetic operations using it. Use static methods appropriately.
10. Redefine the Circle class in exercise 1 to use value of Pi as a constant and a variable to count number of instances created as you go on creating objects.
11. Develop a class to perform the following tasks on a line of text
    a. Count the number of words in the text
    b. Searches a particular string in the text
    c. Checks if the text is a palindrome
12. A library is a collection of books. Generally, a book is authored by one or more authors. Develop a program to add books and display a list of books when searched by author name. Consider title, ISBN number, publisher name, publication year for book; designation, organization, and country for author.
13. In CET, two types of people are there: students and employees. As per Govt. of India, everyone must have his or her AADHAR number for unique identification. Model these objects appropriately using inheritance and create an array of people with several students and employees in it. Write a program to search a student or an employee based on AADHAR number and print its details.

14. There are different shapes such as circles, rectangles and squares and need to be kept track of if they are painted or not with colors. Create a collection of shapes to be painted. Consider some cost of a color per square unit of the shape area. Write a program to calculate the painting cost of different shapes. Print the list of shapes which are not painted. Also print the list of painted shapes with their color, painting cost and area.
15. A bank account maintains a minimum balance. If the account balance comes down below this level due to some withdrawal, then it raises warning and disallows the operation. Define a custom exception class called "InsufficientFundException" which will be raised when such event occurs. Also use the built-in exception class "IllegalArgumentException" which is to be raised when you try to either withdraw or deposit an amount less than or equal to zero.
16. Write a multithreaded program to perform following parallel operations on a set of numbers.
    a) Find the largest number
    b) Find the sum of the number
    c) Sort the numbers
17. Write program using console I/O.
18. Write Programs using File I/O.
19. Write program using serialization.
20. Write client server programs using Java sockets.
21. Write JDBC programs to perform CRUD operations.
22. Write JDBC program to execute stored procedures.
23. Write GUI programs using basic swing classes
24. Write GUI program involving Menus
25. Write a GUI program using JavaFX

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Semester-6

Core 16: Operations Research (BH3142)

Prerequisites: Linear Algebra.

Module-I: (10hrs)
Modeling of problems and principle of modeling. ***Linear programming:*** Formulation of LPP, Graphical solution, Simplex method, BigM method, II Phase method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming.

Module –II:(10hrs)
Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method.
Assignment problems: Hungarian method for solution of Assignment problems.

Module –III:(10hrs)
Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems.
Simulation and Modeling: Introduction to simulation and modeling. Markov analysis: Introduction to markov processes, State and Transition Probabilities, Transition Diagram, n-step transition probabilities.

Module –IV :(10hrs)
Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline. Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Constrained optimization with inequality constraint: Kuhn-Tucker condition.

Text Books:
1. A. Ravindran, D. T. Philips, J. Solberg, "Operations Research- Principle and Practice", Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, "Optimization for Engineering Design", PHI Learning Pvt Ltd

Reference Books:
1. Stephen G. Nash, A. Sofer, " Linear and Non-linear Programming", McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis," Engineering Optimization", Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, "Operations Research", Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, "Operations Research", Eighth Edition, Tata McGraw Hill
5. P.K.Gupta, D.S.Hira, "Operations Research", S.Chand and Company Ltd.
6. KantiSwarup, P. K. Gupta, Man Mohan, "Operations Research", Sultan Chand and Sons.

Course Outcomes: After the successful completion of this course the students will be able to
1. Identify and develop operational research models from the verbal description of thereal system.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.
4. Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

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Core 17: Complex Analysis (BH3144)

Prerequisites: Real Analysis.

Module-I:(10hrs)

The complex number system: The real numbers, The field of complex numbers, the complex plane, polar representation and roots of complex numbers, Line and half planes in the complex plane. Power series and radius of convergence.

Module-II:(10hrs)

Analytic function, Power series representation of analytic functions, Cauchy- Riemann equation, analytic function as mapping and its Mobius transformation. Zeros of analytic function, entire function,Complex integration.

Module-III:(10hrs)

Liouville's theorem, fundamental theorem of algebra, maximum modulus theorem, Index of a closed curve, Cauchy's theorem and Cauchy's integral formula, Morera's theorem.
Classification of singularity, Poles, absolute convergence.

Module-IV:(10hrs)

Laurent series development,Residue theorems, evaluation of integrals by using residue theorem, Argument principle, Rouche's theorem, Maximum Modulus theorem, Schwarz's Lemma.

Text Book:

1. Functions of one Complex variable- J. B. Conway (Springer Verlag , International student edition, Narosa Publishing house, Chapter-1(1.1-1.5), Chapter-3(3.1- 3.3), Chapter-4(4.2 - 4.5), Chapter-5(5.1-5.3), Chapter-6(6.1 - 6.2).

Reference Books:

1. Complex Analysis by Alhfors, TMH.
2. Complex Variable; Theory &Application:Kasana, PHI

Course Outcomes: After the successful completion of this course the students will be able to

1. Explain the fundamental concepts of complex analysis and their role in modern mathematics and applied contexts.
2. Demonstrate accurate and efficient use of complex analysis techniques for evaluation of different types of integrals.
3. Learn mapping and series expansion of complex valued function.
4. Apply problem-solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Core 18: Differential Equation–II (BH3146)

Prerequisites: 1st Order O.D.E. and Higher Order O.D.E. with constant coefficients

Module-I: (10hrs)
Boundary value problems for Ordinary Differential Equations;Sturm-Lioville Problems, Orthogonalism of Eigen functions, Green's functions, Self adjoint Equations of second order.Ordinary Differential Equations in more than two variables.

Module-II:(08hrs)
Simultaneous linear first order equations in three variables, Methods of solution of Pfaffian differential Equations in three variables.
Partial Differential Equations of first order: Formulation of first order Partial Differential Equation,

Module-III:(08hrs)
Linear Partial Differential Equations of first order,Non-Linear Partial Differential Equations of first order, Special types of Partial Differential Equations of first order, Solution of Partial Differential Equations of first order satisfying given conditions (Charpit's Methods)

Module-IV:(14hrs)
Partial Differential Equations of second and higher order: Linear Partial Differential Equations with constant coefficients, Equations reducible to linear Partial Differential Equations with constant coefficients, Partial Differential Equations with variable coefficients. Some standard forms of variable coefficients, Separation of variables (Product method), Non linear equations of the second order (Mange's Method).

Text Books:

1. A course on Ordinary and Partial Differential Equations: J Sinha Roy and Padhy
2. Ordinary and Partial Differential Equations: M D Raisinghania.

Course outcomes: After the successful completion of this course the students will be able to

1. solve Strum-Liouville problems and use Green's function in solving these problems.
2. solve systems of linear differential equations with appropriate methods provided.
3. know different forms of linear and non-linear partial differential equations of 1st order and solve the equations analytically.
4. recognize various types of linear and non-linear partial differential equations of 2nd and higher order and solve the equations.

School/ Department: School of Basic Sciences & Humanities
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Duration: 5 years (Ten Semesters)

Core 19: Computer Networks (BH3148)

Module-I: (10hrs)
Network architecture, Layers, Transmission Media, Data Link Layer, Issues in the data link layer, Framing Error detection and correction, Link-level Flow Control, Medium access, CSMA, Ethernet, Token ring, FDDI, Wired LAN, Wireless LAN

Module-II:(10hrs)
Connecting Devices, Bridges and Switches, Circuit switching vs. Packet switching, Packet switched networks, Network Layer: Design issues, Logical Addressing, Subnetting, CIDR, IPV4, IPV6, Address Mapping, ARP, RARP, DHCP, ICMP;

Module-III:(10hrs)
Delivery, Forwarding, Routing algorithms, RIP, OSPF, BGP-Multicasting-Congestion avoidance in network layer.
Transport layer: Process- to-process delivery, UDP, TCP Adaptive Flow Control, Adaptive Retransmission, Congestion control,

Module-IV:(10hrs)
Congestion avoidance and QoS,Application Layer: Email (SMTP, MMIME, IMAP, POP3), Remote Logging (Telnet), File Transfer(FTP), WWW and HTTP, Domain Name System (DNS), Network management (SNMP).

TextBooks:
1. Data Communications and Networking by Behrouz A. Forouzan. Third Edition, TMH.

Reference Books:
1. Computer Networks by Andrew S Tanenbaum, David. J. Wetherall, 5th Edition. Person Education/PHI
2. Computer Networks: A System Approach by Larry L. Peterson, Bruce S. Davie, Morgan Kauffmann Inc.,2003.
3. Computer and Communication Networks by Nader F. Mir, Person Education, 2007
4. Data and Computer Communication, William Stallings, Sixth Edition, Person Education,2000

Course Outcomes:
On successful completion of the course, the students will be able to:
1. Understand the basic concepts of computer network and data communication.
2. Understand the functions of each layer in the OSI and TCP/IP reference model.
3. Understand the working of essential protocols of computer networks,
4. They can be applied in network design and implementation.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
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Core 20: Coding Theory (BH3150)

Prerequisites: Abstract Algebra

Module-I: (10hrs)
The communication channel, the coding problem, Block codes, Hamming metric, Nearest neighbour decoding, Linear codes, Generator and Parity-check matrices, Dual code, Standard array decoding, Syndrome decoding.

Module-II:(10hrs)
Hamming codes, Golay codes, Reed-Muller codes, Codes derived from Hadamard matrices.
Bounds on codes: Sphere packing bound, Perfect codes, Gilbert-Varshamov bound, Singleton bound, MDS codes, Plotkin bound, Weight distribution of codes, MacWilliams Identities.

Module-III:(10hrs)
Algebra of polynomials, Residue class rings, Finite fields, Cyclic codes, Generator polynomial and check polynomial, Defining set of a cyclic code, BCH bound, Encoding and decoding of cyclic codes

Module-IV:(10hrs)
Hamming and Golay codes as cyclic codes, BCH codes, Reed-Solomon codes, Quadratic residue codes, Graphical codes, Convolutional codes.

Text books:
1. S. Ling and C. Xing: Coding Theory: A First Course, Cambridge University Press
2. F.J. MacWilliams and N.J.A. Sloane: The theory of error correcting codes, North Holland

Reference Books:
1. V. Pless: Introduction to the theory of error correcting codes, John Wiley
2. W.C. Huffman and V. Pless: Fundamentals of error correcting codes, Cambridge University Press
3. R.M. Roth: Introduction to coding theory, Cambridge University Press

Course Outcomes: After completion of the course, the student is able to
1. Comprehend various error control code properties
2. Apply linear block codes for error detection and correction
3. Apply convolution codes for performance analysis & cyclic codes for error detection and correction.
4. Design BCH & RS codes for Channel performance improvement against burst errors.

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Duration: 5 years (Ten Semesters)

Lab 15 (Core Lab 3): Operation Research Lab (BH3542)

List of Experiments:

2. Introduction to linear programming problem,solving lpp by mat lab(Introduction)
3. Solve various simplex problem using mat lab Function
4. Solve Transportation and assignment problem using, Any suitable simulator
5. Compare. between Transportation, Assignment problem by Using mat lab
6. Explore queuing theory for scheduling, resource allocation, and traffic flow applications using MATLAB
7. Elementary concepts of Modelling and Simulation using MATLAB
8. Solve Various Decision Problem Using MATLAB
9. IntroductiontoNonlinearProgramming by any suitable simulator
10. Iterativemethods for optimization problem by any suitable simulator
11. Application of nonlinear programming using MATLAB

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Lab 16 (Core Lab 4): STATISTICAL DATA ANALYSISLab (BH3544)

List of Experiment:

1. Introduction to statistical problem by STATISTICA/ PYTHON / R.
2. Finding Correlation, Regression by the use of STATISTICA/ PYTHON / R.
3. T- test, Chi square test by using STATISTICA/ PYTHON / R.
4. Testing of hypothesis, confidence interval by using STATISTICA/ PYTHON / R.
5. Statistical validation of various types of data by using STATISTICA/ PYTHON / R.
6. Design and modeling of Binomial and Poisson distribution by STATISTICA/ PYTHON / R.
7. Generation of random numbers, by any simulator.
8. Simple integration by random numbers, STATISTICA/ PYTHON / R implementation.
9. Finding 1st,2nd moments by using STATISTICA/ PYTHON / R.
10. General statistical application in validation of medical related data.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Semester-7

PC-1: Advanced Analysis (BH4141)

Prerequisites: Basics of Real Analysis

Module-I: (10hrs)

Lebesgue Measure: Introduction, Lebesgue outer measure, The σ-algebra of Lebesgue measurable sets, Outer and inner approximations of Lebesgue measurable sets. Countable additivity, Continuity and the Borel-Cantelli lemma. Non-measurable sets, The Cantor set and the Cantor-Lebesgue function.

Module-II:(10hrs)

Lebesgue Measurable Functions: Sums, Products and compositions, Sequential point-wise limits and simple approximation, Littlewood's three principles, Egoroff's theorem and Lusin's theorem.

Lebesgue Integration: The Riemann integral, The Lebesgue integral of a bounded measurable function over a set of finite measure. The Lebesgue integral of a measurable non-negative function, The general Lebesgue integral, Countable additivity and continuity of integration, Uniform integrability: The Vitali convergence theorem.

Module-III:(10hrs)

Lebesgue Integration: Uniform integrability and Tightness: A general Vitali convergence theorem, Convergence in measure, Characterization of Riemann and Lebesgue's integrability.

Differentiation and Integration: Continuity of monotone functions, Differentiability of monotone functions: Lebesgue's theorem,

Module-IV:(10hrs)

Functions of bounded variation: Jordon's theorem, Absolutely continuous functions, Integrating derivatives, Differentiating Indefinite integrals, Convex functions. The L^p-spaces, completeness and approximation, Normed linear spaces, The inequalities of Young, Ho¨lder and Minkowski, L^p is complete, The Riesz-Fisher theorem, Approximation and Separability.

Text Books:

1. Real Analysis by H.L. Royden (3rdedition) PHI.
   Chapter 3(3.1 to 3.5), Chapter 4(4.1 to 4.4), Chapter 11, Chapter 12(12.1 to 12.7).
2. Mathematical analysis by Tom M. Apostol, 2nd Edition, Addison-Wesley publication company Inc. New york, 1974.
   Chapter 6(6.1 to 6.8), Chapter 7(7.1 to 7.11)

Reference Books:

1. Bartle, R.G. Real Analysis, Wiley.
2. Rudin, W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik, S.C. and Savita Arora. Mathematical Analysis, Wiley Eastern Limited, New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.
6. A.L. Gupta and N.R. Gupta, Principles of Real Analysis, Pearson Education, (Indian print) 2003.
7. Measure theory and integration by G. De. Barra (Wiley Eastern Limited)

Course outcomes: After the successful completion of this course the students will be able to

1. demonstrate a competence in formulating, analyzing and solving problems in several core areas of mathematics at a detailed level, including analysis,
2. understand the fundamentals of measure theory and be acquainted with the proofs of the fundamental theorems underlying the theory of integration,
3. learn about measure theory random variables, independence, expectations and conditional expectations, product measures,
4. apply the general principles of measure theory and integration in such concrete subjects as the theory of probability or financial mathematics.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-2: Advanced Linear Algebra (BH4143)

Prerequisites: Linear Algebra.

Module-I: (10hrs)
Dual Spaces, Algebra of Linear transformations, Characteristics roots, Modules, Direct sums, Cyclic modules, Vector spaces, Quotient modules,

Module-II: (10hrs)
Homomorphisms, Simple modules, Semi simple modules, Schur's modules.
Artinian &Notherian Modules & Rings, Hilbert basis theorem,

Module-III: (10hrs)
Fundamental theorem of finitely many generated modules over PID's.
Canonical forms: Similarity of linear transformations, Invariant spaces,

Module-IV: (10hrs)
Reduction to triangular forms, Invariants of nilpotent transformation, Primary decomposition theorem. Jordan Canonical form & Rational Canonical form.

Text Book

1. I.N. Herstein: Topics in Algebra, Vikas Publishing House Pvt. Ltd.
2. C. Musili: Introduction to Rings and Modules, Narosa Publishing House
3. I.S.Luthar and I.B.S Passi: Algebra (Vol-3- Modules) Narosa Publishing House

Course Outcomes: After the successful completion of this course the students will be able to:

1. Demonstrate accurate and efficient use of advanced algebraic techniques
2. Demonstrate capacity for mathematical reasoning through analysis.
3. Prove and explain the concepts from advanced algebra.
4. Apply problem-solving using advanced algebraic techniques applied to diverse situations in physics, engineering and other mathematical contexts.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-3: Advanced Differential Equation (BH4145)

Prerequisites: Basics of Differential Equation.

Module-I: (13hrs)

Application of first order differential equation in Growth, decay, Chemical Reactions, Elementary Mechanics, One dimensional heat flow, Orthogonal trajectories, Biological Sciences (The oxygen debt), Mixing problems, Business and Economics. Application of Linear differential equation in Escape velocity problem, Undamped simple harmonic vibrations, Damped vibrations.

Electric circuits problems. Hermite equations and Hermite Polynomials, Hypergeometric equations, Hypergeometric functions, Elementary properties hypergeometric functions.

Module-II:(13hrs)

System of Linear Differential Equations: Basic Theory of Linear Systems, Trial Solution Method for Linear System with Constant coefficients, Operator method for linear system with Constant coefficients, Martix method for linear system with Constant coefficients. Non-Homogeneous Linear Systems.

The Laplace Equation: Boundary value problem for Laplace's Equations, Fundamental Solution of Laplace's Equation, Integral Representation of Harmonic Functions, Mean Value Formula for Harmonic Functions, Green's Functions for Laplace's Equation.

Module-III:(14hrs)

The Wave equation: Derivation of One-Dimensional Wave Equation, Solution of the wave Equation (Method of separation of variables), D'Alembert's solutions of the wave Equation, Derivations of Two Dimensional Wave equation,Solutions of Two Dimensional Wave equation.

The Heat equation: The One-Dimensional Heat Equation, Solution of One-Dimensional Heat Equation Derivation of two Dimensional Heat Equation, Solution of Two Dimensional Heat Equation, Laplace Equations in Polar Coordinates.

Text Books:

1. A course on Ordinary and Partial Differential Equations by J. Sinha Roy and S. Padhy,Kalyani Publishers.Chapters: 2(2.8), 4(4.8), 7(7.3.2,7.4.3,7.4.4), 8, 15(15.1-15.4), 16(16.1-16.4)
2. Higher Engineering Mathematics by B V Ramana, Chapter 19 (19.1-19.8).

Reference Book:

1. Ordinary and Partial Differential Equations by M. D. Raisinghania.

Course outcomes: After the successful completion of this course the students will be able to

1. have the skills to build mathematical models of relevant real-world problems based on first and higher order differential equation and solve the problems.
2. have adequate knowledge on some specific polynomials(Hermite polynomial) and functions(Hypergeometric functions) which frequently occur in physical science and engineering.
3. solve systems of linear differential equations with appropriate method.
4. solve elliptic, parabolic and hyperbolic differential equations which govern various physical phenomena

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 1: Graph Theory (BH4241)

Prerequisites: Set Theory, Linear Algebra.

Module-I: (10 hrs)
Basic Terminologies, connectedness, walk, path circuits, Eulerian graph, Hamiltonian graph, some applications.
Trees: Elementary properties of trees, rooted tree, binary tree, spanning tree, Kruskal's and Prim's algorithmmore applications

Module-II: (10 hrs)
Cut sets, fundamental circuits and fundamental cut-sets.
Directed graph: digraphs and binary relations, adjacency and incidence matrices, strongly connectedness, Euler digraphs.

Module-III: (10 hrs)
Planarity: Kuratowski's two graphs, detection of planarity, Euler's formula, geometric dual Graph.
Coloring: coloring of some standard graphs, chromatic number, map coloring, four color problem. Chromatic polynomial.

Text Books:

1. W. B. Douglas: Introduction to Graph Theory, Pearson.
2. N. Deo Graph Theory and its Application to Engineering and Computer Science.

Reference Books:

1. R. J. Wilson, Introduction to Graph Theory, Longman.
2. F. Harary, Graph Theory, Addison Wesley.

Course Outcomes: Upon completion of the course, the students will be able to:

1. Describe directed graph and adjacency matrices, and analyze strongly connectedness of graph.
2. Describe Basic Terminologies and connectedness in graph theory and recognize elementary properties of trees, rooted tree, binary trees and spanning trees MST algorithm.
3. Analyze detection of planarity and Euler's formula.
4. Demonstrate graph coloring and chromatic number.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 1: Computational Finance (BH4243)

Prerequisites: Probability, Differential Equation.

Module-I:(10hrs)

Stochastic process: Markov process, Wiener process, Geometric Brownian Motion, Ito Integral, Ito's Lemma.
Basic concepts of financial- Stock options, Forward and Futures, Speculation, Hedging, put-call parity, Principle of non-arbitrage pricing, Computation of volatility.

Module-II:(10hrs)

Derivation of blacks-scholes differential equation and Black-scholes Option Pricing formula, Greeks and Hedging strategies.

Module-III:(10hrs)

Finite difference methods for partial differential equations-finite difference approximation to derivatives, Explicit and implicit and methods for parabolic equations, Iterative methods for solution of a system of linear algebraic equations, Two dimensional Parabolic equations- alternating – direct implicit method, Convergence, Stability and Consistency of finite difference schemes.

Text Book:

1. J. Bax and G. Chacko-Financial Derivatives: Pricing, Application and Mathematics-Cambridge Univ. Press, 2004.
2. G. D. Smith: Numerical Solution of Partial Differential Equations, Oxford University Press.

References Book:

1. P. Wilmott: Qualitative Finance-John Wiley, 2000.
2. P. Copinsui and T. Zastawrian: Mathematics for Finance-an Introduction to Financial Engineering, Springer Verlag.
3. J. C. Hull: Options, Futures and others Derivatives-PHI, 2003

Course Outcomes: After successful completion of the course, students will be able to:

1. Understand the underlying concepts computational finance and translate mathematical problems (well defined systems of mathematical equations) into computational tasks,
2. process numerical results into a comprehensible form (including the use of standard graphical plotting packages), for presentation in a report,
3. to be able to give a critical assessment of the integrity of numerical methods and results,
4. recall the advantages and limitations of different methods, assess / evaluate the performance of several financial models

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 2: Soft Computing (CS4281)

Module – I:(10hrs)

Introduction to Soft Computing, Artificial Neural Network(ANN): Fundamentals of ANN, Basic Models of an artificial Neuron, Neural Network Architecture, Learning methods, Terminologies of ANN, Hebb network, Supervised Learning Networks: Perceptron, MLP, Architecture of a Back propagation Network : back propagation, Learning Effect of Tunning parameters of the Back propagation, Adaline, Madaline, RBF Network, Associative memory: Auto, hetero and linear associative memory, network, Adaptive Resonance Theory ART1, ART2, Applications

Module –II:(10hrs)

Fuzzy Logic Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations, Fuzzy Systems: Crisp logic predicate logic, fuzzy logic, fuzzy Rule based system, Defuzzification Methods, Fuzzy rule-based reasoning GENETIC ALGORITHMS Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction. Genetic Modeling: Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm. Applications, Real life Problems

Module – III:(10hrs)

Hybrid Soft Computing Techniques Hybrid system, neural Networks, fuzzy logic and Genetic algorithms hybrids. Genetic Algorithm based Back propagation Networks: GA based weight determination applications: Fuzzy logic controlled genetic Algorithms soft computing tools, Applications.

Text Book:

1. Principles of Soft Computing- S.N.Sivanandan and S.N.Deepa, Wiley India, 2nd Edition,2011

Reference Book:

1. Neuro Fuzzy and Soft Computing, J. S. R. Jang,C.T. Sun, E. Mitzutani, PHI
2. Neural Networks, Fuzzy Logic, and Genetic Algorithm (synthesis and Application) S.Rajasekaran, G.A. VijayalakshmiPai, PHI

Course Outcomes: Upon completion of the course, the student should be able to:

1. Application of soft computing on various engineering problems.
2. Hybridization of various soft computing tools for prediction and analysis of various data sets.
3. Application of genetic programming for optimization.
4. Knowledge about performance measure of a data set using soft computing tools

PE 2: Mobile Computing (CS4283)

Module –I:(10hrs)

Introduction to Personal Communications Services (PCS): PCS Architecture, mobility management, Networks signaling, Global System for Mobile Communication (GSM) System overview: GSM Architecture, Mobility management, Network signaling. General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes, Mobile Data Communication; WLANs (Wireless LANs) IEEE 802.II standard, Mobile IP.

Module-II:(10hrs)

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML), Wireless Local Loop (WLL) : Introduction to WLL Architecture, wireless Local Loop Technologies. Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) Vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000

Module –III:(10hrs)

Global Mobile Satellite Systems; case studies of the IRIDIUM, ICO and GLOBALSTAR systems.
Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols. Server-side programming in Java, Pervasive web application architecture, Device independent example application.

Text Book:

1. Mobile Communication: J. Schiller, Pearson Education
2. Mobile Computing: P.K. Patra, S.K. Dash, Scitech Publications.
3. Mobile Computing: Talukder, TMH, 2nd Edition.

Reference Books:

1. Pervasive Computing: Burkhardt, Pearson Education.
2. Principles of Mobile Computing: Hansmann, Merk, Springer, 2nd Edition.
3. Wireless Communication & Networking: Garg, Elsevier
4. Third Generation Mobile Telecommunication Systems: P. Stavronlakis, Springer.
5. The Wireless Application Protocol: Sandeep Singhal, Pearson Education.

Course Outcomes :

1. The student will be able to understand the new trends in mobile/wireless communications networks.
2. Understand multiple radio access techniques.
3. Analyze various routing algorithms used in mobile/wireless networks.
4. Identify the issues in transport and application layers

MC 1: Software Engineering (CS4481)

Module I: (10hrs)

Software Process Models:

Software Product, Software crisis, Handling complexity through Abstraction and Decomposition, Overview of software development activities, Process Models, Classical waterfall model, iterative waterfall model, prototyping mode, evolutionary model, spiral model, RAD model, Agile models: Extreme Programming, and Scrum.

Software Requirements Engineering:

Requirement Gathering and Analysis, Functional and Non-functional requirements, Software Requirement Specification (SRS), IEEE 830 guidelines, Decision tables and trees.

Module II:(10hrs)

Structured Analysis & Design:

Overview of design process: High-level and detailed design, Cohesion and coupling, Modularity and layering, Function–Oriented software design: Structured Analysis using DFD Structured Design using Structure Chart, Basic concepts of Object Oriented Analysis & Design. User interface design, Command language, menu and iconic interfaces.

Coding and Software Testing Techniques:

Coding, Code Review, documentation. Testing: - Unit testing, Black-box Testing, Whitebox testing, Cyclomatic complexity measure, coverage analysis, mutation testing, Debugging techniques, Integration testing, System testing, Regression testing.

Module III:(10hrs)

Software Reliability and Software Maintenance:

Basic concepts in software reliability, reliability measures, reliability growth modelling, Quality SEI CMM, Characteristics of software maintenance, software reverse engineering, software reengineering, software reuse.

Emerging Topics:

Client-Server Software Engineering, Service-oriented Architecture (SOA), Software as a Service (SaaS).

Text Book:

1. Software Engineering, A Practitioner's Approach, Roger S. Pressman, TMG Hill.
2. Software Engineering, I. Sommerville, 9th Ed. , Pearson Education.

Reference Books:

1. Fundamentals of Software Engineering, Rajib Mall, PHI, 2014.
2. Pankaj Jalote, "An Integrated Approach to Software Engineering", Narosa Publishing House, Delhi, 2000.

Course outcomes: After the successful completion of this course the students will be able to

1. Apply knowledge of Software engineering in the fields like mathematics, and engineering.
2. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Identify, formulate, and solve engineering problems.

Seminar: Seminar-I (BH4741)

[As to be decided by the department]

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
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Semester-8

PC-5: Topology (BH4142)

Prerequisites: Real Analysis

Module –I: (13hrs)
Countable and uncountable set, Infinite sets and the Axiom of choice, Well-ordered sets. Topological spaces, Basis and sub basis for a topology, The order, product and subspace topology, closed sets and limit points. Continues function and homeomorphism, Metric topology, Connected spaces, connected subspaces of the real line, Components and local connectedness.

Module –II:(13hrs)
Compact spaces, Basic properties of compactness, Compactness and finite intersection property, Compact subspaces of the real line, Compactness in metric spaces, Limit point compactness, Sequential compactness and their equivalence in metric spaces, Local compactness and one point compactification.

Module –III:(14hrs)
First and second countable spaces, Product spaces, Lindelo'f space, Separable spaces, separable axioms, Hausdorff, Regular and normal spaces. The Urysohn lemma, completely regular spaces, The Urysohnmetrization theorem, Imbedding theorem, Tietn extension Theorem, Tychonoff theorem, Stone-Cechcompactification.

Text Book:

1. Topology, J.R. Munkres, 2e, Pearson Education, 2000.
   Chapter: 1(7,9,10),2(excluding section 22), 3, 4 (excluding section 36), 5.

Reference Book:

1. Introduction to general Topology, by K.D.Joshi, Wiley Eastern Ltd., 1983.
2. Foundation of General Topology, by W.J. Pervin, Academic Press, 1964.
3. General Topology, by S.Nanda and S.Nanda, Macmillan India.

Course outcomes: After the successful completion of this course the students will be able to

1. The student will be familiar with basic notions of metric and topological spaces.
2. The student will be familiar with methods and techniques of proving basic theorems on topological spaces and continuous mappings.
3. The student can check if a given function is metric, continuous and check if a given set is open, closed, dense, compact, connected.
4. The student is able to apply his or her knowledge of general topology to formulate and solve problems of a topological nature in mathematics and other fields where topological issues arise.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-5: Probability and Stochastic Processes (BH4144)

Prerequisites: Probability Distribution and Expectation of single random variable.

Module-I: (10hrs)
Multiple random variables, Functions of several random variables, Covariance, Correlation and Moments, Conditional expectation. Modes of convergence of a sequence of random variables,

Module-II:(10hrs)
Weak law of large numbers, Strong law of large numbers, Central limit theorem.
Introduction to Stochastic process, Specification of stochastic process, Markov chain, Transition probability,

Module-III:(10hrs)
Classification of states and chains, Determination of higher transition probability, , Markov chain with discrete and continuous space.

Module-IV:(10hrs)
Poisson process with related distribution, Generalization of Poisson process: Pure birth process, Birth and death process.

Text book

1. An Introduction of Probability and Statistics by V. K. Rohatgi and A. K. Md.E. Saleh,2nd Edition, Wiley Publication. (Chapter 4 and Chapter 6)
2. Stochastic Process by J. Medhi, New Age International Publication (2nd edition}
3. A first course in Stochastic process, S.Karlin& H. Taylor,2nd Edition, Academic Press.

Reference book

1. Fundamentals of Mathematical Statistics by S.C.Gupta&V.K.Kapoor, S Chand & Sons.
2. Stochastic Process by Sheldon M. Ross, Wiley & sons, (2nd edition)
3. Stochastic Process by D N Shanbhag, C R Rao, Gulf Publishing.
4. Stochastic Methods by Crispin Gardiner, Springer.
5. Probability, Random Variables and Stochastic Processes, 4thEdn., A. Papoulis and S. U. Pillai, TMH Publication.

Course outcomes: After the successful completion of this course the students will be able to

1. Have a general overview of discrete and continuous random variables and their statistical properties
2. Understand how random variables and stochastic processes can be described and analyzed and Know the law of large numbers and their application
3. Overview of Markov process and applications.
4. Application of Poisson process and birth and death problems.

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Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-6: Advanced Numerical Analysis (BH4146)

Prerequisites: Numerical Methods.

Module –I: (14hrs)

Solution of Equations: Zeros of Polynomials, Horner's method, Muller's method, Interpolation & Polynomial Approximation: Lagrange polynomial, Data approximation Hermite, cubic spline and piecewise interpolation (Natural cubic splines, clamped Splines)

Numerical differentiation& Integration: Numerical differentiation, Richardson Extrapolation.

Numerical Integration & Composite Integration (Newton Cotes & Gaussian Quadrature), Romberg Integration, brief idea of Adaptive quadrature method, Asymptotic error formula,Multiple Integrals, Improper Integrals,

Module –II: (13hrs)

Numerical solution to ODE; Taylor's series methods, Adaptive Runge - Kutta method, predictor- corrector method, convergence and stability, multistep methods.

Boundary value problem for ODE: Shooting method for linear & non-linear problems, finite difference methods for linear & non-linear problems, The Rayleigh- Ritz method..

Module –III:(13hrs)

Approximating Eigenvalue: power method, shifted power method, inverse power, Householder's method, QR-method, error and stability.

Numerical solution to partial differential equations: Solution of parabolic, elliptic, Hyperbolic differential equations using finite difference method and stability considerations.

Text Book:

1. Numerical Analysis:Richard L. Burden&J.D.Faires.
   Cengage Learning 9th Edition (chapter –2(2.6),chapter-3(3.1,3.2,3.4-3.6),chapter4(4.1-4.9),chapter-5(5.1-5.8,5.10),Chapter9(9.1-9.5),chapter-11(11.1-11.5),chapter12(12.1-12.3))

Reference Books:

1. Numerical methods, Srimanta Pal.Oxford Higher Education.
2. Numerical methods for Scientific and Engineering Computation, M.K.Jain, S.R.K.Iyengar (5^{th} edition).
3. Numerical methods for Engineers by Chapra&Canale, TMH.
4. An introduction to Numerical Analysis: by Kendall E. Atkinson,Wiley.

Course Outcomes: After the successful completion of this course the students will be able to:

1. Solve an algebraic or transcendental equation and differential equation (ODE & PDE) using an appropriate numerical method.
2. Approximate a function using an appropriate numerical method.
3. Evaluate a derivative at a value and a definite integral using an appropriate numerical method.
4. Solve a linear system of equations using an appropriate numerical method.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-7: Abstract Algebra (BH4148)

Prerequisites: Basics of Group, Ring, Field

Module-I: (14hrs)

Structure theorems for groups: Direct Product, finitely generated abelian group. Structure theorem for groups: Invariants of a finite abelian group, Sylow's theorem. Algebraic extension of fields: Irreducible polynomials and Einstein criterion, Adjunction of roots.

Module-II:(13hrs)

Algebraic extension, Algebraically closed fields, Normal separable extensions***:*** splitting fields, normal extensions. Normal separable extension: Multiple roots, Finite fields, Separable extensions.

Module-III:(13hrs)

Galois Theory: Automorphism groups and fixed fields, Fundamental theorem of Galois theory. Application of Galois Theory to classical problems: Roots of unity and Cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Symmetric functions, Ruler and compass constructions.

Text Book

1. P.B. Bhattacharya, S.K. Jain and S.R.Nagpaul: Basic Abstact Algebra, Cambridge University Press. Chapter: 8(Art 1-4), 15(Art 1-4), 16(Art 1-5), 17 (Art 1,2), 18(1-5).

Reference Books:

1. VivekSahai and VikasBist: Algebra (Narosa publication House).
2. I.S. Luthar and I.B.S. Passi: Algebra Vol. 1 Groups (Narosa publication House).
3. I.N. Herstein: Topics in Algebra (Wiley Eastern Ltd.).
4. Surjit Singh and QuaziZameeruddin:Modern Algebra (Vikas Publishing House).
5. S.K. Jain & S.R. Nagpal: Basic Abstract Algebra (Cambridge University Press, 1995).
6. Dummit: Abstract Algebra, Wiley
7. Modern Algebra by A. R. Vasishtha, Krishna PrakashanMandir, Meerut.

Course Outcomes: After the successful completion of this course the students will be able to

1. Apply algebraic ways of thinking.
2. Demonstrate knowledge and understanding of fundamental concepts including groups, subgroups, normal subgroups, homeomorphisms and isomorphism.
3. Demonstrate knowledge and understanding of rings, fields and their properties.
4. Understand and prove fundamental results and solve algebraic problems using appropriate techniques.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

MC 2: Computer Graphics (CS4484)

Module – I: (10 hrs)

Overview of Graphics System: Video Display Units, Raster-Scan and Random Scan Systems, Graphics Input and Output Devices.

Output Primitives: Line drawing Algorithms: DDA and Bresenham's Line Algorithm, Circle drawing Algorithms: Midpoint Circle Algorithm and Bresenham's Circle drawing Algorithm.

Two Dimensional Geometric Transformation: Basic Transformation (Translation, Rotation, Scaling) Matrix Representation, Composite Transformations, Reflection, Shear, Transformation between coordinate systems.

Two Dimensional Viewing: Window-to- View Port Coordinate Transformation. Line Clipping (Cohen-Sutherland Algorithm) and Polygon Clipping (Sutherland-Hodgeman Algorithm)

Aliasing and Antialiasing, Half Toning, Thresholding, Dithering.

Module – II: (10 hrs)

Polygon Filling: Seed Fill Algorithm, Scan line Algorithm.

Two Dimensional Object Representations: Spline Representation, Bezier Curves, B-Spline Curves.

Fractal Geometry: Fractal Classification and Fractal Dimension.

Three Dimensional Geometric and Modeling Transformations: Translation, Rotation, Scaling,Reflections, shear, Composite Transformation.

Projections: Parallel Projection, Perspective Projection.

Module – II: (10 hrs)

Visible Surface Detection Methods: Back-Face Detection, Depth Buffer, A- Buffer, Scan- LineAlgorithm, Painters Algorithm.

Illumination Models: Basic Models, Displaying Light Intensities.

Surface Rendering Methods: Polygon Rendering Methods: Gouraud Shading, Phong Shading.

Computer Animation: Types of Animation, Key frame Vs. Procedural Animation, Methods ofControlling Animation, Morphing.

Text Book:

1. Computer Graphics, D. Hearn and M.P. Baker (C Version), Pearson Education.

Reference Books:

1. Computer Graphics Principle and Practice, J.D. Foley, A. Dam, S.K. Feiner, Addison Wesley.
2. Procedural Elements of Computer Graphics, David Rogers, TMH.
3. Computer Graphics: Algorithms and Implementations, D.P Mukherjee, D. Jana, PHI.
4. Computer Graphics, Z. Xiang, R. A. Plastock, Schaum's Outlines, McGrow Hill.
5. Computer Graphics, S. Bhattacharya, Oxford University Press.
6.

Course Outcomes

1. Understands the core concepts and mathematical foundations of computer graphics.
2. Knows fundamental computer graphics algorithms and data structures.
3. Has an overview of different modelling approaches and methods.
4. Has detailed knowledge about basic shading and texture mapping techniques.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

MC 3: Data Mining (CS4482)

Prerequisites: Statistics, MATLAB.

Module-I: (10 hrs)

Introduction to Data mining: - Role Data in Data Mining, Data Mining functionalities, patterns in data mining, Type of patterns, Classification of Data Mining Systems, Major issues in Data Mining. Data Preprocessing:- Why Preprocess the Data?, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction,Data Warehousing and OLAP Technology for Data Mining: -What Is a DataWarehouse? A Multidimensional Data Model, DataWarehouse Architecture, DataWarehouse Implementation, From DataWarehousing to Data Mining, OLAP tools.

Module – II: (10 hrs)

Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses, From Association Mining to Correlation Analysis, Constraint- Based Association Mining.Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Backpropagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, and Classifier Accuracy.

Module – III : (10 hrs)

Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Outlier Analysis.

Mining Complex Data: Graph Mining, Social Network Analysis, Multirelational Data Mining, Spatial data mining, Multimedia data mining, Text data mining,Mining the World Wide Web

OLAP tools, Tools for Data warehousing, WEKA tool.

TEXT BOOK

1. Data Mining – Concepts and Techniques – Jiawei Han, MichelinenKamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.
2. Pieter Adriaans, DolfZantinge, “Data Mining”, Addison Wesley, 1996.

Reference books:

1. Data Mining: Arun Pujari, University Press
2. Data Mining –a Tutorial based primer by R.J.Roiger, M.W.Geatz, Pearson Education.
3. Data Mining & Data Warehousing Using OLAP: Berson, TMH.
4. Data Warehousing: ReemaThareja, Oxford University Press

Course Outcomes

1. Analyzing Dimensionality. Reduction. Feature Subset Selection.
2. Understanding, Discretization and Analyzing Similarity – Basics and Dissimilarity.
3. Understanding. Association Rules
4. Application of Datamining to analyse various problems like social network ,multiple relation among two or more data set of different domains.

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Lab 17 (MC-4 Lab): Data Mining Lab UsingMATLAB (CS4582)

List of Experiments:

1. Introduction to statistical problem by MATLAB.
2. Finding Correlation, Regression by the use of MATLAB.
3. T- test, Chi square test by using MATLAB.
4. Testing of hypothesis, confidence interval by using MATLAB.
5. Statistical validation of various types of data by using MATLAB.
6. Design and modeling of Binomial and Poisson distribution by MATLAB.
7. Generation of random numbers, by any simulator.
8. Simple integration by random numbers, MATLAB implementation.
9. Finding 1st,2nd moments by using MATLAB.
10. General statistical application in validation of medical related data.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Semester-9

PC-8: Functional Analysis (BH5141)

Prerequisites: Real Analysis, Linear Algebra.

Module-I: (10hrs)
Normed spaces, Banach spaces, Compactness and Finite Dimension, Linear Oprators, bounded and Continuous linear Operators, Linear Functionals, Linear Operators and Functionals on Finite Dimensional Spaces, Normed Space of Operators, Dual Space, Duals of $L^P[a,b]$, C[a,b], etc. ,Algebraically Reflexive Spaces, Reflexive Spaces.

Module-II: (10hrs)
Inner product spaces, Hilbert Spaces, Orthogonal Complements and Direct Sum, Orthonormal sets and Sequences, Bessel Inequality, Projections, Riesz Representation Theorem. Hilbert Adjoint Operator, Normal,Unitary and Self-AdjointOperators.

Module-III: (10hrs)
Totally Ordered Set, Partially Ordered Set, Zorn's, Lemma, Hahn-BanachTheorems, Category, Bair's Category Theorem, Uniform boundedness Theorem, Strong and weak Convergence, Convergence of Sequences of Operators and Functionals.

Module-IV: (10hrs) Application-Divergence of Fourier Series of Continuous Functions, Closed Graph Theorem, Open Mapping Theorem, Bounded Inverse Theorem, Spectrum of Bounded Linear Operators, Compact Operators.

Text book:
1. B. V. Limaye: Functional Analysis (2nd Edition)- New Age International Limited.
2. Erwin Kreyszig, Introductory Functional Analysis with Applications, John Wiley and Sons (Asia), pvt.ltd., 2006.

Reference book:
1. John B. Conway, A course in Functional Analysis, 2nd edition, Springer verlag, 2006
2. G. Bachman, L. Narici, Functional Analysis, Academic Press

Course Outcomes: After the successful completion of this course the students will be able to
1. Define and thoroughly explain Banach and Hilbert spaces and self-adjoint operators.
2. Apply Hilbert space-theory.
3. To work with families of applications appearing in the course.
4. Produce examples and counterexamples illustrating the mathematical concepts presented in the course.

PC-9 : Machine Learning (BH5143)

Prerequisites: Probability, Statistics.

Module-I: (14 hrs)
Testing of hypothesis, Performance analysis of machine learning algorithms,Linear methods for Regression and Classification: Overview of supervised Learning, Linear regression models and least squares,Logistic regression, Multiple Regression, Subset selection, Ridge regression, least angle regression and Lasso.

Module-II:(13 hrs)
Cluster analysis, Principal Component Analysis, Gaussian mixtures and selection,Linear discriminate analysis. Additive Models, Decision Trees and Boosting: Generalized additive models, Regression and Classification trees.

Module-III:(13 hrs)
Boosting Methods- exponential loss and AdaBoost, Random forests and analysis, Basis expansion and regularization, Kernel smoothing methods, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest Neighbor classifiers.

Text Books

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning-Data Mining Inference and Prediction, Second Edition, Springer Verlag, 2009.
2. Ethem Aipaydin, Introduction to Machine Learning, The MIT Press.

References

1. C.M. Bishop- Pattern Recognition and Machine Learning, Springer,2006.
2. L. Wasserman- All of statistics.

Course Outcomes: - After the successful completion of this course the students will be able to

1. Understand concepts of Large Numbers and different distributions in statistics and their limitations;
2. Understand modern notions in data analysis-oriented computing;
3. be capable of confidently applying common Supervised & Unsupervised Learning algorithms in practice and implementation;
4. Capable of performing distributed computations.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-10: Optimization Theory (BH5145)

Prerequisites: Operation research.

Module-I: (13hrs)

Linear programming: Introduction to LPP, Simplex method, Big M method, Two Phase method, Revised simplex method, Duality theory and Dual simplex method,

Integer programming: Branch and bound method, Zero-one- Programming, Gomory cutting method, Dynamic programming problem.

Module-II: (13hrs)

Calculus on R and Rn,Convex Analysis, One Dimensional Optimization: Function Comparison Methods, Polynomial Interpolation Methods, Iterative Methods, Two Point Equal Interval Search, Method of Bisection, Fibonacci search Method, Golden Section Search Method, Quadratic Interpolation, Cubic Interpolation.

Iterative Methods: Newton's Method, Secant Method.

Module-III: (14hrs)

Unconstraint Optimization:One dimensional Optimization, Optimization without constraints, Conjugate Gradient method, Steepest Descent Method, Newton's, Quasi-Newton's Method

Constraint Optimization: Method of Multipliers, Lagrange Multiplier, Kuhn-Tucker conditions, Convex Optimization, Penalty Function Techniques.

Text Books

1. Mohan C Joshi, Kannan M Moudgalya, "Optimization Theory and Practice", Narosa Publishing House Pvt. Ltd.
2. Ashok D Belegundu, A R Chandrupatla, Second Edition Cambridge University Press.

Reference Books

1. KalyamoyDed, "Optimization for Engineering Design", PHI Learning Pvt Ltd
2. Stephen G. Nash, A. Sofer," Linear and Non-Linear Programming", McGraw Hill
3. H.A.Taha, A.M. Natarajan, P. Balasubramanie, A.Tamilarasi, 'Operations Research" 8th Edition Pearson Education.

Course Outcomes: After successful completion of the course, students will be able to:

1. understand and use methods for constrained and unconstrained optimization,
2. understand the solution for simple multistage problems using dynamic programming and geometric programming,
3. formulate and solve nonlinear programming problems from real field data,
4. Demonstrate the ability to choose and justify optimization techniques that are appropriate for solving realistic engineering problems.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-11: Matrix Computation (BH5147)

Prerequisites: Determinant, Matrices, MATLAB.

Module-I: (10hrs)

Gaussian Elimination and Its Variants: Matrix Multiplication Systems of Linear Equations, Triangular Systems, Positive Definite Systems; Cholesky Decomposition, Banded Positive Definite Systems, Sparse Positive Definite Systems, Gaussian Elimination and the LU Decomposition, Gaussian Elimination with Pivoting, Sparse Gaussian Elimination, Sensitivity of Linear Systems: Vector and Matrix Norms, Condition Numbers.

Module-II: (10hrs)

The Least Squares Problem, The Discrete Least Squares Problem, Orthogonal Matrices, Rotators, and Reflectors, Solution of the Least Squares Problem, The Gram-Schmidt Process, Geometric Approach, Updating the QR Decomposition, The Singular Value Decomposition, Introduction, Some Basic Applications of Singular Values.

Module-III: (10hrs)

Eigen values and Eigen vectors, Systems of Differential Equations, Basic Facts, The Power Method and Some Simple Extensions, Similarity Transforms, Reduction to Hessenberg and Tridiagonal Forms, The QR Algorithm, Implementation of the QR algorithm, Use of the QR Algorithm to Calculate Eigenvectors, The SVD Revisited, Eigen values and Eigen vectors, Eigen spaces and Invariant Subspaces, Subspace Iteration, Simultaneous Iteration, and the QR Algorithm, Eigen values of Large, Sparse Matrices, Eigen values of Large, Sparse Matrices, Sensitivity of Eigen values and Eigenvectors, Methods for the Symmetric Eigenvalue Problem, The Generalized Eigenvalue Problem.

Text Book:

1. Fundamentals of Matrix Computation by David S Watkins
   Ch1.Ch 2.1,2.2,Ch 3,Ch 4.1,4.2,Ch 5,Ch 6.

Reference Book:

1. Matrix Computations by Gene H. Golub, Charles F.Van Loan The Johns Hopkins University Press, Baltimore.

Course Outcomes: After the successful completion of this course the students will be able to

1. Account for basic concepts of projections, transformations, sensitivity of linear systems vector and matrix norm .
2. Use matrix computations in theory and practice to solve linear system of equations, eigen value problems.
3. practice and to have in-depth understanding on orthogonality and angles, rank, matrix factorizations and least square problems.
4. Apply a scientific approach to analyse and compile results w.r.t. the conditioning of the problems and stable algorithms.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 3: Multi Variate Analysis (BH5241)

Course Objectives:

1. Introduction to multivariate data analysis
2. Building theoretical foundations of properties of random vectors and their distributions
3. In-depth treatment of several important multivariate distributions
4. Identification and development of appropriate statistical tools to analyze real-world problems involving multivariate datasets

Module-I: (13hrs)

Multivariate Distributions: Distributions and Density Function, multivariate normal distribution and its properties, Heavy- Tailed distributions, distributions of linear and quadratic forms, tests for partial and multiple correlation coefficients and regression coefficients and their associated confidence regions.

Module-II: (13hrs)

Theory of the Multinormal: Wishartdistribution (definition, properties), construction of tests, union-intersection and likelihood ratio principles, inference on mean vector, Hotelling's T2distribution, Spherical and Elliptical distribution. MANOVA. Inference on covariance matrices.

Module-III: (14hrs)

Discriminant analysis. principal component analysis, StandardizedLinear Combination, Interpretation of the PCs, Asymptotic Properties of the PCs. factor analysis, the orthogonal factor model, Estimation of the factor model, Factor Scores and Strategies. Cluster Analysis, cluster algorithm, Boston housing.

Text Book

1. W.Hardle, L. Simar, “Applied Multivariate Statistical Analysis” Second Edition, Springer.

References Texts:

1. T. W. Anderson, An Introduction to Multivariate Statistical Analysis.
2. R. A. Johnson and D. W. Wichern, Applied Multivariate Statistical Analysis.
3. K. V. Mardia, J. T. Kent and J. M. Bibby, Multivariate Analysis.
4. M. S. Srivastava and C. G. Khatri, An Introduction to Multivariate Statistics.
5. C. R. Rao: Linear statistical inference and its applications.

Course Outcomes: After the successful completion of this course the students will be able to

1. appreciate the range of multivariate techniques available
2. summarize and interpret multivariate data,
3. understand the link between multivariate techniques and corresponding univariate techniques,
4. use multivariate techniques appropriately, undertake multivariate hypothesis tests, and draw appropriate conclusions.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 3: Numerical Optimization (BH5243)

Prerequisites: Optimization Theory.

Module-I: (13hrs)

Trust-Region Methods: The Cauchy Point and Related Algorithms, The Cauchy Point, Improving on the Cauchy Point, The Dogleg Method, Two-Dimensional Subspace Minimization, Steinhaug's Approach,

Newton Methods: Inexact Newton Steps, Line Search Newton Methods, Line Search Newton–CG Method, Modified Newton's Method, Hessian Modifications, Eigenvalue Modification, Adding a Multiple of the Identity,Modified Cholesky Factorization. Gershgorin Modification, Modified Symmetric Indefinite Factorization,Trust-Region Newton Methods, Newton–Dogleg and Subspace-Minimization Methods, Accurate Solution of the Trust-Region Problem, Trust-Region Newton–CG Method, Preconditioning the Newton–CG Method, Local Convergence of Trust-Region Newton Methods

Module-II: (13hrs)

Quasi-Newton Methods: The BFGS Method, Properties of the BFGS Method, Implementation,TheSR1Method, Properties of SR1 Updating, The Broyden Class, Properties of the BroydenClass,Convergence Analysis, Global Convergence of the BFGS Method, Super linear Convergence of BFGS,Convergence Analysis of the SR1Method,Large-Scale Quasi-Newton and Partially Separable Optimization: Limited-Memory BFGS Relationship with Conjugate Gradient Methods,General Limited-Memory Updating,Compact Representation of BFGS Updating,SR1Matrices,Unrolling the Update,Sparse Quasi-Newton Updates, Partially Separable Functions, Internal Variables,Invariant Subspaces and Partial Separability, Sparsity vs. Partial Separability,Group Partial Separability,Algorithms for Partially Separable Functions,Exploiting Partial Separability in Newton's Method,Quasi-Newton Methods for Partially Separable Functions.

Module –III: (14hrs)

Fundamentals of Algorithms for Nonlinear Constrained Optimization

Initial Study of a Problem, Categorizing Optimization Algorithms, Elimination of Variables, Simple Elimination for Linear Constraints, General Reduction Strategies for Linear Constraints, The Effect of Inequality Constraints, Measuring Progress: Merit Functions

Quadratic Programming: Portfolio Optimization,Equality–Constrained Quadratic Programs,Properties of Equality-Constrained QPs,Solving the KKT System,Direct Solution of the KKT System,Range-Space Method,Null-Space Method,Method Based on Conjugacy,Inequality-Constrained Problems,Optimality Conditions for Inequality-Constrained Problems,Degeneracy,Active-Set Methods for Convex QP,Specification of the Active-Set Method for Convex QP, Finite Termination of the Convex QP Algorithm,Updating Factorizations,Active-Set Methods for Indefinite QP,Choice of Starting Point .

Text books:

1. Numerical Optimization, Jorge Nocedal& Stephen J. Wright, Springer.

Reference books:

1. Linear and Nonlinear Programming, David G. Luenberger&Yinyu Ye, Springer
2. Numerical Optimization: Theoretical and Practical Approach, J.FredericBonnans,J.Charles Gilbert, Claude Lemarechal, Claudia A. Sagas

Course Outcomes: After successful completion of the course, students will be able to

1. use sophisticated scientific computing and visualization environments to solve application problems involving matrix computation algorithms,
2. analyze numerical algorithms, and understand the relationships between the computational effort and the accuracy of these algorithms,
3. interpret the results produced by computer implementations of numerical algorithms,
4. explain the effects of errors in computation and how such errors affect solutions,

PE 3: Numerical Solution of Differential Equation (BH5245)

Prerequisites: Numerical Method, Differential Equation, MATLAB.

Module – I:(13hrs)
Finite Difference Methods for Parabolic Equations: stability, consistence and convergence, 1-D parabolic equations, 2-D and 3-D parabolic equations. Finite Difference Methods for Hyperbolic Equations: some basic difference scheme, dissipation and dispersion errors, extensions to conservation laws, the second-order hyperbolic PDEs. Finite Difference Methods for Elliptic Equations: numerical solution of linear systems, error analysis with a maximum principle.

Module – II:(13hrs)
Finite Element Methods: Basic Theory: introduction to one-dimensional problems, introduction to two-dimensional problems, abstract finite element theory, examples of conforming finite element spaces, examples of nonconforming finite elements, finite element interpolation theory, finite element analysis of elliptic problems, finite element analysis of time-dependent problems.

Module – III:(14hrs)
Finite Element Methods: Programming: FEM mesh generation. Forming FEM equations, calculation of element matrices, assembly and implementation of boundary conditions, the MATLAB code for P_1 element, the MATLAB code for Q_1 element.

Text Book:

1. Computational Partial Differential Equations using MATLAB by J. Li and Y-T Chen CRC Press Chapman & Hall.Chapters: 2, 3, 4, 6, 7

Course Outcomes: After successful completion of the course, students will be able to

1. apply numerical methods to obtain approximate solutions to mathematical problems,
2. derive numerical methods for various mathematical operations and tasks,
3. analyse and evaluate the accuracy of common numerical methods,
4. write efficient, well-documented MATLAB code and present numerical results in an informative way.

Lab 18 (PC Lab 1): Optimization Laboratory (BH5541)

List of Experiments:

1. Introduction to linear programming problem,solving LPP by MATLAB (Introduction)
2. Solve various simplex problem using MATLAB Function
3. Solve Transportation and assignment problem using any suitable simulator
4. Compare. between Transportation,Assignment problem by Using MATLAB
5. Explore queuing theory for scheduling, resource allocation, and traffic flow applications using MATLAB.
6. Elementary concept of Modelling and Simulation using MATLAB.
7. Solve Various Decision Problem Using MATLAB.
8. Introduction to Nonlinear Programming by any suitable simulator
9. Iterative method for optimization problem by any suitable simulator
10. Application of nonlinear programming using MATLAB.

Lab 19 (PC Lab 2): Matrix Computation &Machine Learning Laboratory Using R Programming (BH5543)

Syllabus:

Implementation of following methods using R Programming

Simple and multiple linear regression, Logistic regression, Linear discriminant analysis, Ridge Regression, Cross validation and boot strap, Fitting Classification and Regression trees, K-nearest neighbours, Principal component analysis, K-means clustering.

Reference (For R Programming)

1. G.James, D.Witten, T.Hastie, R.Tibshirani-An introduction to statistical learning with applications in R, Springer,2013.

Course Outcomes: Upon successful completion of the course students will be able to

1. apply R Programming to solve statistical problems,
2. understand about statistical based computer programming,
3. apply different programming tools on various statistical problems,
4. code statistical functions.

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Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

Semester-10

PC-12: Number Theory and Cryptography (BH5142)

Prerequisites: Set of Integers, Permutation & Combination, Programming language.

Module-I:(13 hrs)
Euclidean GCD Algorithm, Extended GCD Algorithm, Congruences and Modular Arithmetic: Modular Exponentiation, Fast Modular Exponentiation, Linear Congruences: Chinese Remainder Theorem, Polynomial Congruences: Hensel Lifting, Quadratic Congruences: Quadratic Residues and Non-Residues, Legendre Symbol, Jacobi Symbol, Multiplicative Orders: Primitive Roots, Computing Orders, Prime Number Theorem and Riemann Hypothesis
Polynomial-Basis Representation, Fermat's Little Theorem for Finite Fields, Multiplicative Orders of Elements in Finite Fields, Normal Elements, Minimal Polynomials,
Application to cryptography: The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher, Stream Ciphers.

Module-II :(13 hrs)
Primality Testing: Fermat Test, Solovay-Strassen Test, Miller-Rabin Test, AKS Test, Integer Factorization: Trial Division, Pollard's Rho Method, Floyd's Variant, Block GCD Calculation, Brent's Variant, Pollard's p-1 Method: Large Prime Variation, Quadratic Sieve Method: Sieving, Incomplete Sieving, Large Prime Variation, Multiple-Polynomial Quadratic Sieve Method
The RSA Cryptosystem: Introduction to Public-key Cryptography, Implementing RSA Cryptosystem, Other Attacks on RSA: Computing $\phi(n)$, The Decryption Exponent, Wiener's Low Decryption Exponent Attack, Cryptographic Hash Functions: Hash Functions and Data Integrity, Security of Hash Functions : The Random Oracle Model, Algorithms in the Random Oracle Model, Comparison of Security Criteria, Discrete Logarithms: The ElGamal Cryptosystem, Algorithms for the Discrete Logarithm Problem: Shank's Algorithm , The Pollard Rho Discrete Logarithm Algorithm, Security of ElGamal Systems.

Module-III:(14 hrs)
Elliptic Curves: Elliptic Curves over the Reals, Elliptic Curves Modulo a Prime, Properties of Elliptic Curves, Point Compression and the ECIES, Computing Point Multiples on Elliptic Curves. Signature Schemes: Introduction, Security Requirements for Signature Schemes, Signatures and Hash Functions, The ElGamal Signature Schemes, Security of the ElGamal Signature Scheme, Variants of the ElGamal Signature Schemes: The Schnorr Signature Scheme, The Digital Signature Algorithm, The Elliptic Curve DSA, Elliptic Curve Primality Test.

Text Books:

1. Computational Number Theory-Abhijit Das, CRC Press (First Indian Reprint,2015) Chapter 1(1.2-1.7, 1.9) ,Chapter 2 (2.2.1,2.4.1,2.4.2, 2.4.3, 2.4.4), Chapter 5 (5.2.1,5.2.2, 5.2.3, 5.3.2) , Chapter 6(6.1-6.6, 6.8).
2. Cryptography Theory and Practice- Douglas R. Stinson, Chapman & Hall/ CRC (Third Edition) Chapter 1, Chapter 4 (4.1 ,4.2), Chapter 5(5.1,5.3,5.7), Chapter 6 (6.1,6.2,6.5,6.7), Chapter 7(7.1-7.4)

Reference Books:

1. Neal Koblitz: A Course in number theory and Cryptography, Springer Veriag, Chapter 6(section 3)

Course Outcomes:

After successful completion of the course, students will be able to:

1. develop a deeper conceptual understanding of the theoretical basis of number theory and identify how number theory is related to and used in cryptography.
2. identify the order of an integer, primitive roots, Euler's criterion, the Legendre symbol, Jacobi symbol and their properties.
3. acquire knowledge of a wide variety of number theoretic ideas and techniques like Divisibility results, Euclid's algorithm,Fermat's little Theorem , Chinese Remainder Theorem, Diophantine equations,finite field etc.
4. Understand modular arithmetic number-theoretic functions, RSA scheme and apply them to cryptography.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PC-13 : Theory of Computation (BH5144)

Prerequisites: Discrete Mathematics.

Module – I: (13 hrs)
Alphabet, languages and grammars. Production rules and derivation of languages. Chomsky hierarchy of languages. Regular grammars, regular expressions and finite automata (deterministic and nondeterministic). Closure and decision properties of regular sets. Pumping lemma of regular sets. Minimization of finite automata. Left and right linear grammars.

Module – II:(13 hrs)
Context free grammars and pushdown automata. Chomsky and Griebach normal forms. Parse trees, Cook, Younger, Kasami, and Early's parsing algorithms.
Ambiguity and properties of context free languages. Pumping lemma, Ogden's lemma, Parikh's theorem. Deterministic pushdown automata, closure properties of deterministic context free languages.

Module – III:(14 hrs)
Turing machines and variation of Turing machine model, Turing computability, Type 0 languages. Linear bounded automata and context sensitive languages. Primitive recursive functions. Cantor and Godel numbering. Ackermann's function, mu- recursive functions, recursiveness of Ackermann and Turing computable functions.
Church Turing hypothesis. Recursive and recursively enumerable sets. Universal
Turing machine and undecidable problems. Undecidability of Post correspondence problem. Valid and invalid computations of Turing machines and some undecidable properties of context free language problems. Time complexity class P, class NP, NP completeness.

Text Books:

1. Introduction to Automata Theory, Languages and Computation: J.E. Hopcroft and J.D Ullman, Pearson Education, 3rd Edition.
2. Introduction to the theory of computation: Michael Sipser, Cengage Learning

Reference Books:

1. Introduction to Languages and the Theory of Computation: Martin, Tata McGraw Hill, 3rd Edition
2. Introduction to Formal Languages, Automata Theory and Computation: K. Kirthivasan, Rama R, Pearson Education.
3. Theory of computer Science (Automata Language & computations) K.L. Mishra N. Chandrashekhar, PHI.
4. Elements of Theory of Computation: Lewis, PHI
5. Theory of Automata and Formal Languages: Anand Sharma, Laxmi Publication
6. Automata Theory: Nasir and Srimani, Cambridge University Press.
7. Introduction to Computer Theory: Daniel I.A. Cohen, Willey India, 2nd Edition.
8. Theory of computation by Saradhi Varma, Scitech Publication

Course Outcomes: After successful completion of the course, students will be able to:

1. analyze and design finite automata, difference between complete system and NFA, Pushdown automata, Turing machines, Formal languages, and Grammars,
2. Demonstrate and understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving,
3. Prove the basic results of the Theory of Computation,
4. Model, compare and analyze different computational models,state and explain the relevance of the Church-Turing hypothesis

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 4: Image Processing (CS5282)

Expected outcome: The students will be able to:

1. Distinguish / Analyse the various concepts and mathematical transforms necessary for image processing
2. Differentiate and interpret the various image enhancement techniques
3. Illustrate image segmentation algorithm
4. Analyse basic image compression techniques

Module I:(10hrs)

Introduction – Origin – Steps in Digital Image Processing – Components – Elements Of Visual Perception – Image Sensing And Acquisition – Image Sampling And Quantization – Relationships Between Pixels – Color Models.

Image Enhancement:Spatial Domain: Gray Level Transformations – Histogram Processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction To Fourier Transform – Smoothing And Sharpening Frequency Domain Filters – Ideal, Butterworth And Gaussian Filters.

Module II:(10hrs)

Image Restoration and SegmentationNoise Models – Mean Filters – Order Statistics – Adaptive Filters – Band Reject Filters – Band Pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener Filtering Segmentation: Detection of Discontinuities–Edge Linking And Boundary Detection – Region Based Segmentation- Morphological Processing- Erosion And Dilation.

Module III:(10hrs)

Wavelets and Image Compression

Wavelets – Subband Coding – Multiresolution Expansions – Compression: Fundamentals – Image Compression Models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

Image Representation and Recognition: Boundary Representation – Chain Code – Polygonal Approximation, Signature, Boundary Segments – Boundary Description – Shape Number – Fourier Descriptor, Moments- Regional Descriptors –Topological Feature, Texture – Patterns and Pattern Classes – Recognition Based On Matching.

Text Books:

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, 3rd Edition, Pearson Education
2. R C Gonzalez, Woods and Eddins, Digital Image Processing using Matlab, 2nd Edition, Tata McGraw Hill

Reference Books:

1. S.Sridhar, Digital Image Processing, Oxford University Press, 2011
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
3. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
4. William K Pratt, "Digital Image Processing", John Willey, 2002.
5. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

Course Outcomes

1. Knowledge about digital image processing
2. To know the relation between Computer graphics and image processing
3. Use various image processing algorithms for general purpose
4. Knowledge about single bit pixel and multi bit pixels.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 4: Fractal and Chaos Theory (CS5283)

Course Prerequisites:
This course requires basic knowledge of Euclidean geometry, algebra and probability.

Module-I:(10hrs)
Fractal Geometry: Introduction, Self similar fractals, exact similarity; random fractals, fractal dimension: The Euclidean and Topological Dimensions,Natural fractals, statistical self similar,The Cantor Set, The Koch Curve, The Sierpinski Gasket, Randomizing the Cantor Set and Koch Curve.

Module-II:(10hrs)
The Box Counting Dimension and the Hausdorff Dimension, The Structured Walk Technique and the Divider Dimension, The Perimeter-Area Relationship, Regular and Fractional Brownian Motion, The Colour and Power of Noise, Power Spectra

Module-III:(10hrs)
Chaos Dynamics: Deterministic Chaos, Population Growth and the Verhulst Model, The Effect of Variation in the Control Parameter, Bifurcation, Stability and the Feigenbaum Number, Julia Sets and the Mandelbrot Set.
The Duffing Oscillator, The Lorenz Model, The Rössler Systems, The Lyapunov Dimension

Text books:
1. Paul S Addition, “Fractals and Chaos”, IOP Publication.
   Chapters: 1, 2, 3, 4, 5, 6, 7.

Reference books:
1. Heinz-Otto Peitgen, HartmutJürgens, DietmarSaupe, “Chaos and Fractals”, Second Edition, Springer., USA

Course Outcomes:
On successful completion of the course, the students will be able to:
1. Understand basic principles and techniques of fractional and chaotic theory
2. Demonstrate their proficiency in representation and reasoning of natural objects
3. Demonstrate understanding of basic dimensional measurement of similar and natural objects.

Understand the effect of Variation in the Control Parameter, Bifurcation, Stability and the Feigenbaum Number.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 5: Finite Element Method (BH5242)

Prerequisites: Real Analysis, Differential Equation. Linear Algebra.

Module – I: (13hrs)

Direct Approach for Discrete Systems: Describing the behaviour of a single bar element, Equations for a system, Applications to other linear systems, two-dimensional truss systems, transformation law, three-dimensional truss systems. Strong and Weak Form in One-dimensional problems: The strong form in one-dimensional problems, the weak form in one-dimension, continuity, the equivalence between the weak and strong forms, one-dimensional stress analysis with arbitrary boundary conditions, one-dimensional heat conduction with arbitrary boundary conditions, two-point boundary value problems with generalized boundary conditions, advection-diffusion, minimum potential energy.

Module – II:(13hrs)

Approximation of Trial Solutions, Weight Functions and Gauss Quadrature for One-dimensional problems: two-node linear element, quadratic one-dimensional element, direct construction of shape functions in one dimension, approximation of the weight functions, global approximation and continuity, Gauss quadrature. Finite Element Formulation for one-dimensional problems: development of discrete equation (simple case), element matrices for two-node element, application to heat conduction and diffusion problems, development of discrete equations for arbitrary boundary conditions, two-point boundary value problem with generalized boundary conditions, convergence of the FEM, FEM for advection-diffusion equation. Strong and Weak Forms for Multidimensional Scalar Field Problems: divergence theorem and Green's formula, strong form, weak form, the equivalence between weak and strong forms, generalization to three-dimensional problems, Strong and weak forms of scalar steady-state advection-diffusion in two-dimensions.

Module – III:(14hrs)

Approximations of Trial solutions, Weight Functions and Gauss quadrature for Multidimensional problems: completeness and continuity, three-node triangular element, four-node rectangular elements, four-node quadrilateral element, higher order quadrilateral elements, triangular coordinates, completeness of isoparametric elements, Gauss quadrature in two-dimensions, three dimensional elements. Finite Element Formulation for Multidimensional Scalar Field Problems: finite element formulation for two-dimensional heat conduction problems, verification and validation, advection-diffusion equation.

Text Book:

1. A First Course in Finite Elements by J. Fish and T. Belytschko, John Wiley & Sons
   Chapters 2, 3, 4, 5, 6, 7, 8

Course Outcomes: After successful completion of this course students will be able to

1. understand the concepts behind variational methods and weighted residual methods in FEM,
2. develop element characteristic equation procedure and generation of global stiffness equation will be applied,
3. apply suitable boundary conditions to a global structural equation, and reduce it to a solvable form,
4. able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.

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Syllabus (Effective from 2023-24)

School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 5: Advanced Machine Learning (BH5244)

Prerequisites: Statistics, Linear Algebra, Probability

Module –I:(13 hrs)
Introduction: generative models for discrete data (Bayesian concept learning, Naïve Bayes classifier), Gaussian discriminant analysis, Inference in jointly Gaussian distributions, Bayesian statistics, Bayesian linear and logistic regression, General linear models and exponential family, Mixture models and EM algorithm, Gaussian Processes.

Module –II:(13 hrs)
Review of SVM, Multiclass SVM, kernels for building generative models, kernels for strings.Neural Networks-Perceptron, MLP and back propagation, Methods of acceleration of convergence of BPA, Introduction to Deep Learning.

Module –III:(14 hrs)
Dimensionality Reduction (Factor Analysis, Kernel PCA, Independent Component Analysis, ISOMAP, LLE), feature selection, Spectral Clustering, Markov and Hidden Markov Models, Performance Analysis, Model Assessment, Bias Variance Trade-off, Training error, Test error, Model Complexity, Cross Validation and Boot Strap Method.

Text Books:

1. Machine Learning: A Perspective Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin.

Course Outcomes: Upon successful completion, students will be able to:

1. Understand the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc
2. Understand the strengths and weaknesses of many popular machine learning approaches,
3. appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning,

Design and implement various machine learning algorithms in a range of real-world applications.

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School/ Department: School of Basic Sciences & Humanities
Course: Integrated M. Sc., Programme: Mathematics & Computing,
Duration: 5 years (Ten Semesters)

PE 5: Differential Geometry (BH5246)

Prerequisites: Differential Calculus.

Module-I : (14 hrs)

Preliminary Comments on R^n, Topological Manifolds, Differentiability for Functions of Several Variables, Differentiability of Mappings and Jacobians, The Space of Tangent Vectors at a point of R^n.
Definition of a Differential Manifold, Example of Differential Manifolds, Differentiable Functions and Mappings, The Tangent Space at a point of a Manifold, Vector, Fields, Tangent Covectors, Covectors on Manifolds, Covector Fields and Mappings, Bilinear Forms, The Riemannian Metric, Riemannian Manifolds as Metric Spaces, Tensors on a Vector Space.

Module-II :(13 hrs)

Lie Groups, The Action of a Lie Group on a Manifold, The Action of a Discrete Group on a Manifold, One parameter and local one parameter Groups acting on a Manifold, The Lie Algebra of Vector Fields on a Manifold. Tensor Fields, mapping and Covariant Tensors, Symmetrizing and Alternating transformations, Multiplication of Tensors on a Vector Space, Multiplication of Tensor Fields, Exterior Multiplication of Alternating Tensors, Exterior Algebra on Manifolds, Exterior Differentiation.

Module-III: (13 hrs)

Differentiation of Vector Fields along curves in R^n, The Geometry of Space Curves, d ifferentiation of Vector Fields on Sub-manifolds of R^n, Formulas for Covariant Derivatives, Differentiation on Riemannian Manifolds, The Curvature Tensor, The Riemannian Connection and Exterior Differential Forms, Basic Properties of Riemannian Curvature Tensor, The Curvature Forms and the equations of Structure.

Text Book:

1. William Boothby; An Introduction to Differentiable manifolds and Riemannian Geometry, Academic Press, New York.
2. U. C. De, A. A. Shaikh; Differential Geometry of Manifolds, Narosa Publishing House Pvt. Ltd., New Delhi, Chennai, Mumbai, Kolkata, 2007 Reprinted 2009.
   The course is covered by Chapters II, III, IV, V, VI, VII and VIII.

Reference Book:

1. Loring W. Tu; An Introduction to Differentiable manifolds, Second Edition, Springer International Edition, First Indian Reprint 2012.
2. Wilmore- Differential and Riemannian geometry, Oxford University Press, 1996.
3. Warner-Foundations of differential geometry and Lie groups Springer, 1983.

Course Outcomes: After successful completion of the course, students will be able to

1. Define the equivalence of two curves and analyse the equivalence of two curves by applying some theorems.
2. Express definition and parametrization of surfaces
3. Express tangent spaces of surfaces and explain differential maps between surfaces and finding derivatives of such maps.
4. Listing topological aspects of surfaces, defining the concept of manifolds with examples and investigate their properties.

PE 5: Computational Fluid Dynamics (BH5248)

Module-I: (13 hrs)

Basic Concepts, Continuum Hypothesis, Viscosity, Strain Analysis, Stress Analysis, Relation between Stress and rate of Strain components, Thermal Conductivity, Law of heat Conduction, Equation of Continuity in Vector Form and in Various Co-ordinate Systems, Boundary Conditions.

Module-II :(13 hrs)

Navier-Stokes Equations, Energy Equations, Vorticity and Circulation in Viscous Flow, Bernoulli's equation, Dynamical Similarity by Inspection Analysis, Physical Importance of Non- Dimensional Parameters, Important Non-Dimensional Coefficients in the Dynamics of Viscous Fluids, Exact Solution of Navier-Stokes Equations (Flow between Parallel Plates, Circular Pipes -Velocity and Temperature Distribution).

Module-III: (14 hrs)

Finite Difference methods for Parabolic Equation in one Space Variable (Explicit Method and Its Convergence, Fourier Analysis of the Error, Implicit andWeighted Average Methods and Their Convergence). Finite Difference Method for Hyperbolic Equations in one Space Dimension, characteristics, The CFL Condition, Furior Error Analysis of The Upwind Scheme, The Lax-Wendroff Shceme and its Application to Conservation Laws. Consistency, Convergence and Stability of Finite Difference Methods

Text Books

1. J. L. Bansal- Viscous Fluid Dynamics, Oxford University Press.
2. K.W,Morton & D. F. Mayers: Numerical Solution of Partial Differential Equations, Second Edition, 2005, Cambridge University Press.

References

1. P. Wesseling–Principles of Computational Fluid Dynamics, Springer Verlag, 2000.
2. T. Petrila and D. Trif–Basics of fluid Mechanics and Introduction to Computational Fluid Mechanics, Springer Verlag, 2005.
3. Z. U. A. Warsi – Fluid Dynamics–Theoretical and Computational Approach, C R C Press.
4. M. D. Raisinghania – Fluid Dynamics, S. Chand and Company.

Course Outcomes: After successful completion of the course, students will be able to:

1. Describe the physical properties of a fluid, the principles of motion for fluids and their formulation.
2. Calculate the pressure distribution for incompressible fluids, the hydrostatic pressure and force on plane and curved surfaces.
3. Demonstrate the application point of hydrostatic forces on plane and curved surfaces.
4. Use the dimensional analysis and derive the dimensionless numbers, apply the similitude concept and set up the relation between a model and a prototype.

Seminar 2: Seminar II(BH5742)

[Will be decided by the Department]

Major Project: Project (BH5642)

[As to be decided by the Department]