



## **SEMESTER I**

**Paper Name: Mathematics for Computer Science**

**Code:**

**Contact:** 3L+1T

**Credits:**

**Allotted Hrs:** 36

### **UNIT I: Modern algebra**

Binary Operation; Addition Modulo  $n$ ; Multiplication modulo  $n$ ; semi group; properties of groups; subgroup.

### **UNIT II: Trigonometry**

Radian or circular Measure; Trigonometric Functions; Trigonometric ratios of angle  $\theta$  when  $\theta$  is acute; trigonometric ratios of certain standard angles; allied angles; compound angles; multiple and sub- multiple angles.

### **UNIT III: Limits and Continuity**

The real number system; The concept of limit; concept of continuity.

### **UNIT IV: Differentiation**

Differentiation of powers of  $x$ ; Differentiation of  $e^x$  and  $\log x$ ; differentiation of trigonometric functions; Rules for finding derivatives; Different types of differentiation; logarithmic differentiation; differentiation by substitution; differentiation of implicit functions; differentiation from parametric equation. Differentiation from first principles.

### **UNIT V: Integrations**

Integration of standard Functions; rules of Integration; More formulas in integration; Definite integrals.

### **UNIT VI: Differential equations**

First order differential equations; practical approach to Differential equations; first order and first degree differential equations; homogeneous equations. Linear equations; Bernoulli's equation; Exact Differential Equations.

### **UNIT VII: Complex Numbers**

Complex Numbers; Conjugate of a complex number; modulus of a complex Number; geometrical representation of complex number; De Moivre's theorem; nthroots of a complex number.

### **UNIT VIII: Matrices and Determinants**

Definition of a matrix; Operations on matrices; Square Matrix and its inverse;



determinants; properties of determinants; the inverse of a matrix; solution of equations using matrices and determinants; solving equations using determinants.

#### **UNIT IX: Infinite Series**

Convergence and divergence; series of positive terms; binomial series; exponential series; logarithmic series.

#### **UNIT X: Probability**

Concept of probability; sample space and events; three approaches of probability; kolmogorov's axiomatic approach to probability; conditional probability and independence of events; bay's theorem.

#### **UNIT XI: Basics Statistics**

Measures of central Tendency; Standard Deviation; Discrete series. Methods; Deviation taken from assumed mean; continuous series; combined standard deviation; coefficient of variation; variance.

#### **Reference Books:**

1. Banerjee A., De S.K. and Sen S.: Mathematical Probability, U.N. Dhur& Sons.
2. Gupta S. C and Kapoor V K: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.



**Paper Name: Programming for Problem Solving**

**Code:**

**Contact:** 3L

**Credits:**

**Allotted Hrs:** 36

**Unit I:**

Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. Number Systems: Binary, Octal, Decimal, Hexadecimal Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

**Unit II:**

Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If- Else, Switch-Statement and Examples. Loop Control Statements: For, While, DoWhile and Examples. Continue, Break and Goto statements Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. Recursion- Recursive Functions.. Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

**Unit III:**

Preprocessors: Preprocessor Commands Arrays - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.

**Unit IV:**

Pointers - Introduction, Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, Lvalue and Rvalue, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command Line Arguments. Strings - Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions.

**Unit V:**

Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self Referential Structures, Unions, Type Definition (typedef), Enumerated Types. Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/Output Functions, Character Input/Output Functions.



**Reference Books :**

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3. Gary J. Bronson, A First Book of ANSI C, 4th Edition, ACM
4. Kenneth A. Reek, Pointers on C, Pearson
5. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

**Introduction to Financial Technology**

Code:

B

CT102

CONTAC

TS: 3L

CREDITS: 3

**Unit I :**Use of computers for managerial applications, Technology issues and data processing in organisations, Introduction to Information Systems, shift in Information system thinking, latest trends in Information Technology

**Unit I I :** Computer Based Information Systems- office automation systems. Decision making and MIS, transaction processing systems. Decision support system, Group Decision Support, Executive Information systems, DSS generator

**Unit I I I :** Introduction to:Artificial Intelligence Based Systems, End user computing, Distributed data processing. Deciding on IS architecture, IT leadership & IS strategic planning.

**Unit I V :** Introduction to:IS strategy and effects of IT on competition. Introduction to: ERP, re-engineering work processes for IT applications, Business Process Redesign Knowledge engineering and data warehouse.

**Books:**

1. Management Information System, O'Brien, TMH
2. Management Information System: A Concise Study, Kelkar, PHI
3. Decision support Systems, Janaki Raman, PHI
3. Business Information Systems, Munish Kumar, VIKAS
5. Business Application of Computers, M.M. Oka, EPH



## **CNS104: e-Commerce**

**Contact: 3hours**

**Credit: 3**

Ecommerce, doing business on the internet, the scope of ecommerce, using web to reach customer, benefits of ecommerce market, Ecommerce technology, the internet environment.

Ebusiness models and markets, business models, ebusiness market, traditional buy build approach and vendors, online sales shannels, advantages of out sourcing and infrastructure of TCP.

Ecommerce website creation: the elements of ecommerce, website server, developing a ecommerce website, requirement for your site, building the site, implementation.

Building shopping base systems, a shopping cart scenario, a customer servlet, real world application model, loose coupling.

Mobile commerce: wireless industry standard, wireless communication, platforms based iofcommrec, wireless wan, facilities for wireless-s environment. Concerns for mobile enterprise.

Security issues, security solution, symmetric and asymmetric scryptosystems, RSA,DES platforms, Protocols for secure messaging, secure electronic transaction protocol, electronic cash over the internet, internet security.

Electronic payment system, issues, smart cards, digital currencies.

### **Text Books:**

1. “Electronic commerce”, Pete loshin and vecca.



**Paper Name: English Communication**

**Code:**

**Contact: 3L**

**Credits:**

**Allotted Hrs: 36**

**Unit I: Grammar( 5 lectures)**

Correction of sentence, Vocabulary / word formation, Single word for a group of words, Fill in the blank, transformation of sentences, Structure of sentences – Active / Passive Voice – Direct / Indirect Narration

**Unit II:( 7 lectures)**

Essay – Descriptive – Comparative – Argumentative – Thesis statement- Structure of opening / concluding paragraphs – Body of the essay

**Unit III:( 8 lectures)**

Reading Comprehension – Global – Contextual – Inferential – Select passages from recommended text

**Unit IV:( 7 lectures)**

Business Correspondence – Letter Writing – Formal. Drafting. Biodata- Resume'- Curriculum Vitae

**Unit V:( 8 lectures)**

Report Writing – Structure , Types of report – Practice Writing

**Unit VI:( 7 lectures)**

Communication / Public Speaking skills , Features of effective speech, verbal-nonverbal

**Unit VII:( 6 lectures)**

Group discussion – principle – practice

**Reference Books:**

1. Mark MaCormack : “Communication”
2. John Metchell“ How to write reports”
3. S R Inthira& V Saraswathi“ Enrich your English – a) Communication skills b) Academic

skills “ Publisher CIEFL & OUP

4. R.C. Sharma and K.Mohan , “Business Correspondence and Report Writing “ , Tata McGraw Hill , New Delhi , 1994
5. L.Gartside , “Model Business Letters” , Pitman , London , 1992
6. Longman , “Longman Dictionary of Contemporary English” ( or ‘Oxford Advanced Learner’s Dictionary of Current English’ , OUP , 1998.
7. Maxwell Nurnberg and RosenblumMorris , “All About Words” , General Book Depot, New Delhi , 1995
8. A Text Book for English foe Engineers & Technologists



### **Programming for Problem Solving Lab:**

**Contacts:**

**Credits: 2**

Exercises should include but not limited to:

1. DOS System commands and Editors ( Preliminaries)
2. UNIX system commands and vi ( Preliminaries)
3. Simple Programs: simple and compound interest. To check whether a given number is a palindrome or not, evaluate summation series, factorial of a number , generate Pascal's triangle, find roots of a quadratic equation
4. Programs to demonstrate control structure : text processing, use of break and continue, etc.
5. Programs involving functions and recursion
6. Programs involving the use of arrays with subscripts and pointers
7. Programs using structures and files.

### **Language laboratory :**

**contacts:**

**Credit: 2**

- a) Honing 'Listening Skill' and its sub skills through Language Lab Audio device; 3P
- b) Honing 'Speaking Skill' and its sub skills; 2P
- c) Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/Voice modulation/ Stress/ Intonation/ Pitch &Accent) of connected speech; 2P 17
- j) Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Face to Face / via Telephone , Mobile phone & Role Play Mode); 2P
- k) Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success; 2P
- f) G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD; 4P
- g) Honing 'Reading Skills' and its sub skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non Technical Passages; Learning Global / Contextual / Inferential Comprehension; 2P
- h) Honing 'Writing Skill' and its sub skills by using Language Lab Audio –Visual input; Practice Sessions 2P

Total Practical Classes 17

### **Books :**

Dr. D. Sudharani: Manual for English Language Laboratory Pearson Education (WB edition),2010 Board of Editors: Contemporary Communicative English for Technical Communication Pearson Longman, 2010.



**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**  
NH-12 (Old NH-34), Simhat, Haringhata, Nadia -741249  
Department of Information Technology

## **CNS194: e-Commerce Lab**

**Contact: 3hours**

**Credit: 3**

Experiments should include but not limited to :

1. Configuration of IIS server.
2. Study of Scripting language
3. Static Web Page Designing
4. Dynamic Web Page designing





## SEMESTER II

**Paper Name: Discrete Mathematics**

**Code:**

**Contact:** 3L+1T

**Credits:**

**Allotted Hrs:** 36

### **Unit I: Set Theory:**

Definition of Sets, Venn Diagrams, complements, Cartesian products, power sets, counting principle, cardinality and countability (Countable and Uncountable sets), proofs of some general identities on sets, pigeonhole principle. Relation: Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation. Function: Definition and types of function, composition of functions, recursively defined functions.

### **Unit II: Propositional logic:**

Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradictions, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification. Notion of proof: proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example.

### **Unit III: Combinatorics**

Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.)

### **Unit IV: Algebraic Structure:**

Binary composition and its properties definition of algebraic structure; Groyas Semi group, Monoid Groups, Abelian Group, properties of groups, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields (definition and standard results).

### **Unit V: Graphs**

Graph terminology, types of graph connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number. Tree: Definition, types of tree (rooted, binary), properties of trees, binary search tree, tree traversing (preorder, inorder, post order). Finite Automata: Basic concepts of Automation theory, Deterministic finite Automation (DFA), transition function, transition table, Non Deterministic Finite Automata (N DFA), Mealy and Moore Machine, Minimization of finite



Automation.

**Reference Books:**

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Mc.Graw Hill, 2002.
2. J.P.Tremblay& R. Manohar, "Discrete Mathematical Structure with Applications to PDF created with pdfFactory Pro trial version www.pdffactory.com Computer Science" Mc.Graw Hill, 1975.
3. V. Krishnamurthy, "Combinatorics:Theory and Applications", East-West Press.
4. Seymour Lipschutz, M.Lipson, "Discrete Mathematics" Tata McGraw Hill, 2005.
5. Kolman, Busby Ross, "Discrete Mathematical Structures", Prentice Hall International.

**CNS202: Computation Number Theory**

**Contact: 3hours**

**Credit: 3**

Algorithms for integer arithmetic: Divisibility, gcd, modular arithmetic, modular exponentiation, Montgomery arithmetic, congruence, Chinese remainder theorem, Hensel lifting, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, continued fractions and rational approximations.

Representation of finite fields: Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials.

Algorithms for polynomials: Root-finding and factorization, Lenstra-Lenstra-Lovasz algorithm, polynomials over finite fields.

Elliptic curves: The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm.

Primality testing algorithms: Fermat test, Miller-Rabin test, Solovay-Strassen test, AKS test.

Integer factoring algorithms: Trial division, Pollard rho method,  $p-1$  method, CFRAC method, quadratic sieve method, elliptic curve method.

Computing discrete logarithms over finite fields: Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm.

Applications: Algebraic coding theory, cryptography.

**Text books:**



1. V. Shoup, *A computational introduction to number theory and algebra*, Cambridge University Press.
2. M. Mignotte, *Mathematics for computer algebra*, Springer-Verlag.
3. I. Niven, H. S. Zuckerman and H. L. Montgomery, *An introduction to the theory of numbers*, John Wiley

### **CNS204: Mathematics (Operation Research and Game theory)**

**Contact: 3hours**

**Credit: 3**

Basics of Operational Research: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modeling of Real Life Problems.

Linear Programming: Introduction to Linear algebra. Solution of a system of Linear Equations, Linear independence and dependence of vectors, Concept of Basis, Basic Feasible solution, Convex sets. Extreme points, Hyperplanes and Halfspaces, Convex cones, Polyhedral sets and cones.

Linear Programming Problem Formulation, solution by Graphical Method, Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charnes-M Method, Degeneracy, Theory of Duality, Dual-simplex method.

Theory of Games: Introduction to Game theory, Formulation of two person zero sum rectangular game; Solution of rectangular games with saddle points; dominance principle; rectangular games without saddle point – mixed strategy, Graphical, algebraic and linear programming solution of  $m \times n$  games.

### **Text Books**

1. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition, 2010.
2. P. R. Thie, G. E. Keough: An Introduction to Linear Programming and Game Theory, Wiley, New Jersey, 3rd edition, 2008.
3. F.S. Hillier and G.J. Lieberman: Introduction to operation research, 9<sup>th</sup> edition, Tata Mcgrawhill, 2010



**Paper Name: Data Structure and Algorithm with Python**

**Code:**

**Contact:** 3L+1T

**Credits:**

**Allotted Hrs:** 36

**Unit I: Introduction to Data Structure:**

Abstract Data Type.

**Unit II: Arrays**

1D, 2D and Multi-dimensional Arrays, Sparse Matrices. Polynomial representation (Polynomial Representation as Application).

**Unit III: Linked Lists**

Singly, Doubly and Circular Lists; Normal and Circular representation of Self Organizing Lists; Skip Lists, Polynomial representation (Polynomial Representation as Application).

**Unit IV: Stacks**

Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

**Unit V: Queues**

Array and Linked representation of Queue, Circular Queue, De-queue, Priority Queues

**Unit VI: Recursion**

Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

**Unit VII: Trees**

Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion, Recursive and Iterative Traversals of Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

**Unit VIII: Searching and Sorting**

Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, Merge Sort, Quick sort, Shell Sort, Comparison of Sorting Techniques

**Unit IX: Hashing**



**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**  
NH-12 (Old NH-34), Simhat, Haringhata, Nadia -741249  
Department of Information Technology

Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collision by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function.

**Reference Books:**

1. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, Susan AndersonFreed, Silicon Pr.
2. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, Cengage Learning
3. Data Structures In C, Noel Kalicharan, CreateSpace Independent Publishing Platform.
4. Adam Drozdek, Data Structures and algorithm in C, Cengage Learning.
5. The C Programming Language, Brian W. Kernighan and Dennis Ritchie, Prentice Hall.
6. SartajSahni, Data Structures, Algorithms and applications in C++, Second Edition, Universities Press, 2011.
7. Aaron M. Tanenbaum, Moshe J. Augenstein, YedidyahLangsam, Data Structures Using C and C++, 2nd ed., PHI, 2009.



**Paper Name: Environmental Science**

**Code:**

**Contact: 1L**

**Credits:**

**Allotted Hrs: 36**

### **Unit I: General**

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. 1L

Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth,

Sustainable Development. 2L

Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function. 1L

Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. 2L

### **Unit II: Ecology**

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. 1L

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar

ban); Food chain [definition and one example of each food chain], Food web. 2L

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. 1L

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. 2L

### **Unit III: Air pollution and control**

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level,



agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

#### **Unit IV:Water Pollution and Control**

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river[deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Wastewater treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic

#### **Unit V:Land Pollution**

Lithosphere; Internal structure of earth, rock and soil 1L Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).

#### **Unit VI: Noise Pollution**

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, 10 L (18hr Index),



**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**  
NH-12 (Old NH-34), Simhat, Haringhata, Nadia -741249  
Department of Information Technology

Ldn.Noise pollution control.

**Unit VII:Environmental Management:**

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.

**Reference Books**

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

**Data Structure with Python Lab**

**Contact: 3P**

**Credit: 2**

**Experiments should include but not limited to :**

Implementation of array operations: Stacks and Queues: adding, deleting elements  
Circular Queue: Adding & deleting elements Merging Problem : Evaluation of expressions operations on Multiple stacks & queues : Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists: Polynomial addition, Polynomial multiplication Sparse Matrices : Multiplication, addition. Recursive and Nonrecursive traversal of Trees Threaded binary tree traversal. AVL tree implementation Application of Trees. Application of sorting and searching algorithms Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.