

**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB**  
**(Formerly West Bengal University of Technology)**  
**Syllabus for B.Sc.in Cyber Security (Industry Induced)**  
 (Effective for Students Admitted in Academic Session 2019-2020)  
**PROGRAM STRUCTURE**

**1<sup>ST</sup> YEAR**

| SL No              | CODE        | Paper                                   | Contact Periods per week |   |   | Total Contact Hours | Credits |
|--------------------|-------------|---|--------------------------|---|---|---------------------|---------|
|                    |             |   | L                        | T | P |                     |         |
| <b>SEMESTER I</b>  |             |   |                          |   |   |                     |         |
| <b>Theory</b>      |             |   |                          |   |   |                     |         |
| 1                  | CYS-101     | Fundamental of Computing                | 3                        | 0 | 0 | 3                   | 3       |
| 2                  | CYS(M)-101  | Mathematics for Computing Professionals | 3                        | 1 | 0 | 4                   | 4       |
| 3                  | CYS(HU)-101 | English Communication                   | 3                        | 1 | 0 | 4                   | 4       |
| 4                  | CYS-102     | Digital principles and system design    | 3                        | 0 | 0 | 3                   | 3       |
| 5                  | CYS-103     | Computational Statistics                | 3                        | 0 | 0 | 3                   | 3       |
| <b>Practical</b>   |             |   |                          |   |   |                     |         |
| 1                  | CYS-191     | Fundamental of Computing                | 0                        | 0 | 2 | 2                   | 1       |
| 2                  | CYS-192     | Digital principles and system design    | 0                        | 0 | 2 | 2                   | 1       |
| 3                  | CYS-193     | Computational Statistics- (Lab)         | 0                        | 0 | 2 | 2                   | 1       |
| <b>Total</b>       |             |   | <b>20</b>                |   |   |                     |         |
| <b>SEMESTER II</b> |             |   |                          |   |   |                     |         |
| <b>Theory</b>      |             |   |                          |   |   |                     |         |
| 1                  | CYS-201     | Computer Architecture & Organization    | 3                        | 1 | 0 | 4                   | 4       |
| 2                  | CYS-202     | Data Structures and Algorithms          | 3                        | 0 | 0 | 0                   | 3       |
| 3                  | CYS(HU)-201 | Environmental Science                   | 3                        | 1 | 0 | 0                   | 4       |
| 4                  | CYS(HU)-202 | Cyber Law and Ethics                    | 3                        | 1 | 0 | 4                   | 4       |
| 5                  | CYS-203     | Object Oriented Concepts                | 3                        | 0 | 0 | 3                   | 3       |
| <b>Practical</b>   |             |   |                          |   |   |                     |         |
| 1                  | CYS-291     | Data Structures and Algorithms          | 0                        | 0 | 2 | 2                   | 1       |
| 2                  | CYS-292     | Object Oriented Concepts                | 0                        | 0 | 2 | 2                   | 1       |
| <b>Total</b>       |             |   | <b>20</b>                |   |   |                     |         |

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**2<sup>ND</sup> YEAR**

| SL No               | CODE    | Paper   | Contact Periods per week |   |   | Total Contact Hours | Credits |
|---------------------|---------|---|--------------------------|---|---|---------------------|---------|
|                     |         |   | L                        | T | P |                     |         |
| <b>SEMESTER III</b> |         |   |                          |   |   |                     |         |
| <b>Theory</b>       |         |   |                          |   |   |                     |         |
| 1                   | CYS-301 | Database Management Systems & Distributed Databases             | 3                        | 0 | 0 | 3                   | 3       |
| 2                   | CYS-302 | Security Architecture and Models                                | 3                        | 1 | 0 | 4                   | 4       |
| 3                   | CYS-303 | Operating System & system programming                           | 3                        | 0 | 0 | 3                   | 3       |
| 4                   | CYS-304 | Computer Networks   | 3                        | 0 | 0 | 3                   | 3       |
| 5                   | CYS-305 | Cyber Threat and Modelling                                      | 3                        | 1 | 0 | 4                   | 4       |
| <b>Practical</b>    |         |   |                          |   |   |                     |         |
| 1                   | CYS-391 | Database Management Systems                                     | 0                        | 0 | 2 | 2                   | 1       |
| 2                   | CYS-392 | Operating System & system programming (LINUX)                   | 0                        | 0 | 2 | 2                   | 1       |
| 3                   | CYS-393 | Computer Networks   | 0                        | 0 | 2 | 2                   | 1       |
| <b>Total</b>        |         |   | <b>20</b>                |   |   |                     |         |
| <b>SEMESTER IV</b>  |         |   |                          |   |   |                     |         |
| <b>Theory</b>       |         |   |                          |   |   |                     |         |
| 1                   | CYS-401 | Cryptography & Information Security                             | 3                        | 1 | 0 | 4                   | 4       |
| 2                   | CYS-402 | Parallel and Distributed Computing (inc. Cloud computing)       | 3                        | 1 | 0 | 4                   | 4       |
| 3                   | CYS-403 | Ethical Hacking and Systems Defence                             | 3                        | 0 | 0 | 3                   | 3       |
| 4                   | CYS-404 | Software Engineering & software design with UML                 | 3                        | 0 | 0 | 3                   | 3       |
| 5                   | CYS-405 | Advanced computer network & Security (TCP/IP, Wireless, mobile) | 3                        | 0 | 0 | 3                   | 3       |
| <b>Practical</b>    |         |   |                          |   |   |                     |         |
| 1                   | CYS-491 | Ethical Hacking and Systems Defence                             | 0                        | 0 | 2 | 2                   | 1       |
| 2                   | CYS-492 | Software Engineering & software design with UML                 | 0                        | 0 | 2 | 2                   | 1       |
| 3                   | CYS-493 | Advanced computer network & Security                            | 0                        | 0 | 2 | 2                   | 1       |
| <b>Total</b>        |         |   | <b>20</b>                |   |   |                     |         |

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**3<sup>RD</sup> YEAR**

| SL No              | CODE         | Paper  | Contact Periods per week |   |    | Total Contact Hours | Credits |
|--------------------|--------------|--|--------------------------|---|----|---------------------|---------|
|                    |              |  | L                        | T | P  |                     |         |
| <b>SEMESTER V</b>  |              |  |                          |   |    |                     |         |
| <b>Theory</b>      |              |  |                          |   |    |                     |         |
| 1                  | CYS-501      | Cyber Forensics  | 3                        | 0 | 0  | 3                   | 3       |
| 2                  | CYS-502      | Vulnerability Analysis, Penetration Testing, and Incident Handling | 3                        | 1 | 0  | 4                   | 4       |
| 3                  | CYS-503      | Malware Analysis   | 3                        | 1 | 0  | 4                   | 4       |
| 4                  | CYS(PE)-504A | Enterprise Security Architecture and Design                        | 3                        | 1 | 0  | 4                   | 4       |
|                    | CYS(PE)-504B | Visualisation and Cloud Security                                   |                          |   |    |                     |         |
|                    | CYS(PE)-504C | Intrusion Detection and Prevention System                          |                          |   |    |                     |         |
|                    | CYS(PE)-504D | Auditing IT Infrastructures for Compliance                         |                          |   |    |                     |         |
| 5                  | CYS(PE)-505A | Big Data & IoT Security  | 3                        | 1 | 0  | 4                   | 4       |
|                    | CYS(PE)-505B | Disaster Recovery & business continuity management                 |                          |   |    |                     |         |
|                    | CYS(PE)-505C | Data Science, Algorithms, and Complexity in the Cyber Context      |                          |   |    |                     |         |
|                    | CYS(PE)-505D | Biometric Security   |                          |   |    |                     |         |
| <b>Practical</b>   |              |  |                          |   |    |                     |         |
| 1                  | CYS-591      | Cyber Forensics  | 0                        | 0 | 2  | 2                   | 1       |
| <b>Total</b>       |              |  | <b>20</b>                |   |    |                     |         |
| <b>SEMESTER VI</b> |              |  |                          |   |    |                     |         |
| 1                  | CYS-601      | Artificial Intelligence In Cyber security & Industry use cases     | 3                        | 0 | 0  | 3                   | 3       |
| 2                  | CYS(PE)-602A | Advanced Ethical Hacking   | 3                        | 1 | 0  | 4                   | 4       |
|                    | CYS(PE)-602B | Block Chain & Cryptocurrency                                       |                          |   |    |                     |         |
|                    | CYS(PE)-602C | Penetration Testing  |                          |   |    |                     |         |
|                    | CYS(PE)-602D | Risk Management  |                          |   |    |                     |         |
| <b>Practical</b>   |              |  |                          |   |    |                     |         |
| 1                  | CYS-691      | Project  | 0                        | 0 | 24 | 24                  | 12      |
| 2                  | CYS-692      | Artificial Intelligence In Cyber security & Industry use cases     | 0                        | 0 | 2  | 2                   | 1       |
| <b>Total</b>       |              |  | <b>20</b>                |   |    |                     |         |

Total credits in the Program: 120 credits

Honours degree requirements: Additional 16 credits from MOOCS of the MOOCS basket

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**Detailed Syllabus**

**SEMESTER-I**

**Paper: Fundamental of Computing**

**Code: CYS-101**

**Contacts Hours / Week: 3L**

**Credits: 3**

**Module 1-Computer fundamentals:** Computing systems: hardware & software, Architecture & organization history: von Neumann Architecture: memory, processor, I/O; Data vs Information: Bit, byte number system: binary, octal, hexadecimal, 1's, 2's complement arithmetic, digital logic: AND, OR etc. BIOS, Booting, Application software, system software, Introduction of Operating systems, program, process; introduction of programming languages: brief overview of Pascal, FORTRAN, and BASIC. [6L]

**Module 2- General problem Solving concepts:** Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops, time & space complexity; Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C). [4L]

**Module 3- Types Operator and Expressions with discussion of variable naming and Hungarian Notation:** Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation [4L]

**Module 4- Control Flow with discussion on structured and unstructured programming:** Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, Goto Labels, structured and un- structured programming [4L]

**Module 5- Functions and Program Structure with discussion on standard library:** Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Preprocessor, Standard Library Functions and return types [4L]

**Module 6- Arrays and Pointers:** Arrays, Pointers and address, Pointers and Function Arguments, Pointers, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialization of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated. [8L]

**Module 7- Structures:** Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral Structures, Table look up, Typedef, Unions, Bit-fields [4L]

**Module 8- Input and Output:** Standard I/O, Formatted Output – printf, Formated Input – scanf, Variable length argument list, file access including FILE structure, fopen, stdin, stdout

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and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions, scope of advance C, a brief introduction of VDU basics, Mouse programming, C-assembly. [6L]

**Paper: Fundamental of Computing Lab**

**Code: CYS-191**

**Contacts Hours / Week: 2P**

**Credits: 1**

**Laboratory Outcomes**

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

**Programming Method:** Debugging, macro, User defined Header, User defined Library Function, make file

**Competitive Programming Laboratory**

1. Algorithm and flowcharts of small problems like GCD
2. Structured code writing with:
  - a. Small but tricky codes
  - b. Proper parameter passing
  - c. Command line Arguments
  - d. Variable parameter
  - e. Pointer to functions
  - f. User defined header
  - g. Make file utility
  - h. Multi file program and user defined libraries
  - i. Interesting substring matching / searching programs
  - j. Parsing related assignments
    - Familiarization of Computer Hardware & components

**Text Books:**

1. Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill.
2. B. Gottfried, "Programming in C", Second Edition, Schaum Outline Series.

**Reference Books:**

1. B. W. Kernighan and D. M. Ritchi, The 'C Programming Language', Second Edition, PHI.
2. Yashavant Kanetkar, "Let Us C", BPB Publications.

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**Paper: Mathematics for Computing Professionals**

**Code: CYS(M)-101**

**Contacts Hours / Week: 3L+1T**

**Credits: 4**

**Module-1:** Prime numbers, unique factorization, finite fields, powers and primitive roots in finite fields, Greatest common divisors, modular arithmetic, Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix, Vectors and linear combinations; Rank of a matrix; Gaussian elimination; LU Decomposition, Vector space; Gram-Schmidt orthogonalization and QR decomposition Eigenvalues and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices [10L]

**Module-2: Calculus:** Basic concept of Differential calculus and integral calculus, application of double and triple integral. [6L]

**Module-3: Abstract algebra & Combinatorics:** Set, relation, group, ring, field; Basic combinatorics, Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle. [8L]

**Module-4: Graph-Theory:** Graph-terminology, Handshaking, lemma, Connectivity, Planarity of graphs, Graph coloring, Using graphs to represent social relationships, graphs and sociograms, levels of measurement [6L]

**Module-5: Discrete logarithm problem,** Analysis of discrete logarithm problem, collision algorithms, Chinese remainder theorem, Pohlig-Hellman algorithm, Euler's formula, Pollard's p-1 factorization algorithm, Factorization by difference of squares and the quadratic sieve, Index calculus for discrete logarithms, quadratic residues and quadratic reciprocity, Overview of information theory and complexity theory [10L]

**Text Books:**

1. I. N. Herstein, "Topics in Algebra", John Wiley and Sons.
2. M. Morris Mano, "Digital Logic & Computer Design", Pearson
3. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi.

**Reference Books:**

1. Gilbert Strang: Introduction to linear algebra
2. Peter V. O'Neil, "Advanced Engineering Mathematics", Seventh Edition, Thomson Learning.
3. M. D. Greenberg, "Advanced Engineering Mathematics", Second Edition, Pearson Education.
4. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics". Vol. I & II, Vidyarthi Prakashan.
5. P. N. Wartikar & J. N. Wartikar, *Applied Mathematics* (Vol. I & II)

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**Paper: English Communication**  
**Code: CYS(HU)-101**  
**Contacts Hours / Week: 3L+1T**  
**Credits: 4**

**Unit/ Module 1:** Vocabulary Enhancement –Synonyms, Antonyms, Prefixes and suffixes. Understanding the proper way of letter writing. Comprehension, Passage reading and question answer handling. Noun, Verb, Adjective. Construction of sentences and passages with proper grammar.(8L)

**Unit/ Module 2:** Spelling and Punctuation/ Spelling Pitfalls, Grammar Revisited - Review of parts of speech. Proper pronunciation from language lab. Hearing fluent English and identifying and answering questions. Understanding the proper way to utilize punctuation and spelling Pitfalls. (8L)

**Unit/ Module 3:** Functional English - Language functions: descriptive, expressive and social, Types of language functions: to inform, enquire, attract, influence, regulate and entertain. Understanding the importance of communication. Communication in an organization. Types of communication (8L)

**Unit/ Module 4:** Reading Skills - Strategies for developing reading skills, Skimming and scanning, Predicting, Inferring, Reading critically. Reading passages, comprehension and letters. Reading with proper pronunciation. (6L)

**Unit/ Module 5:** Book reading, Shakespearian Literature reading. Reading silently, sub-vocalization, Reading at speeds of at least 250 words per minute, Inferring meaning or content after reading the heading, Guessing meaning of unfamiliar words from context, Identifying the central idea as well as supporting ideas, Spelling pitfalls, Preparing notes in diagrammatic form after reading a text, showing the central idea and supporting ideas and the relationships between them. (10L)

**Text Books:**

1. Scot Ober, Contemporary business communication, fifth edition, biztantra.
2. Lesiler & Flat lay, Basic Business communication. Tata McGrawHill.

**Reference Books:**

1. Alan Mc'Carthy and O'dell ; English vocabulary in use
2. APAART: Speak Well 1 (English language and communication)
3. APAART: Speak Well 2 (Soft Skills)
4. Dr. Saroj Hiremath -Business Communication

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**Paper: Digital principles and system design**

**Code: CYS-102**

**Contacts Hours / Week: 3L**

**Credits: 3**

**Module-1: BOOLEAN ALGEBRA AND LOGIC GATES**

Number Systems – Arithmetic Operations – Binary Codes- Boolean Algebra and Logic Gates – Theorems and Properties of Boolean Algebra – Boolean Functions – Canonical and Standard Forms – Simplification of Boolean Functions using Karnaugh Map – Logic Gates – NAND and NOR Implementations. [10L]

**Module-2: COMBINATIONAL LOGIC**

Combinational Circuits – Analysis and Design Procedures – Binary Adder-Subtractor – Decimal Adder – Binary Multiplier – Magnitude Comparator – Decoders – Encoders – Multiplexers – Introduction to HDL – HDL Models of Combinational circuits. [10L]

**Module-3: SYNCHRONOUS SEQUENTIAL LOGIC**

Sequential Circuits – Storage Elements: Latches , Flip-Flops – Analysis of Clocked Sequential Circuits – State Reduction and Assignment – Design Procedure – Registers and Counters – HDL Models of Sequential Circuits.[10L]

**Module-4: ASYNCHRONOUS SEQUENTIAL LOGIC**

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.[6L]

**Module-4: MEMORY AND PROGRAMMABLE LOGIC**

RAM – Memory Decoding – Error Detection and Correction – ROM – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices.[4L]

**Text Books:**

1. Morris Mano M. and Michael D. Ciletti, “Digital Design”, IV Edition, Pearson Education, 2008.

**Reference Books:**

1. John F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 2007.
2. Charles H. Roth Jr, “Fundamentals of Logic Design”, Fifth Edition – Jaico Publishing House, Mumbai, 2003.
3. Donald D. Givone, “Digital Principles and Design”, Tata Mcgraw Hill, 2003.
4. Kharate G. K., “Digital Electronics”, Oxford University Press, 2010.



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**Paper: Digital principles and system design Lab**

**Code: CYS-192**

**Contacts Hours / Week: 2P**

**Credits: 1**

**List of Experiments: [For Laboratory]**

Expt. No. Name of expt.

- 1 Study of digital IC and trainer kit
- 2 Realization of Logic Circuits using basic gates.
- 3 Half adder and full adder using gates and ICs
- 4 Flip-Flops using gates
- 5 Shift Registers
- 6 Multiplexers and Demultiplexers using gates and ICs
- 7 Realization of combinational circuits using multiplexer/demultiplexer ICs
- 8 Asynchronous counters using flip flops and ICs
- 9 Synchronous counter
- 10 Ring counters and Johnson counter using flip flops and ICs
- 11 Four-bit magnitude comparator
- 12 BCD to Decimal and BCD to 7-segment decoder & display
- 13 Astable and monostable multivibrators using ICs

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**Paper: Computational Statistics**

**Code: CYS-103**

**Contacts Hours / Week: 3L**

**Credits: 3**

**Module-1:** Concept of experiments, sample space, event. Definition of Combinatorial Probability. Conditional Probability, Bayes Theorem. Probability distributions: discrete & continuous distributions, Binomial, Poisson and Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions. Expected values and moments: mathematical expectation and its properties, Moments (including variance) and their properties, interpretation, Moment generating function. [12L]

**Module-2:** Definition of Statistics. Basic objectives. Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample. Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution. Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. [12L]

**Module-3:** Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling [8L]

**Module-4:** Simple linear regression & correlation, multiple regression & multiple correlation, Analysis of variance, Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.[8L]

**Text Books:**

1. S. M. Ross, "Introduction of Probability Models", Academic Press, N.Y.
2. A. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", vol. I & II, World Press.
3. I.R. Miller, J.E. Freund and R. Johnson, *Probability and Statistics for Engineers* (4th Edition),

**Reference Books:**

1. S. M. Ross, "A first course in Probability", Prentice Hall.
2. I. R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers". Fourth Edition, PHI.
3. A. M. Mood, F.A. Graybill and D.C. Boes, "Introduction to the Theory of Statistics", McGraw Hill Education.

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**Paper: Computational Statistics Lab**  
**Code: CYS-193**  
**Contacts Hours / Week: 2P**  
**Credits: 1**

**Laboratory: Programming Method—Implementation using R & R-studio-- Debugging,**  
Library Function, file

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**SEMESTER-II**

**Paper: Computer Architecture & Organization**

**Code: CYS-201**

**Contacts Hours / Week: 3L + 1T**

**Credits: 4**

**Module-1:** Principles of Computer design - Software, hardware interaction layers in computer architecture. Central processing unit. Machine language instructions, Addressing modes, instruction types, Instruction set selection, Instruction cycle and execution cycle. (10L)

**Module-2:** Control unit, Data path and control path design, Microprogramming V s hardwired control, RISC Vs CISC, Pipelining in CPU design: Superscalar processors. (8L)

**Module-3:** Memory system, Storage technologies, Memory array organization, Memory hierarchy, interleaving, cache and virtual memories and architectural aids to implement these. (8L)

**Module-4:** Input-output devices and characteristics, Input-output processing, bus interface, data transfer techniques, I/O interrupts, channels. (8L)

**Module-5:** Performance evaluation - SPEC marks, Transaction Processing benchmarks. (6L)

**Text Books:**

1. Mano, M, "Computer System and Architecture", (3rd edition) Prentice Hall of India, New Delhi, 1994.
2. Pal Chauduri, P., "Computer Organisation and Design", Prentice Hall of India, New Delhi, 1994.

**Reference Books:**

1. Rajaraman,V., and Radhakrishnan, T., "Introduction to Digital Computer Design" (4th edition). Prentice Hall of India, New Delhi, 1997.
2. Stallings. W, "Computer Organization and Architecture, (2nd edition) Prentice Hall of India, New Delhi

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**Paper: Data Structures and Algorithms**

**Code: CYS-202**

**Contacts Hours / Week: 3L**

**Credits: 3**

**Module-1: Basic Terminologies & Introduction to Algorithm and Data Organisation:** Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction (4L)

**Module-2: Linear Data Structure:** Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures (10L)

**Module-3: Non-linear Data Structure:** Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected), Various Representations, Operations (search and traversal algorithms and complexity analysis) & Applications of Non-Linear Data Structures (12L)

**Module-4: Searching and Sorting on Various Data Structures:** Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing (10L)

**Module-5: File:** Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes. (4L)

**Text Books:**

1. E. Horowitz and S. Sahni , *Fundamentals of Data Structures*, 1977.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, *Data Structures and Algorithms*.

**Reference Books:**

1. *Donald E. Knuth, The Art of Computer Programming: Volume 1: Fundamental Algorithms*
2. H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms, Thomas,*
3. *Pat Morin-Open Data Structures: An Introduction (Open Paths to Enriched Learning)*, 31st ed. Edition

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**Syllabus for B.Sc.in Cyber Security (Industry Induced)**  
(Effective for Students Admitted in Academic Session 2019-2020)

**Paper: Data Structures and Algorithms**

**Code: CYS-291**

**Contacts Hours / Week: 2P**

**Credits: 1**

**Laboratory**

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file

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**Paper: Environmental Science**  
**Code: CYS(HU)-201**  
**Contacts Hours / Week: 3L + 1T**  
**Credits: 4**

**Module-1:** Definition, Principles and scope of Environmental Science. Earth, Man and Environment. Ecosystems, Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes. Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind. Atmospheric stability, inversions and mixing height, windroses. Natural resources, conservation and sustainable development. (4L)

**Module-2:** Fundamentals of Environmental Chemistry, Chemical composition of Air : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry. Chemistry of air pollutants, Photochemical smog. Water Chemistry, Principles of Analytical Methods : Titrimetry, Gravimetry, Colourimetry, Spectrophotometry. Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC, Electrophoresis, X-ray fluorescence, X-ray diffraction, Flame photometry. (5L)

**Module-3:** Definition, Principles and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation. Ecosystem, Common flora and fauna in India Aquatic Microflora of Atmosphere : Air Sampling techniques, Identification of aeroallergens. Air-borne diseases and allergies. Environmental Biotechnology : Fermentation Technology, Vermiculture technology, Biofertilizer technology. (5L)

**Module-4:**

Environmental Geosciences, Earth's Processes and Geological Hazards, Mineral Resources and Environment : Resources and Reserves, Minerals and Population. Oceans as new areas for exploration of mineral resources. Ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals. Water Resources and Environment, Resources of oceans. Ocean pollution by toxic wastes. Human use of surface and groundwaters. Groundwater pollution. Landuse Planning, Environmental Geochemistry, Biogeochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land. Principles of Remote sensing and its application of Environmental Sciences. Application of GIS in Environmental Management. (6L)

**Module-5:**

Sun as source of energy; solar radiation and its spectral characteristics; Fossil fuels—classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas. Principles of generation of hydroelectric power, nuclear energy—fission and fusion; magnetohydrodynamic power, bio-energy—energy from biomass and biogas, anaerobic digestion; energy use pattern in different parts of the world. Environmental implication of energy use; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy (3L)

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**Module-6:**

Air : Natural and anthropogenic sources of pollution. Acid Rain, Air Quality Standards. Water : Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard. Soil, Soil Pollution Control. Industrial waste effluents and heavy metals, Noise : Sources of noise pollution, measurements of noise and Indices. Marine : Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system–coastal management. Radioactive and Thermal Pollution. (4L)

**Module-7:**

Introduction to environmental impact analysis, Environmental impact Statement and Environmental Management Plan. EIA guidelines 1994, Notification of Government of India. Impact Assessment Methodologies. Generalized approach to impact analysis. Procedure for reviewing Environmental impact analysis and statement. Guidelines for Environmental audit. Introduction of Environmental planning. Base line information and predictions (land, water, atmosphere, energy, etc.) Restoration and rehabilitation technologies. Landuse policy for India. Urban planning for India. Rural planning and landuse pattern. Concept and strategies of sustainable development. Cost-Benefit analysis. Environmental priorities in India and sustainable development. (3L)

**Module-8:**

Sources and generation of solid wastes, their characterization, Hazardous Waste Management and Handling Rules, 1989, Resource Management, Disaster Management and Risk analysis. Environment protection–issues and problems, International and National efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A) Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control, Wildlife Protection Act, Forest Conservation Act, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, Motor Vehicle Act. 1988, The Water (Prevention and Control of Pollution) Act, 1974, Public Liability Insurance Act, 1991 and Rules 1991. (3L)

**Module-9:**

Basic elements and tools of statistical analysis; Probability, sampling, measurement and distribution of attributes; Distribution– Normal, t and  $\chi^2$ , Poisson and Binomial; Arithmetic, Geometric and Harmonic means; Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting. Models of population growth and interactions–Lotka-Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model. (3L)

**Module-10:**

Environmental Education and Awareness. Environmental Ethics and Global imperatives. Context : Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil. Waste lands and their reclamation, Vehicular pollution and urban air quality. Depletion of Nature resources. Biodiversity conservation and Agenda-21. Waste disposal, recycling and power generation, Fly ash utilization. Rain water harvesting. Wet lands conservation. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic) (4L)



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**Text Books:**

1. Enger, E. and Smith, B., Environmental Science: A Study of Interrelationships, Publisher: McGraw-Hill Higher Education; 12th edition, 2010.
2. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

**Reference Books:**

1. Richard T Wright, Environmental Science: Towards a Sustainable Future, Prentice-Hall Inc., 2008.

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**Paper: Cyber Law and Ethics**  
**Code: CYS(HU)-202**  
**Contacts Hours / Week: 3L + 1T**  
**Credits: 4**

**Module I: Introduction** □ Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level [3L]

**Module II: Jurisdictional Aspects in Cyber Law**

Issues of jurisdiction in cyberspace, Types of jurisdiction, The Test evolved, Minimum Contacts Theory, Sliding Scale Theory Effects Test and International targeting, Jurisdiction under IT Act, 2000. [4L]

**Module III: Cyber Crimes & Legal Framework** Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud, Cyber Terrorism, Cyber Defamation, Right to Privacy and Data Protection on Internet, Concept of privacy, Threat to privacy on internet, Self-regulation approach to privacy, Ingredients to decide confidentiality of information, Breach of sensitive personal information and confidentiality under IT Act and penalties for the same, Right of Interception under IT Act, Different offences under IT Act, 2000 [10L]

**Module IV: Digital signature and Electronic Signature and Data Protection**

Concept of public key and private key, Certification authorities and their role, Creation and authentication of digital signature, Concept of electronic signature certificates, Electronic Governance, Concept of electronic records and electronic signatures, Rules for attribution, acknowledgement and dispatch of such records [6L]

**Module V: E-Contracting & E-commerce**

Salient features of E-contract, Formation of E-contract and types, E-mail Contracting Indian Approach on E-contracts [3L]

**Module VI: E Commerce**

E-commerce-Salient Features and advantages, Models of E-commerce like B2B, B2C, Indian Laws on E-commerce [3L]

**Module VII: Intellectual Property Issues in Cyber Space**

Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues, Dispute Resolution in Cyberspace [5L]

**Module VIII: Cyber Ethics**

Introduction to Cyber Ethics, Ethical Concepts & Critical Thinking, Professional Ethics & Privacy, Security in Cyberspace, Regulating Commerce, Community in Cyberspace, Ethical Aspects of Emerging Technology [6L]

**Text Books:**

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1. Karnika Seth, *Computers, Internet and New Technology Laws*, Lexis Nexis Butterworths Wadhwa Nagpur.
2. Chris Reed & John Angel, *Computer Law*, OUP, New York, (2007).
3. Justice Yatindra Singh, *Cyber Laws*, Universal Law Publishing Co, New Delhi, (2012).
4. Tavani, H.T. (2010). *Ethics and technology: Controversies, questions and strategies in ethical computing* (3rd ed.) Massachusetts, John Wiley & Sons Inc. ISBN: 978-0-470-50950-0

**Reference Books:**

1. Verma S, K, Mittal Raman, *Legal Dimensions of Cyber Space*, Indian Law Institute, New Delhi, (2004)
2. Jonthan Rosenoer, *Cyber Law*, Springer, New York, (1997).
3. Sudhir Naib, *The Information Technology Act, 2005: A Handbook*, OUP, New York, (2011)
5. S. R. Bhansali, *Information Technology Act, 2000*, University Book House Pvt. Ltd., Jaipur (2003).
5. Vasu Deva, *Cyber Crimes and Law Enforcement*, Commonwealth Publishers, New Delhi, (2003).

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**Paper: Object Oriented Concepts**

**Code: CYS-203**

**Contacts Hours / Week: 3L**

**Credits: 3**

**Module-1:** Object oriented programming concepts objects-classes, Methods and messages, abstraction and encapsulation, Inheritance, abstract classes, Polymorphism [4L]

**Module-2:** Introduction to C++ objects-classes, Constructors and destructors, Operator overloading, Operator overloading through member functions, Operator overloading, Unary operator overloading, Binary operator overloading, Overloading through friend functions and assignment Operator, Friend Function, Type Conversions [8L]

**Module-3:** Function Templates, Function Templates with single arguments, Function Templates with multiple arguments, Function Templates with 2 generic arguments, non – generic parameters [5L]

**Module-4:** Class template, Defining functions outside Class template, Inheritance, Multiple Inheritance, Virtual Function, Runtime Polymorphism [4L]

**Module-5:** Exception handling, Streams, formatted I/O, File handling, opening & closing files Text files, Binary files, End of file, namespaces- std namespace.[5L]

**Module-6:** String Objects, Standard template library, Introduction, principles, Working of STL, Function & predicate objects, Allocators. [4L]

**Module-7:** Introduction to JAVA, Byte code, Virtual Machines, Objects-Classes, Javadoc, Packages, Arrays, Strings, Inheritance, Single and Multilevel Inheritance, Interfaces, Inner Classes, Exception Handling, Threads, Multi-threaded programming, thread states – thread properties – thread synchronization, Streams, I/O [10L]

**Text Books:**

1. B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2007.
2. Cay S. Horstmann, Gary Cornell, “Core JAVA volume 1”, Eighth Edition, Pearson Education, 2008.

**Reference Books:**

1. ISRD Group, “Introduction to Object-oriented Programming and C++”, Tata McGraw-Hill Publishing Company Ltd., 2007.
2. ISRD Group, “Introduction to Object-oriented programming through Java”, Tata McGraw-Hill Publishing Company Ltd., 2007.
3. S. B. Lippman, Josee Lajoie, Barbara E. Moo, “C++ Premier”, Fourth Edition, Pearson Education, 2005.
4. D. S. Malik, “C++ Programming: From Problem Analysis to Program Design”, Third Edition, Thomson Course Technology, 2007.
5. K. Arnold and J. Gosling, “The JAVA programming language”, Third edition, Pearson Education, 2000.

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6. C. Thomas Wu, “An introduction to Object-oriented programming with Java”, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd., 2006.

**Paper: Object Oriented Concepts**

**Code: CYS-292**

**Contacts Hours / Week: 2P**

**Credits: 1**