Vidya Prasarak Mandal's
B. N. Bandodkar College of
Science (Autonomous), Thane
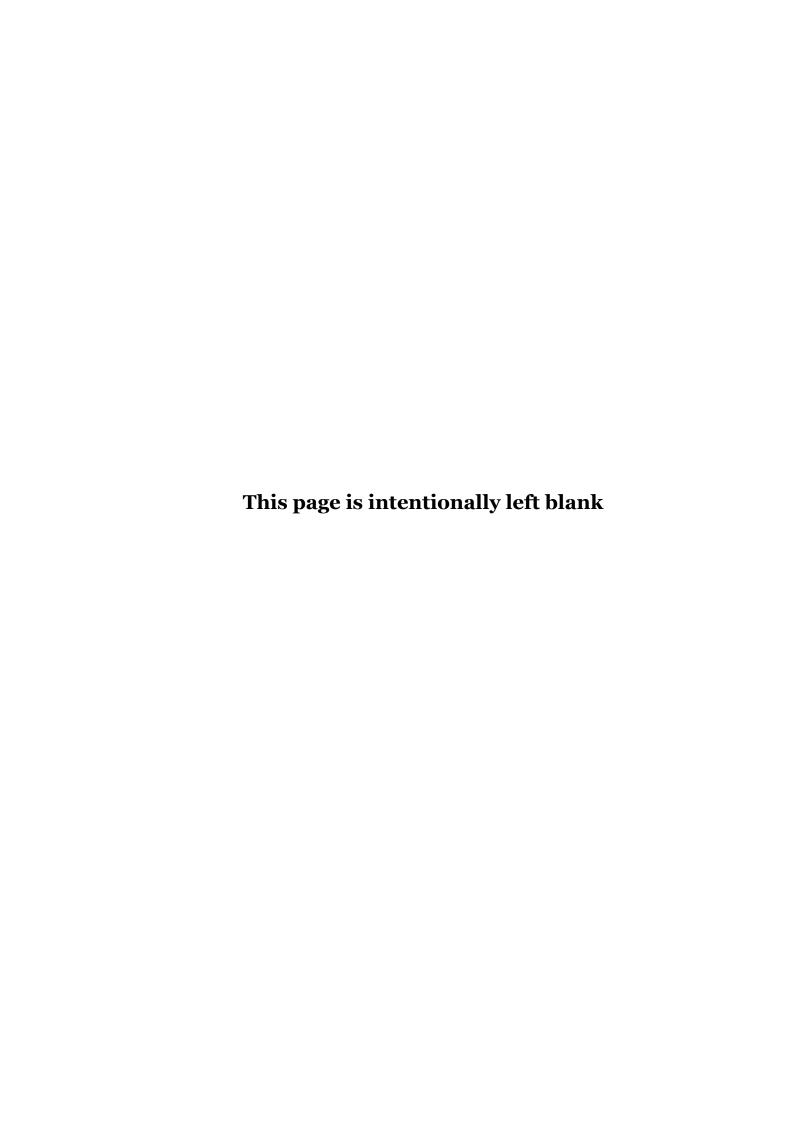
Syllabus for

Programme : Bachelor of Science

Specific Programme : Computer Science

[F.Y.B.Sc. (Computer Science)]

Level 4.5

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2023 - 2024

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Preamble

The aim of the BSc Computer Science Syllabus is to lay the theoretical foundations of software and hardware equally supplemented by the practical techniques. With this foundation of computer science along with core subjects like Mathematics, Statistics etc, the computer science students are expected to contribute efficient solutions for the various problems that are given to them.

Over this period of time, computer science students have proved this fact and have done well in Industries (mainly software) which have offered plenty of opportunities to them. With the advancement in software industry and technological innovations, the industry demands from graduate and postgraduate students are changing. The syllabus is been designed to meet the industry expectations, to inspire the students to take-up higher education as well as research, to attract student over other courses and finally to fulfill the expectations of Credit system.

The syllabus will be designed keeping these challenges in mind. The syllabus aims to cover core concepts of Computer Science and also to cover the latest technologies which can be accommodated at BSc level. One such step is that we would like to promote Open Source Technologies as much as possible.

Abhijeet A. Kale
Chairman
Board of Studies in Computer Science

Program Specific Outcomes

- To prepare the students ready for industry usage by providing required training in cutting edge technologies
- An Ability to use the core concepts of computing and optimization techniques to develop more efficient and effective computing mechanisms.
- An Ability to use inculcate professional, social, ethical, effective communication skills and entrepreneurial practice among their holistic growth.
- Demonstrate basic knowledge of computer applications and apply standard practices in software project development.
- Understand, Analyze and Develop computer programs for efficient design of computer-based systems of varying complexity.
- Understand various concepts of Computing, Statistics, Mathematics and Electronics appropriately to the discipline.

Eligibility:

Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board with Mathematics as one of the subjects.

Discipline/Subject:

Name of the Degree Program:	B.Sc.
Duration:	1 Year (includes SEM I and SEM II)
Level:	4.5
Mode of Conduct:	Offline
	Laboratory Practicals / Offline lectures / Online lectures
Total Credits for the Program:	132
Year of implementation:	2023- 24
Specific Programme:	F.Y.B.Sc. Subject (Major) Credits: 06

Eligibility For certificate if exit at level 4.5

VPM's B.N.Bandodkar College of Science (Autonomous), Thane
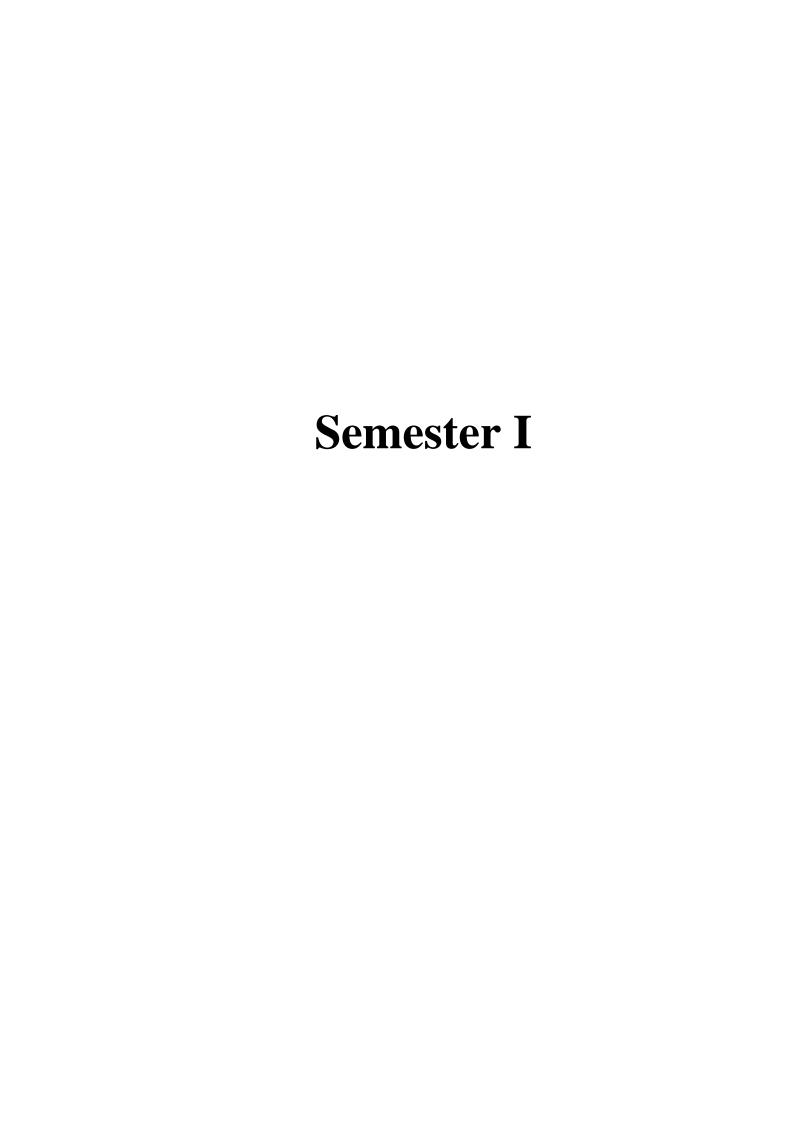## F.Y.B.Sc. (Computer Science) Revised under NEP

Structure of Programme

Semester I

	Course Code	Course Title	No. of lectures	Credits
Major	23BUCS1T1	Computer Organization	30	2
	23BUCS1T2	Systems Programming and Digital Logic	30	2
	23BUCS1P1	Practical 1	60	2
Minor	23BUCS1T3	Discrete Mathematics	30	2
	23BUCS1T4	Object Oriented Programming	30	2
	23BUCS1P2	Practical 2	60	2
Generic	23BUCS1T5	Descriptive Statistics and Introduction to Probability	30	2
OE -ID	23BUID1T6	Soft Skills Development	30	2
VSC	23BUVS1T7	Introduction to Programming/Practical 3	30	2
AEC	23BUEN1T8	Basic English Learning course	30	2
IKS	23BUIK1T9	IKS: Science and Technology	30	2
Total				**22**

Semester II

	Course Code	Course Title	No. of lectures	Credits
Major	23BUCS2T1	Operating System	30	2
	23BUCS2T2	Introduction to Python Programming	30	2
	23BUCS2P1	Practical 3	60	2
Minor	23BUCS2T3	Data Structures	30	2
	23BUCS2T4	Database Systems	30	2
	23BUCS2P1	Practical 4	60	2
Generic	23BUCS2T5	Statistical Method & Testing of Hypothesis	30	2
OE -ID	23BUID2T6	Professional Ethics	30	2
Field Project	23BUFP2T7	Green Technologies	60	2
AEC	23BUAE2T8	Introduction to Technical Writing	30	2
IKS	23BUIK2T9	IKS: Quick Mathematics	30	2
Total				**22**

Semester I

Course Code	Course Title	Credits	No. of
23BUCS1T1	**Computer Organization**	**02**	**lectures**

Course Outcomes: After learning the course, learners will be able to understand • how computer systems work and underlying principles • basics of digital electronics needed for computers • basics of instruction set architecture for reduced and complex instruction sets • basics of processor structure and operation • how data is transferred between the processor and I/O devices		
Unit I	**Computer Abstractions and Technology:** Basic structure and operation of a computer, functional units and their interaction. Representation of numbers and characters. **Logic circuits and functions:** Combinational circuits and functions: Basic logic gates and functions, truth tables; logic circuits and functions. NAND gate, NOR gates, Universal Building Blocks, RS Flip Flop, JK Flip Flop, D latches, edge-triggered D latch. Shift registers, Decoders, multiplexers. **Instruction set architectures:** Memory organization, addressing and operations; word size, big-endian and little-endian arrangements. Instructions, sequencing. Instruction sets for RISC and CISC	**15**
Unit II	Operand addressing modes; pointers; indexing for arrays. Machine language, assembly language, assembler directives. Function calls, processor runtime stack, stack frame. Types of machine instructions: arithmetic, logic, shift, etc. Instruction sets, RISC and CISC examples. **Basic Processor Unit:** Main components of a processor: registers and register files, ALU, control unit, instruction fetch unit, interfaces to instruction and data memories. Datapath. Instruction fetch and execute; executing arithmetic/logic, memory access and branch instructions; hardwired and micro-programmed control for RISC and CISC. **Basic I/O:** Accessing I/O devices, data transfers between processor and I/O devices. Interrupts and exceptions: interrupt requests and processing.	**15**

References:
1. Carl Hamacher et al. Computer Organization & Embedded Systems, 6 ed, McGraw-Hill 2012
2. Patterson and Hennessy, Computer Organization and Design, Morgan Kaufmann, ARM Edition, 2011
3. R P Jain, Modern Digital Electronics, Tata McGraw Hill Education Pvt. Ltd. , 4th Edition, 2010

Course Code	Course Title	Credits	No. of
23BUCS1T2	**Systems Programming and Digital Logic**	**02**	**lectures**

Course Outcomes: After learning the course, learners will be able to understand
- the basic concepts in system programming
- Describe system software and different machine structures.
- Illustrate the principles of Linkers.
- Demonstrate different schemes of loaders

Unit I	Systems Programming: System Hardware And Software Interaction, Language Issues, Translation Of Low-Level Languages And High-Level Languages, Assemblers, Tools, Microprocessors, Linking And Loading, Compilers, Stack	**15**
Unit II	Memory Devices; RAM, ROM, PROM, EPROM, EEPROM, Flash Memory, Memory Sticks, Cache memory, Virtual Memory, Scratch pad memory Programmable Logic Arrays (PLAs), Programmable array logic (PAL), Complex Programmable Logic devices (CPLDs), Field programmable Gate arrays (FPGAs)	**15**

References:
1. Systems Programming by John Donovan, Tata McGraw Hill Edition
2. Digital Circuit Analysis and Design by Steven T. Karris, Orchard Publications
3. Systems Programming by Srimanta Pal, Oxford University Press, 2011.

Course Code	Course Title	Credits	No. of
23BUCS1T3	**Discrete Mathematics**	**02**	**lectures**

	Course Outcomes: After learning the course, learners will be able to understand		

Course Outcomes: After learning the course, learners will be able to understand
- theory of discrete objects, starting with relations and partially ordered sets
- recurrence relations, generating function and operations on them.
- graphs and trees, which are widely used in software
- models of automata theory and the corresponding formal languages

Unit I	**Functions:** Definition of function. Domain, co domain and the range of a function. Direct and inverse images. Injective, surjective and bijective functions. Composite and inverse functions. **Relations**: Definition and examples. Properties of relations , Partial Ordering sets, Linear Ordering Hasse Daigrams , Maximum and Minimum elements **Recurrence Relations:** Definition of recurrence relations, Formulating recurrence relations, solving recurrence relations- Back tracking method, Linear homogeneous recurrence relations with constant coefficients. Solving linear homogeneous recurrence relations with constant coefficients of degree two when characteristic equation has distinct roots and only one root, Particular solutions of non linear homogeneous recurrence relation Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi	**15**
Unit II	**Permutations and Combinations:** Partition and Distribution of objects, Permutation with distinct and indistinct objects, Binomial numbers, Combination with identities: Pascal Identity, Vandermonde's Identity, Pascal triangle, Binomial theorem **Graphs :** Definition and elementary results, Adjacency matrix, path matrix, Representing relations using diagraphs, Warshall's algorithm-shortest path , Linked representation of a graph, Operations on graph with algorithms – searching in a graph; Insertion in a graph, Deleting from a graph, Traversing a graph-Breadth-First search and Depth-First search **Trees:** Definition and elementary results. Ordered rooted tree, Binary trees, Complete and extended binary trees, representing binary trees in memory, traversing binary trees, binary search tree, Algorithms for searching and inserting in binary search trees, Algorithms for deleting in a binary search tree	**15**

References:
1. Discrete Mathematics and Its Applications, Seventh Edition by Kenneth H. Rosen, McGraw Hill Education (India) Private Limited. (2011)
2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.
3. Data Structures Seymour Lipschutz, Schaum's out lines, McGraw- Hill Inc.

Course Code	Course Title	Credits	No. of
23BUCS1T4	**Object Oriented Programming**	**02**	**lectures**

Course Outcomes: After learning the course, learners will be able to understand		

Course Outcomes: After learning the course, learners will be able to understand
- the procedural and object oriented paradigm
- dynamic memory management techniques
- concept of function overloading, operator overloading, virtual functions and polymorphism
- use of various OOPs concepts with the help of programs

Unit I	**Object Oriented Methodology:** Introduction, Advantages and Disadvantages of Procedure Oriented Languages, what is Object Oriented? What is Object Oriented Development? Object Oriented Themes, Benefits and Application of OOPS. **Principles of OOPS:** OOPS Paradigm, Basic Concepts of OOPS: Objects, Classes, Data Abstraction and Data Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing **Classes and Objects:** Simple classes (Class specification, class members accessing), Defining member functions, passing object as an argument, Returning object from functions, friend classes, Pointer to object, Array of pointer to object. **Constructors and Destructors:** Introduction, Default Constructor, Parameterized Constructor and examples, Destructors	**15**
Unit II	**Polymorphism:** Concept of function overloading, overloaded operators, overloading unary and binary operators, overloading comparison operator, overloading arithmetic assignment operator, Data Conversion between objects and basic types, **Virtual Functions:** Introduction and need, Pure Virtual Functions, Static Functions, this Pointer, abstract classes, virtual destructors. **Inheritance:** Introduction, understanding inheritance, Advantages provided by inheritance, choosing the access specifier, Derived class declaration, derived class constructors, class hierarchies, multiple inheritance, multilevel inheritance, containership, hybrid inheritance. **Exception Handling:** Introduction, Exception Handling Mechanism, Concept of throw & catch with example	**15**

References:
1. Object Oriented Analysis and Design by Timothy Budd, TMH Publisher, 3rd edition
2. Object Oriented Programming with C++ by E. Balagurusamy, Tata McGraw Hill

Course Code	Course Title	Credits	No. of
23BUCS1T5	**Descriptive Statistics and Introduction to Probability**	**02**	**lectures**

Course Outcomes: After learning the course, learners will be able to understand
- descriptive statistical concepts
- probability concept required for Computer learners

Unit I	**Data Presentation:** Data types : attribute, variable, discrete and continuous variable Data presentation : frequency distribution, histogram o give, curves, stem and leaf display **Data Aggregation**: Measures of Central tendency: Mean, Median, mode for raw data, discrete, grouped frequency distribution. Measures dispersion: Variance, standard deviation, coefficient of variation for raw data, discrete and grouped frequency distribution, quartiles, quintiles Real life examples **Moments:** raw moments, central moments, relation between raw and central moments **Measures of Skewness and Kurtosis:** based on moments, quartiles, relation between mean, median, mode for symmetric, asymmetric frequency curve.	**15**
Unit II	**Correlation and Regression:** bivariate data, scatter plot, correlation, nonsense correlation, Karl pearson's coefficients of correlation, independence. **Linear regression:** fitting of linear regression using least square regression, coefficient of determination, properties of regression coefficients **Probability :** Random experiment, sample space, events types and operations of events **Probability definition :** classical, axiomatic, Elementary Theorems of probability (without proof) • $0 \leq P(A) \leq 1$, • $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ • $P(A') = 1 - P(A)$ • $P(A) \leq P(B)$ if $A \in B$ Conditional probability, 'Bayes' theorem, independence, Examples on Probability	**15**

References:
1. Trivedi, K.S.(2001) : Probability, Statistics, Design of Experiments and Queuing theory, with applicationsof Computer Science, Prentice Hall of India, New Delhi
2. Ross, S.M. (2006): A First course in probability. 6th Ed^n Pearson
3. Kulkarni, M.B., Ghatpande, S.B. and Gore, S.D. (1999): common statistical tests. Satyajeet Prakashan, Pune
4. Gupta, S.C. and Kapoor, V.K. (1987): Fundamentals of Mathematical Statistics,
S. Chand and Sons, New Delhi
5. Gupta, S.C. and Kapoor, V.K. (1999): Applied Statistics, S. Chand and Son's, New Delhi
6. Montgomery, D.C. (2001): Planning and Analysis of Experiments, wiley

Course Code	Course Title	Credits	No. of
23BUID1T6	**Soft Skills Development**	**02**	**lectures**

Course Outcomes: After learning the course, learners will be able to understand
- various aspects of soft skills and learn ways to develop personality
- importance and type of communication in personal and professional environment
- technical and non-technical qualities in career planning
- Leadership, team building, decision making and stress management

Unit I	**Personality Development:** Knowing Yourself, Positive Thinking, Johari's Window, Communication Skills, Non-verbal Communication, Physical Fitness **Emotional Intelligence**: Meaning and Definition, Need for Emotional Intelligence, Intelligence Quotient versus Emotional Intelligence Quotient, Components of Emotional Intelligence, Competencies of Emotional Intelligence, Skills to Develop Emotional Intelligence **Etiquette and Mannerism**: Introduction, Professional Etiquette, Technology Etiquette **Communication Today:** Significance of Communication, GSC's 3M Model of Communication, Vitality of the Communication Process, Virtues of Listening, Fundamentals of Good Listening, Nature of Non-Verbal Communication, Need for Intercultural Communication, Communicating Digital World **Employment Communication:** Introduction, Resume, Curriculum Vitae, Scannable Resume, Developing an Impressive Resume, Formats of Resume, **Professional Presentation:** Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation	**15**
Unit II	**Job Interviews:** Introduction, Importance of Resume, Definition of Interview, Background Information, Types of Interviews, Preparatory Steps for Job Interviews, Interview Skill Tips, Changes in the Interview Process **Group Discussion:** Introduction, Ambience/Seating Arrangement for Group Discussion, Importance of Group Discussions, Difference between Group Discussion, Panel Discussion and Debate, Traits, Types of Group Discussions, topic based and Case based Group Discussion, Individual Traits **Creativity at Workplace:** Introduction, Current Workplaces, Creativity, Motivation, Nurturing Hobbies at Work, The Six Thinking Hat Method **Ethical Values:** Ethics and Society, Theories of Ethics, Correlation between Values and Behavior, Nurturing Ethics, Importance of Work Ethics, Problems in the Absence of Work Ethics **Capacity Building: Learn, Unlearn and Relearn:** Capacity Building, Elements of Capacity Building, Zones of Learning, Ideas for Learning, Strategies for Capacity Building **Leadership and Team Building:** Leader and Leadership, Leadership Traits, Culture and Leadership, Leadership Styles and Trends, Team Building, Types of Teams, **Decision Making and Negotiation:** Introduction to Decision Making, Steps for Decision Making, Decision Making Techniques, Negotiation Fundamentals, Negotiation Styles, Major Negotiation Concepts	**15**

References:
1. Soft Skills: an Integrated Approach to Maximise Personality Gajendra Chauhan, Wiley India
2. Personality Development and Soft Skills, Barun K. Mitra, Oxford Press
3. Business Communication, Shalini Kalia, Shailja Agrawal, Wiley India
4. Soft Skills - Enhancing Employability, M. S. Rao, I. K. International

Course Code	Course Title	Credits	No. of
23BUVS1T7	**Introduction to Programming**	**02**	**lectures**

	Course Outcomes: After completion of the course, learner will be	
	• Able to explore the concept of programming. • Understand what high-level and low-level programming languages are. • Aware of basic elements of a program. • Aware of software and tools used by professional developers	
Unit I	Introduction, A program, programming languages, The Role of Programming Language, Language Description, elements of program, variable, constants, compilation, compilers, assemblers, Data types, flow chart, DFD, algorithm, Sequence Control and Subprogram Control	**15**
Unit II	Condition checking, loops, functions, Arrays and Basic Algorithms, Pointers and File Handling, Imperative Programming, Object Oriented Programming, Functional Programming, Logic Programming, Concurrent and Network Programming	**15**

	References:
	  1. Introduction to Programming by Deepak Gupta Kataria, S. K., & Sons
	  2. Principles of Programming Language by Dr. Sachin Kumar, Kadambari Agarwal, S.K.Kataria and Sons	

Course Code	Course Title	Credits	No. of
23BUEN1T8	**English Language - I**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to
- read and understand any text in English listening to the inputs given by the teacher in the classroom
- write paragraphs, essays, and letters
- perform various speaking and writing tasks, such as role plays, debates, group discussions apart from the use of correct spelling, punctuation and the ability to transfer information in the writing tasks

Unit I	Sentence, kind of Sentence, Parts of speech, Infinitive and participles, Commands, Requests and questions, Punctuation: Full stop, comma, colon, semicolon, dash Verbs, Kind of verbs, Articles, prepositions, conjunctions, Tenses, Kinds of senses, Use of correct verb forms	**15**
Unit II	Transformation, Antonyms, Synonyms, Homophones, Homonyms, Collocation, Active and passive voices, Degree of comparison, Reading, Vocabulary learning, Conversation, Essay writing, Short speeches, Dialogue writing, Mock interview	**15**

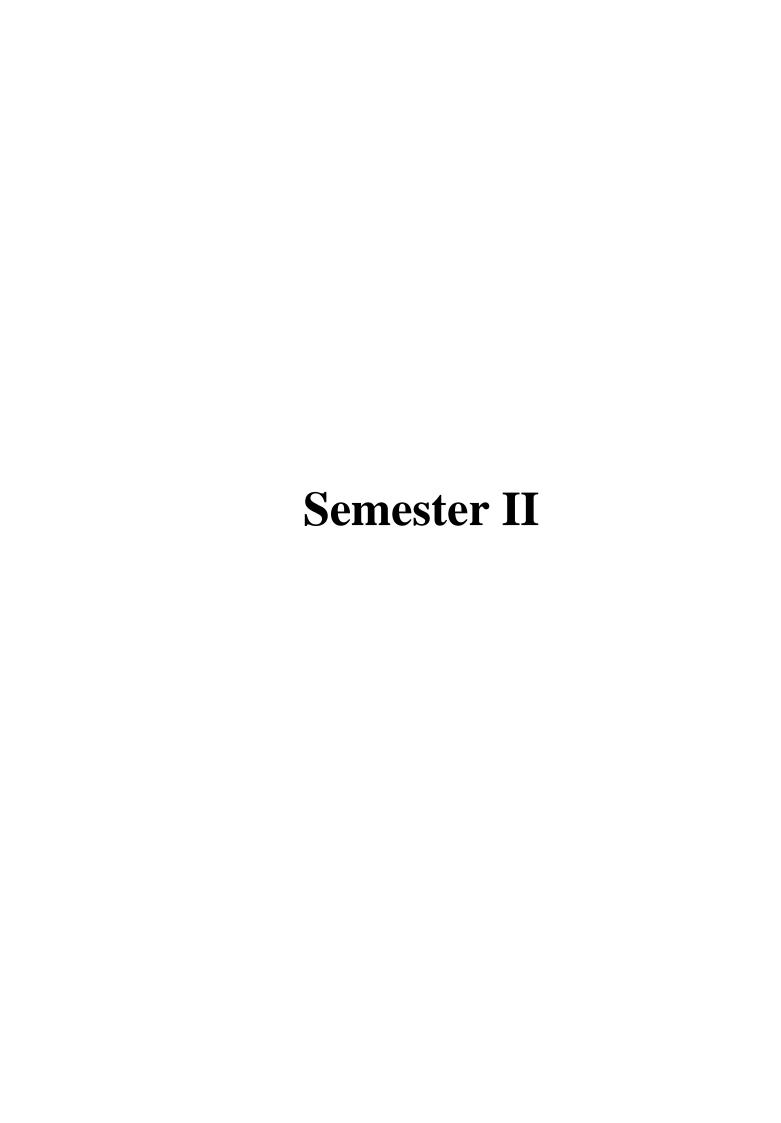| Course Code	Course Title	Credits	No. of
23BUIK1T9	**IKS: Science and Technology**	**02**	**lectures**

Course Outcomes:
- Learners will be able to understand and appreciate the rich heritage that resides in our traditions.
- They will be able to understand of the history and evolution of Indian Intelligence.
- They will be able to understand overall organization of IKS
- They will learn importance of nature of IKS in the contemporary society.
- Learners may get motivate to take up a detailed study of some of these topics and explore their application potential

Unit I	**Introduction:** Importance of Ancient Knowledge, Defining Indian Knowledge system, IKS Corpus, Unique aspects of IKS **Foundational Concepts for Science and Technology**: Number system and Units of Measurement, Knowledge: Framework and classification, Science, Engineering and Technology in IKS: Mathematics, Astronomy	**15**
Unit II	**Space,** The future of Space Exploration, Evolving Space Technologies **The Earth**, Earth and its Resources, The Biosphere **Life**, Food, Energy, Electricity, Water, Health Care	**15**

References:
1. Introduction to Indian Knowledge System, Concepts and Applications, PHI by B. Mahadevan, Vinayak Bhat, Nagendra Pavana R.N.
2. The Scientific Indian by A.P.J. Abdul Kalam and Y.S.Rajan

Course Code	Course Title	Credits	No. of lectures
23BUCS1P1	**Practical 1**	**02**	**60**

Course Outcomes:
- To give knowledge of some basic electronic components and circuits.
- To study logic gates and their usage in digital circuits.
- Make use of assembler.

Practical 1	Study of Logic Gates and their ICs, Universal Building Blocks
Practical 2	Study of RS, JK Flip Flop
Practical 3	Study of Encoder and Decoder
Practical 4	Study of Half adder and Full Adder
Practical 5	Write a program to create, read and write into a file having record of the student.
Practical 6	Write a program for the creation of symbol table in assembly language.
Practical 7	Implementation of a single pass assembler.
Practical 8	Write a program for checking the operator precedence

Course Code	Course Title	Credits	No. of lectures
23BUCS1P2	**Practical 2**	**02**	**60**

Course Outcomes: • To give knowledge of Discrete Mathematics for computers. • To study Fundamentals of Object Oriented Programming.	
Practical 1	Graphs of standard functions such as absolute value function, inverse function, logarithmic and exponential functions, flooring and ceiling functions, trigonometric functions over suitable intervals.
Practical 2	Partial ordering sets, Hasse diagram and Lattices
Practical 3	Recurrence relation.
Practical 4	Different counting principles.
Practical 5	Working with Classes and methods
Practical 6	Using friend functions.
Practical 7	Constructors and method overloading.
Practical 8	Inheritance

Semester II

Course Code	Course Title	Credits	No. of
23BUCS2T1	**Operating System**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to • To understand the basic concepts and functions of operating systems. • To understand Processes, Threads and Deadlocks. • To analyze Scheduling algorithms. • To analyze memory management schemes. • To understand I/O management and File systems		
Unit I	**Introduction:** Timeline of Operating Systems, History of operating system, computer hardware, different operating systems, operating system concepts, system calls, operating system structure. **Processes and Threads:** Processes, threads, inter process communication, scheduling, IPC problems. **Memory Management:** No memory abstraction, memory abstraction: address spaces, virtual memory, page replacement algorithms, design issues for paging systems, implementation issues, segmentation	**15**
Unit II	**File Systems:** Files, directories, file system implementation, file-system management and optimization, MS-DOS file system, UNIX file system **Input-Output:** Principles of I/O hardware, Principles of I/O software, I/O software layers, disks, clocks, user interfaces: keyboard, mouse, monitor, thin clients, power management **Deadlocks**: Resources, introduction to deadlocks, the ostrich algorithm, deadlock detection and recovery, deadlock avoidance, deadlock prevention, issues **Multiple Processor Systems** Multiprocessors, multicomputer, distributed systems	**15**
References: 1. Modern Operating Systems by Andrew S. Tanenbaum, Herbert Bos by Pearson, 4th edition 2. Operating Systems by Godbole and Kahate, McGraw Hill, 3rd edition		

Course Code	Course Title	Credits	No. of
23BUCS2T2	**Introduction to Python Programming**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to
1. Students should be able to understand the concepts of programming before actually starting to write programs.
2. Students should be able to develop logic for Problem Solving.
3. Students should be made familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc.
4) Students should be able to apply the problem solving skills using syntactically simple language

Unit I	**Basic concepts:** interpreting and the interpreter, compilation and the compiler, language elements, syntax and semantics, Python keywords, instructions, indenting, literals: Boolean, integer, floating-point numbers, scientific notation, strings, operators: unary and binary, priorities and binding, numeric operators: ** * / % // + −, **Bitwise operators:** ~ & ^ | <<, >>, string operators: * +, Boolean operators: not and or relational operators (== != > >= < <=), building complex Boolean expressions assignments and shortcut operators, accuracy of floating-point numbers basic input and output: input(), print(), int(), float(), str() functions, formatting print() output with end= and sep= arguments **Conditional Statements:** if, if-else, if-elif, if-elif-else, the pass instruction simple lists: constructing vectors, indexing and slicing, the len() function simple strings: constructing, assigning, indexing, slicing comparing, immutability, **Building loops:** while, for, range(), in, iterating through sequences, expanding loops: while-else, for-else, nesting loops and conditional statements, controlling loop execution: break, continue	**15**
Unit II	Immutability, escaping using the \ character, quotes and apostrophes inside strings, multiline strings, copying vs. cloning, advanced slicing, string vs. string, string vs. nonstring, basic string methods, upper(), lower(), isxxx(), capitalize(), split(), join(), etc. and functions (len(), chr(), ord()), escape characters, **Lists:** indexing, slicing, basic methods (append(), insert(), index()) and functions (len(), sorted(), etc.), del instruction, iterating lists with the for loop, initializing, in and not in operators, list comprehension, copying and cloning lists in lists: matrices and cubes **tuples:** indexing, slicing, building, immutability, tuples vs. lists: similarities and differences, lists inside tuples and tuples inside lists **Dictionaries:** building, indexing, adding and removing keys, iterating through dictionaries as well as their keys and values, checking key existence, keys(), items() and values() methods	**16**

References:
1. Beginning Python: From Novice to Professional by Magnus Lie Hetland, Apress 3rd edition

Course Code	Course Title	Credits	No. of
23BUCS2T3	**Data Structures**	**02**	**lectures**

	Course Outcomes: After completion of the course, learner will be able to 1. Learn about Data structures, its types and significance in computing 2. Explore about Abstract Data types and its implementation	
Unit I	**Abstract Data Types:** Introduction, The Date Abstract Data Type, Bags, Iterators. Application **Arrays:** Array Structure, Python List, Two Dimensional Arrays, Matrix Abstract Data Type, Application **Sets and Maps:** Sets-Set ADT, Selecting Data Structure, List based Implementation, Maps-Map ADT, List Based Implementation, Multi-Dimensional Arrays-Multi-Array ADT, Implementing Multiarrays, Application **Algorithm Analysis:** Complexity Analysis-Big-O Notation, Evaluating Python Code, Evaluating Python List, Amortized Cost, Evaluating Set ADT, Application **Searching and Sorting**: Searching-Linear Search, Binary Search, Sorting-Bubble, Selection and Insertion Sort, Working with Sorted Lists-Maintaining Sorted List, Maintaining sorted Lists. **Linked Structures**: Introduction, Singly Linked List-Traversing, Searching, Prepending and Removing Nodes, Bag ADT-Linked List Implementation. Comparing Implementations, Linked List Iterators, More Ways to Build Kinked Lists, Applications-Polynomials	**15**
Unit II	**Stacks:** Stack ADT, Implementing Stacks-Using Python List, Using Linked List, Stack Applications-Balanced Delimiters, Evaluating Postfix Expressions **Queues:** Queue ADT, Implementing Queue-Using Python List, Circular Array, Using List, Priority Queues- Priority Queue ADT, Bounded and unbounded Priority Queues **Advanced Linked List:** Doubly Linked Lists-Organization and Operation, Circular Linked List-Organization and Operation, Multi Lists **Recursion:** Recursive Functions, Properties of Recursion, Its working, Recursive Applications **Hash Table:** Introduction, Hashing-Linear Probing, Clustering, Rehashing, Separate Chaining, Hash Functions	**15**
	References: 1. Data Structure and algorithm Using Python, Rance D. Necaise, 2016 Wiley India Edition 2. Data Structure and Algorithm in Python, Michael T. Goodrich, Robertom Tamassia, M. H. Goldwasser, 2016 Wiley India Edition	

Course Code	Course Title	Credits	No. of
23BUCS2T4	**Database Systems**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to
- evaluate business information problem & find requirements of a problem in terms of data.
- design database schema with use of appropriate data types for storage of data in database.
- able to create, manipulate, query and back up the databases

Unit I	**Introduction to DBMS** – Database, DBMS – Definition, Overview of DBMS, Advantages of DBMS, Levels of abstraction, Data independence, DBMS Architecture **Data models** - Client/Server Architecture, Object Based Logical Model, Record Based Logical Model (relational, hierarchical, network) **Entity Relationship Model** - Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER) **Relational data model**– Domains, attributes, Tuples and Relations, Relational Model Notation, Characteristics of Relations, Relational Constraints - primary key, referential integrity, unique constraint, Null constraint, Check constraint **ER to Table**- Entity to Table, Relationship to tables with and without key constraints.	**15**
Unit II	**DDL Statements** - Creating Databases, Using Databases, datatypes, Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, Truncating Tables, Backing Up and Restoring databases **DML Statements** – Viewing the structure of a table insert, update, delete, Select all columns, specific columns, unique records, conditional select, in clause, between clause, limit, aggregate functions (count, min, max, avg, sum), group by clause, having clause **Functions** – String Functions (concat, instr, left, right, mid, length, lcase/lower, ucase/upper, replace, strcmp, trim, ltrim, rtrim), Math Functions (abs, ceil, floor, mod, pow, sqrt, round, truncate) Date Functions (adddate, datediff, day, month, year, hour, min, sec, now, reverse) **Joining Tables** – inner join, outer join, left outer, right outer, full outer **Subqueries** – subqueries with IN, EXISTS, subqueries restrictions, Nested subqueries, ANY/ALL clause, correlated subqueries **Views**: creating, altering dropping, renaming and manipulating views **DCL Statements:** creating/dropping users, privileges introduction, granting/revoking privileges, viewing privileges	**15**

References:

1. Ramez Elmasri & Shamkant B.Navathe, Fundamentals of Database Systems, Pearson Education, Sixth Edition, 2010
2. Ramakrishnam, Gehrke, Database Management Systems, McGraw- Hill, 2007
3. Joel Murach, Murach's MySQL, Murach, 2012

Course Code	Course Title	Credits	No. of
23BUCS2T5	**Statistical Method and Testing of Hypothesis**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to • Enable learners to know descriptive statistical concepts • Enable study of probability concept required for Computer learners		
Unit I	**Standard distributions**: random variable; discrete, continuous, expectation and variance of a random variable, pmf, pdf, cdf, reliability, Introduction and properties without proof for following distributions; binomial, normal, chi-square, t, F. Examples	**15**
Unit II	**Hypothesis testing:** one sided, two sided hypothesis, critical region, p-value, tests based on t, Normal and F, confidence intervals. **Analysis of variance** : one-way, two-way analysis of variance **Non-parametric tests:** need of non-parametric tests, sign test, Wilicoxon's signed rank test, run test, Kruskal-Walis tests	**15**
References: 1. Trivedi, K.S.(2009) : Probability, Statistics, Design of Experiments and Queuing theory, with applications of Computer Science, Prentice Hall of India, New Delhi		

Course Code	Course Title	Credits	No. of
23BUID2T6	**Professional Ethics**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to
- should be able to understand the importance of ethics and values in life and society.
- students will be able to work in a professional manner in the organization

Unit I	**Ethics and Human Values**: Ethics and Values, Ethical Vision, Nature of Ethics, Profession and Professionalism, Professional Ethics, Code of Ethics, Ethical Decisions, Human Values – Classification of Values, Universality of Values **Professional ethics** - Profession and its moral value in life, Profession-skill needed Profession and ethics- commitment, honesty, accountability, Professional integrity, transparency, confidentiality, objectivity, respect, obedience to the law and loyalty.	**15**
Unit II	**Safety Social Responsibility and Rights:** Safety and Risk, moral responsibility of engineers for safety, case studies – Bhopal gas tragedy, Chernobyl disaster, Fukushima Nuclear disaster, Professional rights, Gender discrimination, Sexual harassment at work place **Global Issues:** Globalization and MNCs, Environmental Ethics, Computer Ethics, Cyber Crimes, Ethical living, concept of Harmony in life	**15**

References:
1. Human Values for Managers by Chakraborty, S.K
2. Business Ethics, Vrinda Publications by Badi, R.V. and Badi, N.V
3. Values and Ethics for Organizations by Chakraborty
4. Perspectives in Business Ethics by Hartman, Chatterjee

Course Code	Course Title	Credits	No. of
23BUFP2T7	**Green Technologies**	**02**	**lectures**

Course Outcomes:
- Describe awareness among stakeholders and promote green agenda and green initiatives
- Identify IT Infrastructure Management and Green Data Centre Metrics
- Illustrate various green IT services and its roles
- Use Green IT Strategies and metrics for ICT development

Unit I	**Overview and Issues:** Problems: Toxins, Power Consumption, Equipment Disposal, Company's Carbon Footprint: Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power. **Minimizing Power Usage:** Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Bigger Drives, Involving the Utility Company, Low-Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software. **Cooling:** Cooling Costs, Power Cost, Causes of Cost, Calculating Cooling Needs, Reducing Cooling Costs, Economizers, On-Demand Cooling, HP's Solution, Optimizing Airflow, Hot Aisle/Cold Aisle, Raised Floors, Cable Management, Vapour Seal, Prevent Recirculation of Equipment Exhaust, Supply Air Directly to Heat Sources, Fans, Humidity, Adding Cooling, Fluid Considerations, System Design, Datacenter Design, Centralized Control	15
Unit II	**Changing the Way of Work:** Old Behaviors, starting at the Top, Process Reengineering with Green in Mind, Analyzing the Global Impact of Local Actions, Steps: Water, Recycling, Energy, Pollutants, Teleworkers and Outsourcing, Telecommuting, Outsourcing, how to Outsource. **Going Paperless:** Paper Problems, The Environment, Costs: Paper and Office, Practicality, Storage, Destruction, Going Paperless, Organizational Realities, Changing Over, Paperless Billing, Handheld Computers vs. the Clipboard, Unified Communications, Intranets, What to Include, Building an Intranet, Microsoft Office SharePoint Server 2007, Electronic Data Interchange (EDI), Nuts and Bolts, Value Added Networks, Advantages, Obstacles. **Recycling:** Problems, Materials, Means of Disposal, Recycling, Refurbishing, Make the Decision, Life Cycle, from beginning to end, Life, Cost, Green Design, Recycling Companies, Finding the Best One, Checklist, Certifications, Hard Drive Recycling, Consequences, cleaning a Hard Drive, Pros and cons of each method, CDs and DVDs, good and bad about CD and DVDs disposal, Change the mind-set, David vs. America Online **Hardware Considerations:** Certification Programs, EPEAT, RoHS, Energy Star, Computers, Monitors, Printers, Scanners, All-in-Ones, Thin Clients, Servers, Blade Servers, Consolidation, Products, Hardware Considerations, Planned Obsolescence, Packaging, Toxins, Other Factors, Remote Desktop, Using Remote Desktop, Establishing a Connection, In Practice	15

References: 1. Green IT by Toby Velte, Anthony Velte, McGraw Hill,
2. Green Computing and Green IT Best Practice by Jason Harris, Emereo Publication

Course Code	Course Title	Credits	No. of
23BUAE2T8	**Technical Writing**	**02**	**lectures**

Course Outcomes: After completion of the course, learner will be able to
- Clearly convey specialized information from a technical field to a non-specialized audience
- Identify and use appropriate formats and conventions derived from individual disciplines.
- Summarize larger texts in clear, direct style for practical applications.
- Edit documents with peer exchange and according to professional guidelines.

Unit I	Introduction to Technical Communication, Understanding Ethical and Legal Considerations, Writing Technical Documents	**15**
Unit II	Writing Collaboratively, Analyzing Your Audience and Purpose, Researching Your Subject, Organizing Your Information	**15**

References:
1. Technical Communication by Mike Markel, 11th Edition, Launchpad

Course Code	Course Title	Credits	No. of
23BUIK2T9	**IKS: Quick Mathematics**	**02**	**lectures**

Course Outcomes:
- Clear concepts and a strong foundation in mathematics
- Develop problem solving skills
- To enhance computational skills in mathematics
- Crack entrance of competitive examination

Unit I	Basic Mathematical tricks to find Product of two numbers, division of two numbers, square root and cube root of a number	**15**
Unit II	Digit sum method, Magic squares, Dates and Calendar	**15**

References:
- Vedic Mathematics made easy by Dhaval Bhatiya
- Vedic Mathematics by Sri Bharati Krishna

Course Code	Course Title	Credits	No. of
23BUCS2P1	**Practical 3**	**02**	**lectures 60**

Course Outcomes:
- Make use of appropriate Linux commands
- To study Fundamentals of MS-DOS
- To give knowledge of some basic Concepts of Python Programming.

Practical 1	Linux commands: Working with Directories: pwd, cd, absolute and relative paths, ls, mkdir, rmdir, file, touch, rm, cp. mv, rename, head, tail, cat, tac, more, less, strings, chmod
Practical 2	Linux commands: Working with files: ps, top, kill, pkill, bg, fg, grep, locate, find, locate, date, cal, uptime, w, whoami, finger, uname, man, df, du, free, whereis, which
Practical 3	Windows (DOS) Commands – I Date, time, prompt, md, cd, rd, path, Chkdsk, copy, xcopy, format, fidsk, cls, defrag, del, move
Practical 4	Windows (DOS) Commands – II Diskcomp, diskcopy, diskpart, doskey, echo, Edit, fc, find, rename, set, type, ver
Practical 5	Installing and setting up the Python IDLE interpreter. Executing simple statements like expression statement(numeric and Boolean types), assert, assignment, delete statements; the print function for output.
Practical 6	Programs based on lists, conditional constructs, the for statement and the range function; interactively using the built-infunctions len, sum, max, min, string manipulation
Practical 7	Programs based on the while statement; importing and executing built-in functions from the time, math and random modules, break and continue
Practical 8	Programs related to dictionaries

Course Code	Course Title	Credits	No. of lectures
23BUCS2P2	**Practical 4**	**02**	**60**

Course Outcomes:
- To give knowledge of Data formats and Data Structure.
- To study basics of Database.

Practical 1	Implement Linear Search to find an item in a list
Practical 2	Implement binary search to find an item in an ordered list.
Practical 3	Implement Sorting Algorithms A Bubble sort, Insertion sort, Quick sort, Merge Sort
Practical 4	Implement use of Sets and various operations on Sets.
Practical 5	Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Altering a Table, Dropping/Truncating/Renaming Tables
Practical 6	Queries, Queries with Aggregate functions, Date Function, String Functions,
Practical 7	Join Queries, Subqueries
Practical 8	Views, Creating Views, Dropping views, Selecting from a view