Academic Council Meeting No. and Date : 2 / April 30, 2021

Agenda Number : 4 **Resolution Number : 4.16 and 4.32**

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. (C.S.)]

Revised under Autonomy

From academic year 2021 - 2022

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Preamble

The B.Sc. Computer Science programme focuses on making the students capable for emerging technological trends and impart industry oriented training. The main objectives of the course are:

- to think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- to work effectively as a part of a team to achieve a common stated goal.
- to communicate effectively with a range of audiences both technical and non-technical.
- to develop an aptitude to engage in continuing professional development.
- to be capable of understanding the nuances of the technologies available and use them efficiently to excel in the professional career.

The syllabus is aimed to achieve the objectives. The syllabus spanning three years covers the industry relevant courses. The students will be ready for the jobs available in different fields like:

- System Administration
- Website development
- Data analytics
- Ethical Hacking and Security
- Game Development
- Cloud Technologies
- Networking
- Artificial intelligence
- Cyber Forensics
- Software Testing

The students will also be trained in communication skills and green technology.

Eligibility :

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

Duration : 3 years

Mode of Conduct :

Laboratory practicals / Offline lectures / Online lectures

Program Specific Outcome

Identify, design, and analyze complex computer systems and implement and interpret the results from those systems. ... Select and apply current techniques, skills, and tools necessary for computing practice and integrate Computer-based solutions into the user environment effectively.

F.Y.B.Sc. (C.S.)

Structure of Programme

Course Code	Course Title	No. of lectures	Credits
BNBUSCS1T1	Computer Organization and Design	**45**	**2**
BNBUSCS1T2	Programming with Python- I	**45**	**2**
BNBUSCS1T3	Free and Open Source Software	**45**	**2**
BNBUSCS1T4	Database Systems	**45**	**2**
BNBUSCS1T5	Discrete Mathematics	**45**	**2**
BNBUSCS1T6	Descriptive Statistics and Introduction to Probability	**45**	**2**
BNBUSCS1T7	Soft Skills Development	**45**	**2**
BNBUSCS1P1	Practical of BNBUSCS1T1+BNBUSCS1T2	**45**	**2**
BNBUSCS1P2	Practical of BNBUSCS1T3+BNBUSCS1T4	**45**	**2**
BNBUSCS1P3	Practical of BNBUSCS1T5+BNBUSCS1T6	**45**	**2**
Total		**450**	**20**

CourseCode	Course Title	No. of lectures	Credits
BNBUSCS2T1	Programming with C	**45**	**2**
BNBUSCS2T2	Programming with Python– II	**45**	**2**
BNBUSCS2T3	Linux	**45**	**2**
BNBUSCS2T4	Data Structures	**45**	**2**
BNBUSCS2T5	Calculus	**45**	**2**
BNBUSCS2T6	Statistical Methods and Testing of Hypothesis	**45**	**2**
BNBUSCS2T7	Green Technologies	**45**	**2**
BNBUSCS2P1	Practical of BNBUSCS2T1+BNBUSCS2T2	**45**	**2**
BNBUSCS2P2	Practical of BNBUSCS2T3+BNBUSCS2T4	**45**	**2**
BNBUSCS2P3	Practical of BNBUSCS2T5+BNBUSCS2T6	**45**	**2**
Total		**450**	**20**

Semester I

Course Code BNBUSCS1T1	Course Title Computer Organization and Design	Credits 2	No. of lectures
Learning Outcomes: • To learn about how computer systems work and underlying principles • To understand the basics of digital electronics needed for computers • To understand the basics of instruction set architecture for reduced and complex instruction sets • To understand the basics of processor structure and operation			
Unit I:	**Computer Abstractions and Technology**: **History of computers, Charles Babbage, Generations of Computers,** 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. Minimization with Karnaugh maps. Synthesis of logic functions with and-or-not gates, NAND gates, nor gates. Fan-in and fan-out requirements; tristate buffers. Half adder, full adder, ripple carry adder. (Flip flops) Gated S-R and D latches, edge-triggered D latch. Shift registers and registers. Decoders, multiplexers. Sequential circuits and functions: State diagram and state table; finite state machines and their synthesis.		**15**
Unit II:	**Instruction set architectures**: Memory organization, addressing and operations; word size, big-endian and little- endian arrangements. Instructions, sequencing. Instruction sets for RISC and CISC (examples Altera NIOS II and Freescale ColdFire). 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.		**15**
Unit III:	**Basic Processor Unit: Evolution of Microprocessor,** 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 microprogrammed 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**

Course Code	Course Title	Credits	No. of lectures
BNBUSCS1T2	**Programming with Python- I**	2	

Learning outcomes

- Students should be able to understand the concepts of programming before actually starting to write programs.
- Students should be able to develop logic for Problem Solving.
- Students should be made familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc.
- Students should be able to apply the problem solving skills using syntactically simple language i.e. Python (version: 3.X or higher)

Unit I:	**Need of writing programs, How to write a Program, Drawing Flow Charts, Writing Algorithms and pseudocode, Importance of flow chart, pseudocode and algorithm** Reasons for Python as the learner's first programming language. Introduction to the IDLE interpreter (shell) and its documentation. Expression evaluation: similarities and differences compared to a calculator; expressions and operators of types int, float, boolean. Built-in function type. Operator precedence. Enumeration of simple and compound statements. The expression statement. The assert statement, whose operand is a boolean expression (values true or false). The assignment statement, dynamic binding of names to values, (type is associated with data and not with names); automatic and implicit declaration of variable names with the assignment statement; assigning the valueNone to a name. The del (delete) statement. Input/output with print and input functions. A statement list (semicolon-separated list of simple statements on a single line) as a single interpreter command. The import statement for already-defined functions and constants. The augmented assignment statement. The built-inhelp() function. Interactive and script modes of IDLE, running a script, restarting the shell. The compound statement def to define functions; the role of indentation for delimiting the body of a compound statement; calling a previously defined function. Compound data types str, tuple and list (enclosed in quotes, parentheses and brackets, respectively). Indexing individual elements within these types. Strings and tuples are immutable, lists are mutable. Built-in functions min, max, sum. Interactive solution of model problems, (e.g., finding the square root of a number or zero of a function), by repeatedly executing the body of a loop (where the body is a statement list).	**15**

Unit II:	Advantages of functions, function parameters, formal parameters, actual parameters, global and local variables. The range function, the iterative for statement. The conditional statements if, if-else, if-elif-else. The iterative statements while, while-else, for-else. The continue statement to skip over one iteration of a loop, the break statement to exit the loop. Nested compound statements. Dictionaries: concept of key-value pairs, techniques to create, update and delete dictionary items. Problem-solving using compound types and statements.	**15**
Unit III:	Anonymous functions. List comprehensions. Gentle introduction to object-oriented programming; using the built-in dir() function, enumerate the methods of strings, tuples, lists, dictionaries. Using these methods for problem-solving with compound types.	**15**

Course Code BNBUSCS1T3	Course Title **Free and Open-source Software**	Credits 2	No. of lectures

Course Outcome:

- Upon completion of this course, students should have a good working knowledge of Open Source ecosystem, its use, impact and importance.
- This course shall help student to learn Open Source methodologies, case studies with real life examples.
- It will make students to understand difference between copyright and copyright free technologies.
- Learner can contribute by working for open source technologies.

Unit I:	**Introduction** Introduction: Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, FOSS does not mean no cost. History: BSD, The Free Software Foundation and the GNU Project. **Methodologies** Open Source History, Initiatives, Principle and methodologies. Philosophy : Software Freedom, Open Source Development Model Licenses and Patents: What Is A License, Important FOSS Licenses (Apache, BSD, GPL, LGPL), copyrights and copy lefts, Patents Economics of FOSS : Zero Marginal Cost, Income-generation opportunities, Problems with traditional commercial software, Internationalization **Social Impact** Open source vs. closed source, Open source government, Open source ethics. Social and Financial impacts of open source technology, Shared software, Shared source, Open Source in Government.	**15**
Unit II:	**Case Studies** Example Projects: Apache web server, GNU/Linux, Android, Mozilla (Firefox), Wikipedia, Drupal, wordpress, GCC, GDB, github, Open Office. Study: Understanding the developmental models, licensings, mode of funding, commercial/non-commercial use. Open Source Hardware, Open Source Design, Open source Teaching. Open source media. Collaboration, Community and Communication **Contributing to Open Source Projects** Introduction to github, interacting with the community on github, Communication and etiquette, testing open source code, reporting issues, contributing code. Introduction to wikipedia, contributing to Wikipedia Or contributing to any prominent open source project of student's choice. Starting and Maintaining own Open Source Project.	**15**
Unit III:	**Understanding Open Source Ecosystem** Open Source Operating Systems: GNU/Linux, Android, Free BSD, Open Solaris. Open Source Hardware, Virtualization Technologies,	**15**

	Containerization Technologies: Docker, Development tools, IDEs, debuggers, Programming languages, LAMP, Open Source database technologies	

Course Code BNBUSCS1T4	Course Title **Database Systems**	Credits 2	No. of lectures
Course Outcomes • Students should be able to evaluate business information problem and find the requirements of a problem in terms of data. • Students should be able to design the database schema with the use of appropriate data types for storage of data in database. • Students should be able to create, manipulate, query and back up the databases. • Student should be able to understand the relational DBMS which are being used in the most of the organizations.			
Unit I:	**History of Database, Need of Databases, Problems with File Systems** **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:	**Schema refinement and Normal forms:** Functional dependencies, first, second, third, and BCNF normal forms based on primary keys, lossless join decomposition. **Relational Algebra** operations (selection, projection, set operations union, intersection, difference, cross product, Joins –conditional, equi join and natural joins, division)		**15**

	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	
Unit III:	**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 **Database Protection:** Security Issues, Threats to Databases, Security Mechanisms, Role of DBA, Discretionary Access Control **Views** (creating, altering dropping, renaming and manipulating views) DCL Statements (creating/dropping users, privileges introduction, granting/revoking privileges, viewing privileges)	**15**

Course Code BNBUSCS1T5	Course Title **Discrete Mathematics**	Credits 2	No. of lectures

Learning Outcomes:

- To provide overview of theory of discrete objects, starting with relations and partially ordered sets.
- Study about recurrence relations, generating function and operations on them.
- Give an understanding of graphs and trees, which are widely used in software.
- Provide basic knowledge about models of automata theory and the corresponding formal languages.

Unit I:	**Recurrence Relations** **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, Lattices **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, Solution of recurrence relation by the method of generation functions, Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi, Intersection of lines in a plane, Sorting Algorithms.	**15**
Unit II:	**Counting Principles , Languages and Finite State Machine** **a) 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, Combination with indistinct objects. **b) Counting Principles:** Sum and Product Rules, Two-way counting, Tree diagram for solving counting problems, Pigeonhole Principle (without proof); Simple examples, Inclusion Exclusion Principle (Sieve formula) (Without proof). **c) Languages, Grammars and Machines:** Languages , regular Expression and Regular languages, Finite state Automata, grammars, Finite state machines, Gödel numbers, Turing machines.	**15**
Unit III:	**Graphs and Trees** **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**

Course Code BNBUSCS1T6	Course Title **Descriptive Statistics and Introduction to Probability**	Credits 2	No. of lectures

Learning Outcomes:

- Enable learners to know descriptive statistical concepts
- Enable study of probability concept required for Computer learners
- Enable students to work statistically in every field of study
- Enable students to generate the solutions for the data handling problems

Unit I:	**Brief history of Statistics, How Statistics is important for organizations** **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, quantiles Real life examples	**15**
Unit II:	**Moments:** raw moments, central moments, relation between raw and central moments **Measures of Skewness and Kurtosis:** based on moments, quartiles, relation between mean, median, and mode for symmetric, asymmetric frequency curve. **Correlation and Regression:** bivariate data, scatter plot, correlation, nonsense correlation, Karl Pearson's coefficients of correlation, and independence. **Linear regression:** fitting of linear regression using least square regression, coefficient of determination, properties of regression coefficients (only statement)	**15**
Unit III:	**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 $A \subset B$ Conditional probability, 'Bayes' theorem, independence, Examples on Probability	**15**

Course Code BNBUSCS1T7	Course Title **Soft Skills Development**	Credits 2	No. of lectures

Learning Outcomes:

- To know about various aspects of soft skills and learn ways to develop personality
- Understand the importance and type of communication in personal and professional environment.
- To provide insight into much needed technical and non-technical qualities in career planning.
- Learn about Leadership, team building, decision making and stress management

Unit I:	**Introduction to Soft Skills and Hard Skills** **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	**15**
Unit II:	**Academic Skills** **Employment Communication:** Introduction, Resume, Curriculum Vitae, Scannable Resume, Developing an Impressive Resume, Formats of Resume, Job Application or Cover Letter **Professional Presentation:** Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation **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, FAQ During Interviews **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	**15**
Unit III:	**Professional Skills** **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	**15**

	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 **Stress and Time Management:** Stress, Sources of Stress, Ways to Cope with Stress	

Course Code **BNBUSCS1P1**	**Course Title** **BNBUSCS1T1+BNBUSCS1T2**	**Credits** **2**	**No. of lectures**
PRACTICAL BASED ON BNBUSCS1T1			
Practical 1	Study and verify the truth table of various logic gates (NOT, AND, OR, NAND, NOR, EX-OR, and EX-NOR).		**3**
Practical 2	Simplify given Boolean expression and realize it.		**3**
Practical 3	Design and verify a half/full adder		**3**
Practical 4	Design and verify half/full subtractor		**3**
Practical 5	Design a 4 bit magnitude comparator using combinational circuits.		**3**
Practical 6	Design and verify the operation of flip-flops using logic gates.		**3**
Practical 7	Verify the operation of a counter.		**3**
Practical 8	Verify the operation of a 4 bit shift register		**3**
PRACTICAL BASED ON BNBUSCS1T2			
Practical 1	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.		**3**
Practical 2	Script and interactive modes; defining a function in the two modes; executing a script; interactively executing a statement list (semicolon-separated sequence of simple statements); the input function.		**3**
Practical 3	Programs based on lists, conditional constructs, the for statement and the range function; interactively using the built-in functions len, sum, max, min		**3**
Practical 4	Programs related to string manipulation		**3**

Practical 5	Programs based on the while statement; importing and executing built-in functions from the time, math and random modules	**3**
Practical 6	Programs using break and continue statements.	**3**
Practical 7	Programs related to dictionaries	**3**
Practical 8	Programs using list comprehensions and anonymous functions	**3**

Course Code	**Course Title**	**Credits**	**No. of lectures**
BNBUSCS1P2	**BNBUSCS1T3+BNBUSCS1T4**	**2**	
PRACTICAL BASED ON BNBUSCS1T3			
Practical 1	Identify any Open Source software and create detailed report about it. Sample Guidelines.		**3**
A	Idea		
B	What problem does it solves?		
C	Licensing model		
D	Intent behind making it open source		
E	Monetization models		
F	Popularity		
G	Impact		
Practical 2	Learn at least three different open source licenses and create a brief report about them.		**3**
A	History of license		
B	Idea		
C	What problems does it solve?		
D	Detailed licensing model		
E	Which popular software are released under this license?		
F	Any popular news associated with this license?		
G	Popularity		
H	Impact		
Practical 3	Contributing to Open Source		**3**
A	Identify any Open Source project of your interest		
B	Learn more about the project w.r.t. Lab 1.		
C	Start contributing to the project either by		
I	Testing		
II	Reporting bugs		
III	Coding		
IV	Helping in documentation		

V	Participating in discussions	
VI	Participating in pre-release testing programs	
VII	UI development.	
VIII	Or any other important area.	
Practical 4	Hands on with Open Source Software	**3**
A	Identify any open source software of your interest	
B	Learn it from practical view-point	
C	Give a brief presentation about it to the class	
D	Sample projects: gcc, gdb, drupal, wordpress, apache web server, mysql database	
Practical 5	Contributing to Wikipedia:	**3**
A	Introduction to wikipedia: operating model, license, how to contribute?	
B	Create your user account on Wikipedia	
C	Identify any topic of your choice and contribute the missing information	
Practical 6	Github	**3**
A	Create and publish your own open source project: Write any simple program using your choice of programming language.	
B	Create a repository on github and save versions of your project. You'll learn about the staging area, committing your code, branching, and merging,	
C	Using GitHub to Collaborate: Get practice using GitHub or other remote repositories to share your changes with others and collaborate on multi-developer projects. You'll learn how to make and review a pull request on GitHub.	
D	Contribute to a Live Project: Students will publish a repository containing their reflections from the course and submit a pull request.	
Practical 7	Open Source Operating Systems	**3**
A	Learn any open source operating system of your choice : Linux, Android, FreeBSD, Open Solaris etc.	
B	Learn the installation.	
C	Identify the unique features of the OS of your choice.	
Practical 8	Virtualization: Open Source virtualization technologies:	**3**
A	Install and configure any one: VirtualBox, Zen, KVM	
B	Create and use virtual machines	

Practical based on BNBUSCS1T4		
Practical 1	For given scenario Draw E-R diagram and convert entities and relationships to table.	**3**
Practical 2	Write relational algebra queries on the tables created in Practical-1	**3**
Practical 3	**Perform Following**	**3**
A	Viewing all databases	
B	Creating a Database	
C	Viewing all Tables in a Database	
D	Creating Tables (With and Without Constraints)	
E	Inserting/Updating/Deleting Records in a Table	
F	Viewing all databases	
Practical 4	Perform the following:	**3**
A	Altering a Table	
B	Dropping/Truncating/Renaming Tables Backing up / Restoring a Database	
Practical 5	Perform the following:	**3**
A	Simple Queries	
B	Simple Queries with Aggregate functions	
C	Queries with Aggregate functions (group by and having clause)	
Practical 6	Queries involving	**3**
A	Date Functions	
B	String Functions	
C	Math Functions	
Practical 7	Join Queries	**3**
A	Inner Join	
B	Outer Join	
Practical 8	Subqueries	**3**
A	With IN clause	
B	With EXISTS clause	
Practical 9	Views	**3**
A	Creating Views (with and without check option)	
B	Dropping views	
C	Selecting from a view	
Practical 10	DCL statements: Granting and revoking permissions	**3**

Course Code BNBUSCS1P3	Course Title BNBUSCS1T5+BNBUSCS1T6	Credits 2	No. of lectures
Practical Based on BNBUSCS1T5			
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.		**3**
Practical 2	Partial ordering sets, Hasse diagram and Lattices.		**3**
Practical 3	Recurrence relation.		**3**
Practical 4	Different counting principles.		**3**
Practical 5	Finite state Automata and Finite state machines.		**3**
Practical 6	Warshall's Algorithm.		**3**
Practical 7	Shortest Path algorithms.		**3**
Practical 8	Operations on graph.		**3**
Practical 9	Breadth and Depth First search algorithms.		**3**
Practical 10	Concept of searching, inserting and deleting from binary search trees		**3**
Practical Based on BNBUSCS1T6			
Practical 1	Frequency distribution and data presentation		**3**
Practical 2	Measures of central tendency		**3**
Practical 3	Data entry using, functions, c(), scan(), Creating vectors, Mathematical Operations: ** +/-/*/ /^, exp, log, log10, etc, creating vector of text type, useful functions: data, frame, matrix operations, seq(), split() etc.		**3**
Practical 4	Frequency distribution using cut(), table()		**3**
Practical 5	Data presentation		**3**
Practical 6	Summary Statistics (measures of central tendency, dispersion)		**3**
Practical 7	Measures of skewness and kurtosis		**3**
Practical 8	Correlation and regression		**3**
Practical 9	Probability		**3**
Practical 10	Conditional probability		**3**

References

Course Code	Course Title
BNBUSCS1T1	Computer Organization and Design

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Computer Organization and Embedded System	Carl Hamacher	McGraw-Hill	6th	2012
2.	Computer Organization and Design	Patterson and Hennessy, Morgan Kaufmann,	---	ARM	2011
3.	Modern Digital Electronics	R P Jain	McGraw-Hill	4th	2010

Course Code	Course Title
BNBUSCS1T2	Programming With Python- I

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Beginning Python: From Novice to Professional	Magnus Lie Hetland	Apress	3rd	2017
2	Practical Programming: An Introduction to Computer Science Using Python 3	Paul Gries	Pragmatic Bookshelf	2nd	2014
3	Introduction to Computer Science using Python	Charles Dierbach	Wiley	---	2013
4	Practical Programming: An Introduction to Computer Science Using Python 3	Paul Gries , Jennifer Campbell, Jason Montojo	Pragmatic Bookshelf	2nd	2014
5	Programming Languages – Principles and Paradigms	Adesh Pandey	Narosa	---	2008

Course Code	Course Title
BNBUSCS1T3	Free and Open Source Software

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Unix Concepts and Applications	Sumitabha Das	Tata McGraw Hill Education	4th	2006
2.	The official Ubuntu Book	Mathew Helmke,Elizabeth K joseph	Prentice Hall	8th	2014

Course Code	Course Title
BNBUSCS1T4	Database Systems

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Fundamentals of Database Systems	Ramez Elmasri , Shamkant B.Navathe	Pearson Education	6th	2010
2.	Database Management Systems	Ramakrishnam, Gehrke	McGraw-Hill	3rd	2007
3.	Murach's MySQL	Joel Murach	Murach	2nd	2012
4.	Begning MySQL	Robert Sheldon, Geoff Moes	Wrox Press		2005

Course Code	Course Title
BNBUSCS1T5	Discrete Mathematics

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Discrete Mathematics and Its Applications	Kenneth H. Rosen	McGraw Hill Education	7th	2011
2.	Discrete Mathematics	Norman L. Biggs	Clarendon Press		1989
3.	Data Structures Schaum's out lines	Seymour Lipschutz	McGraw Hill Education		
4.	Elements of Discrete Mathematics	C.L. Liu	Tata McGraw- Hill		
5.	Discrete Mathematics , Schaum's out lines:	Semyour Lipschutz, Marc Lipson	McGraw- Hill Inc.		
6.	Concrete Mathematics (Foundation for Computer Science	Graham, Knuth, Patashnik	Pearson Education.	2nd	
7.	Foundations in Discrete Mathematics	K.D. Joshi	New Age Publication		

Course Code	Course Title
BNBUSCS1T6	Descriptive statistics and introduction to probability

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	A First course in probability	Ross, S.M	Pearson	6th	2006
2.	common statistical tests	Kulkarni, M.B., Ghatpande, S.B. and Gore, S.D.	Satyajeet Prakashan		1987
3.	Fundamentals of Mathematical Statistics	Gupta, S.C. and Kapoor, V.K.	S. Chand and Sons		1987
4.	Applied Statistics	Gupta, S.C. and Kapoor, V.K.	S. Chand and Son's		1999
5.	Planning and Analysis of Experiments	Montgomery, D.C.	Wiley		2001

Course Code	Course Title
BNBUSCS1T7	Soft Skills Development

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Soft Skills: an Integrated Approach to Maximise Personality	Gajendra S. Chauhan, Sangeeta Sharma	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		
5.	Cornerstone: Developing Soft Skills	Sherfield	Pearson India		

Semester II

Course Code BNBUSCS2T1	Course Title **Programming with C**	Credits 2	No. of lectures

Learning Outcomes

- Students should be able to write, compile and debug programs in C language.
- Students should be able to use different data types in a computer program.
- Students should be able to design programs involving decision structures, loops and functions.
- Students should be able to explain the difference between call by value and call by reference

Unit I:	**Structure of C program**: Header and body, Use of comments. Interpreters vs compilers, Python vs C. Compilation of a program. Formatted I/O: printf(), scanf(). **Data**: Variables, Constants, data types like: int, float char, double and void, short and long size qualifiers, signed and unsigned qualifiers. Compare with datatypes in Python. Compare static typing in C vs dynamic typing in Python **Variables**: Declaring variables, scope of the variables according to block, hierarchy of data types. Compare explicit declarations in C with implicit declarations in Python. **Types of operators**: Arithmetic, relational, logical, compound assignment, increment and decrement, conditional or ternary, bitwise and comma operators. Precedence and order of evaluation, statements and Expressions. Automatic and explicit type conversion. **Iterations:** Control statements for decision making: (i) Branching: if statement, else.. if statement, (does the writer mean if-else or nested ifs)switch statement. (ii) Looping: while loop, do.. while, for loop. (iii) Jump statements: break, continue and goto.	**15**
Unit II:	**Arrays:** (One and two dimensional), declaring array variables, initialization of arrays, accessing array elements. Compare array types of C with list and tuple types of Python. **Data Input and Output functions**: Character I/O format: getch(), getche(), getchar(), getc(), gets(), putchar(), putc(), puts(). **Manipulating Strings**: Declaring and initializing String variables, Character and string handling functions. Compare with Python strings. **Functions**: Function declaration, function definition, Global and local variables, return statement, Calling a function by passing values. **Recursion**: Definition, Recursive functions.	**15**
Unit III:	**Pointer:** Fundamentals, Pointer variables, Referencing and de-referencing, Pointer Arithmetic, Using Pointers with Arrays, Using Pointers with Strings, Array of Pointers, Pointers as function arguments, Functions returning pointers. **Dynamic Memory Allocation**: malloc(), calloc(), realloc(), free() and sizeof operator. Compare with automatic garbage collection in Python.	**15**

	Structure: Declaration of structure, reading and assignment of structure variables, Array of structures, arrays within structures, structures within structures. Compare C structures with Python tuples. **Unions**: Defining and working with unions. **File handling:** Different types of files like text and binary, Different types of functions: fopen(), fclose(), fgetc(), fputc(), fgets(), fputs(), fscanf(), fprintf(), getw(), putw(), fread(), fwrite(), fseek().	

Course Code BNBUSCS2T2	Course Title **Programming with Python - II**	Credits 2	No. of lectures
Learning Outcomes • Students should be able to understand how to read/write to files using python. • Students should be able to catch their own errors that happen during execution of programs. • Students should get an introduction to the concept of pattern matching. • Students should be made familiar with the concepts of GUI controls and designing GUI applications. • Students should be able to connect to the database to move the data to/from the application. • Students should know how to connect to computers, read from URL and send email.			
Unit I:	**Python File Input-Output:** Opening and closing files, various types of file modes, reading and writing to files, manipulating directories. Iterables, iterators and their problem solving applications. **Exception handling:** What is an exception, various keywords to handle exceptions such try, catch, except, else, finally, raise. **Regular Expressions:** Concept of regular expression, various types of regular expressions, using match function.		**15**
Unit II:	**GUI Programming in Python (using Tkinter/wxPython/Qt)** What is GUI, Advantages of GUI, Introduction to GUI library. Layout management, events and bindings, fonts, colours, drawing on canvas (line, oval, rectangle, etc.) Widgets such as : frame, label, button, checkbutton, entry, listbox, message, radiobutton, text, spinbox etc		**15**
Unit III:	**Database connectivity in Python**: Installing mysql connector, accessing connector module module, using connect, cursor, execute & close functions, reading single & multiple results of query execution, executing different types of statements, executing transactions, understanding exceptions in database connectivity. **Network connectivity**: Socket module, creating server-client programs, sending email, reading from URL		**15**

Course Code BNBUSCS2T3	Course Title Linux	Credits 2	No. of lectures

Learning Outcomes:

- Upon completion of this course, students should have a good working knowledge of Linux, from both a graphical and command line perspective, allowing them to easily use any Linux distribution.
- This course shall help student to learn advanced subjects in computer science practically. Student shall be able to progress as a Developer or Linux System Administrator using the acquired skill set.
- Students will be able to work on various shell programming technologies.
- Students will understand the development and implementation of a kernel.

Unit I:	**Introduction :** History of Unix, GNU Public license, origin of linux, Terminologies used, Distributions, Types of Kernel. Why learn Linux? Importance of Linux in software ecosystem: web servers, supercomputers, mobile, servers. **Installation :** Installation methods, Hands on Installation using CD/DVD , USB drive, Virtual Box based installation. **Linux Structure :** Linux Architecture, Filesystem basics, The boot process, init scripts, runlevels, init Vs systemd, shutdown process, Very basic introductions to Linux processes, Packaging methods: rpm/deb, Graphical Vs Command line.	**15**
Unit II:	**Graphical Desktop :** Session Management, Basic Desktop Operations, Network Management, Installing and Updating Software, Text editors: gedit, vi, vim, emacs, Graphics editors, Multimedia applications. **Command Line :** Command line mode options, Shells, Basic Commands, General Purpose Utilities, Installing Software, User management, Environment variables, Command aliases. **Linux Documentation :** man pages, GNU info, help command, More documentation sources **File Operations :** Filesystem, Filesystem architecture, File types, File attributes, Working with files, Backup, compression	**15**
Unit III:	**Security :** Understanding Linux Security, Uses of root, sudo command, working with passwords, Bypassing user authentication, Understanding ssh **Networking :** Basic introduction to Networking, Network protocols: http, ftp etc., IP address, DNS, Browsers, Transferring files. ssh, telnet, ping, traceroute, route, hostname, networking GUI. **Basic Shell Scripting :** Features and capabilities, Syntax, Constructs, Modifying files, Sed, awk command, File manipulation utilities, Dealing with large files and Text, String manipulation, Boolean expressions, File tests, Case, Debugging, Regular expressions	**15**

Course Code	Course Title	Credits	No. of lectures
BNBUSCS2T4	Data Structure	2	

Learning Outcomes:

- Learn about Data structures, its types and significance in computing
- Explore about Abstract Data types and its implementation
- Ability to program various applications using different data structure in Python
- Ability to analyse and apply various data structure methodologies in various applications.

Unit I:	**Data structure introduction, need of Data structure** **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.	**15**
Unit II:	**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 **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	**15**
Unit III:	**Recursion:** Recursive Functions, Properties of Recursion, Its working, Recursive Applications **Hash Table:** Introduction, Hashing-Linear Probing, Clustering, Rehashing, Separate Chaining, Hash Functions **Advanced Sorting:** Merge Sort, Quick Sort, Radix Sort, Sorting Linked List **Binary Trees:** Tree Structure, Binary Tree-Properties, Implementation and Traversals, Expression Trees, Heaps and Heapsort,Search Trees	**15**

Course Code	Course Title	Credits	No. of lectures
BNBUSCS2T5	**Calculus**	2	

Learning Outcomes:

- Understanding of Mathematical concepts like limit, continuity, derivative, integration of functions.
- Ability to appreciate real world applications which uses these concepts.
- Skill to formulate a problem through Mathematical modeling and simulation.
- Ability to analyze any scenario and develop strategies or contingencies for the same.

Unit I:	**DERIVATIVES AND ITS APPLICATIONS:** Review of Functions, limit of a function, continuity of a function, derivative function. Derivative In Graphing And Applications: Analysis of Functions: Increase, Decrease, Concavity, Relative Extrema; Graphing Polynomials, Rational Functions, Cusps and Vertical Tangents. Absolute Maxima and Minima, Applied Maximum and Minimum Problems, Newton's Method.	**15**
Unit II:	**INTEGRATION AND ITS APPLICATIONS:** An Overview of the Area Problem, Indefinite Integral, Definition of Area as a Limit; Sigma Notation, Definite Integral, Evaluating Definite Integrals by Substitution, Area Between Two Curves, Length of a Plane Curve. Numerical Integration: Simpson's Rule. Modeling with Differential Equations, Separation of Variables, Slope Fields, Euler's Method, First- Order Differential Equations and Applications.	**15**
Unit III:	**PARTIAL DERIVATIVES AND ITS APPLICATIONS:** Functions of Two or More Variables Limits and Continuity Partial Derivatives, Differentiability, Differentials, and Local Linearity, Chain Rule, Directional Derivatives and Gradients, Tangent Planes and Normal, Vectors, Maxima and Minima of Functions of Two Variables.	**15**

Course Code	Course Title	Credits	No. of lectures
BNBUSCS2T6	**Statistical Method and Testing of Hypothesis**	2	

Learning Outcomes:

- Enable learners to know descriptive statistical concepts
- Enable study of probability concept required for Computer learners
- Enable students to work statistically in every field of study
- Enable students to generate the solutions for the data handling problems

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	**15**
Unit III:	**Non-parametric tests:** need of non-parametric tests, sign test, Wilicoxon's signed rank test, run test, Kruskal-Walis tests. Post-hoc analysis of one-way analysis of variance: Duncan's test Chi-square test of Association	**15**

Course Code	Course Title	Credits	No. of lectures
BNBUSCS2T7	**Green Technologies**	2	

Learning Outcomes:

- Learn about green IT can be achieved in and by hardware, software, network communication and data center operations.
- Understand the strategies, frameworks, processes and management of green IT
- Understanding minimizing power usage in IT sector and other industries.
- Understand the to develop strategies to control CFC exertion from Cooling systems.

Unit I:	**Green IT Overview:** Introduction , Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green I , Holistic Approach to Greening IT, Greening IT, Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT , Enterprise Green IT Strategy, Green Washing, Green IT: Burden or Opportunity? **Green Devices and Hardware:** Introduction , Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose **Green Software:** Introduction , Processor Power States , Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power **Sustainable Software Development:** Introduction, Current Practices, Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Defining Actions	**15**
Unit II:	**Green Data Centres:** Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics **Green Data Storage:** Introduction , Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management **Green Networks and Communications:** Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards **Enterprise Green IT Strategy:** Introduction, Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Organizational Considerations in a Green IT Strategy, Steps in Developing a Green IT Strategy, Metrics and Measurements in Green Strategies.	**15**
Unit III:	**Sustainable Information Systems and Green Metrics:** Introduction, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Measuring the Maturity of Sustainable ICT **Enterprise Green IT Readiness:** Introduction, Readiness and Capability, Development of the G-Readiness Framework, Measuring an Organization's G-Readiness **Sustainable IT Services: Creating a Framework for Service Innovation:** Introduction, Factors Driving the Development of Sustainable IT, Sustainable IT	**15**

	Services (SITS), SITS Strategic Framework **Green Enterprises and the Role of IT:** Introduction, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues	

Course Code BNBUSCS2P1	Course Title Practical of BNBUSCS2T1+BNBUSCS2T2	Credits 2	No. of lectures
PRACTICAL BASED ON BNBUSCS2T1			
Practical 1	Programs to understand the basic data types and I/O.		**3**
Practical 2	Programs on Operators and Expressions		**3**
Practical 3	Programs on decision statements.		**3**
Practical 4	Programs on looping.		**3**
Practical 5	Programs on arrays.		**3**
Practical 6	Programs on functions.		**3**
Practical 7	Programs on structures and unions.		**3**
Practical 8	Programs on pointers.		**3**
Practical 9	Programs on string manipulations.		**3**
Practical 10	Programs on basic file operations.		**3**
PRACTICAL BASED ON BNBUSCS2T2			
Practical 1	Programs to read and write files.		**3**
Practical 2	Programs with iterables and iterators.		**3**
Practical 3	Program to demonstrate exception handling.		**3**
Practical 4	Program to demonstrate the use of regular expressions.		**3**
Practical 5	Program to show draw shapes & GUI controls.		**3**
Practical 6	Program to create server-client and exchange basic information.		**3**
Practical 7	Program to send email & read contents of URL.		**3**

Course Code	Course Title	Credits	No. of lectures
BNBUSCS2P2	Practical of BNBUSCS2T3+BNBUSCS2T4	2	
PRACTICAL BASED ON BNBUSCS2T3			
Practical 1	Linux Installation:		**3**
A	Install your choice of Linux distribution e.g. Ubuntu, Fedora, Debian.		
B	Try different installation media like CD/DVD, USB Drive to install.		
C	Customize desktop environment by changing different default options like changing default background, themes, screensavers.		
Practical 2 A	Screen Resolution: Ascertain the current screen resolution for your desktop.		**3**
B	Networking: Get the current networking configuration for your desktop. Are you on a wired or a wireless connection? What wireless networks are available, if any?		
C	Time Settings Change the time zone of your system to (or New York Time if you are currently in Indian time). How does the displayed time change? After noting the time change, change the time zone back to your local time zone.		
Practical 3	Installing and Removing Software: Install gcc package. Verify that it runs, and then remove it.		**3**
Practical 4	Documentations:		**3**
A	Finding Info Documentation: From the command line: bring up the info page for the grep command. Bring up the usage section.		
B	Finding man pages From the command line: Bring up the man page for the 'ls' command. Scroll down to the EXAMPLES section.		
C	Finding man pages by Topic What man pages are available that document file compression?		
D	Finding man pages by Section From the command line, bring up the man page for the printf library function. Which manual page section are library functions found?		
E	Command-Line Help List the available options for the mkdir command. How can you do this?		
Practical 5	Command line operations:.		**3**
A	Install any newpackage on your system		
B	Remove the package installed		
C	Find the passwd file in / using find command		
D	Create a symbolic link to the file you found in last step		
E	Create an empty file example.txt and move it in /tmp directory using relative		

	pathname.	
F	Delete the file moved to /tmp in previous step using absolute path.	
G	Find the location of ls, ps, bash commands.	
Practical 6	File Operations:	**3**
A	Explore mounted filesystems on your system.	
B	What are different ways of exploring mounted filesystems on Linux?	
C	Archive and backup your home directory or work directory using tar, gzip commands.	
D	Use dd command to create files and explore different options to dd.	
E	Use diff command to create diff of two files.	
F	Use patch command to patch a file. And analyze the patch using diff command again.	
Practical 7	Use environment	**3**
A	Which account are you logged in? How do you find out?	
B	Display /etc/shadow file using cat and understand the importance of shadow file. How it's different than passwd file.	
C	Get you current working directory.	
D	Explore different ways of getting command history, how to run previously executed command without typing it?	
E	Create alias to most commonly used commands like	
Practical 8	Linux Editors: vim/emacs	**3**
A	Create,modify, search, navigate a file in editor.	
B	Learn all essential commands like search, search/replace, highlight, show line numbers.	
Practical 9	Linux Security:	**3**
A	Use of sudo to change user privileges to root	
B	Identify all operations that require sudo privileges	
C	Create a new user and add it to sudo configuration file.	
D	Set password for new user.	
E	Modify the expiration date for new user using password ageing.	
Practical 10	Network:	**3**
A	Get IP address of your machine using ifconfig.	

B	If IP is not set, then assign an IP address according to your network settings.	
C	Get hostname of your machine.	
D	Use ping to check the network connectivity to remote machines.	
E	Use telnet/ssh to connect to remote machines and learn the difference between the two.	
F	Troubleshooting network using traceroute, ping, route commands.	
PRACTICAL BASED ON BNBUSCS2T4		
Practical 1	Implement Linear Search to find an item in a list.	**3**
Practical 2	Implement binary search to find an item in an ordered list.	**3**
Practical 3	Implement Sorting Algorithms	**3**
A	Bubble sort	
B	Insertion sort	
C	Quick sort	
D	Merge Sort	
Practical 4	Implement use of Sets and various operations on Sets.	**3**
Practical 5	Implement working of Stacks. (pop method to take the last item added off the stack and a push method to add an item to the stack)	**3**
Practical 6	Implement Program for	**3**
A	Infix to Postfix conversion	
B	Postfix Evaluation	
Practical 7	Implement the following	**3**
A	A queue as a list which you add and delete items from.	
B	A circular queue. (The beginning items of the queue can be reused).	
Practical 8	Implement Linked list and demonstrate the functionality to add and delete items in the linked list.	**3**
Practical 9	Implement Binary Tree and its traversals.	**3**
Practical 10	Recursive implementation of	**3**
A	Factorial	
B	Fibonacci	
C	Tower of Hanoi	

Course Code	Course Title	Credits	No. of lectures
BNBUSCS2P3	Practical of BNBUSCS2T5+BNBUSCS2T6	**2**	
PRACTICAL BASED ON BNBUSCS2T5			
Practical 1	Continuity of functions; Derivative of functions		**3**
Practical 2	Increasing, decreasing, concave up and concave down functions		**3**
Practical 3	Relative maxima, relative minima, absolute maxima, absolute minima		**3**
Practical 4	Newton's method to find approximate solution of an equation		**3**
Practical 5	Area as a limit and length of a plane curve		**3**
Practical 6	Numerical integration using Simpson's rule		**3**
Practical 7	Solution of a first order first degree differential equation, Euler's method		**3**
Practical 8	Calculation of Partial derivatives of functions		**3**
Practical 9	Local linear approximation and directional derivatives		**3**
Practical 10	Maxima and minima of functions of two variables		**3**
PRACTICAL BASED ON BNBUSCS2T6			
Practical 1	Problems based on binomial distribution		**3**
Practical 2	Problems based on normal distribution		**3**
Practical 3	Property plotting of binomial distribution		**3**
Practical 4	Property plotting of normal distribution		**3**
Practical 5	Plotting pdf, cdf, pmf, for discrete and continuous distribution		**3**
Practical 6	T test, normal test, F test		**3**
Practical 7	Analysis of Variance		**3**
Practical 8	Non parametric tests- I		**3**
Practical 9	Non- Parametric tests – II		**3**
Practical 10	Post-hoc analysis of one-way analysis		**3**

Course Code	Course Title
BNBUSCS2T1	Programming with C

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Programming in ANSI C	E Balagurusamy	TMH	3rd	
2.	Programming in C	Pradip Dey, Manas Ghosh	Oxford University Press	2nd	
3.	Let Us C	Yashavant P. Kanetkar	BPB Publications		

Course Code	Course Title
BNBUSCS2T2	Programming with Python II

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Practical Programming: An Introduction to Computer Science Using Python 3,	Paul Gries , Jennifer Campbell, Jason Montojo,	Pragmatic Bookshelf	2nd	2014
2.	Beginning Python: Using Python 2.6 and Python 3	James Payne	Wiley India		2010
3.	MySQL for Python: Database Access Made Easy	A. Lukaszewski	Pact Publisher		2010

Course Code	Course Title
BNBUSCS2T3	Linux

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Unix Concepts and Applications	Sumitabha Das	Tata McGraw Hill Education	4th	2006
2.	The official Ubuntu Book	Mathew Helmke,Elizabeth K joseph	Prentice Hall	8th	2014
3.	Linux A beginners Guide	Wale Soyinka	Tata McGraw Hill Education	6th	

Course Code	Course Title
BNBUSCS2T4	Data Structure

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Data Structure and algorithm Using Python	Rance D. Necaise	Wiley India Edition		2016
2.	Data Structure and Algorithm in Python	Michael T. Goodrich, Robertom Tamassia, M. H. Goldwasser	Wiley India Edition		2016
3.	Data Structure and Algorithmic Thinking with Python	Narasimha Karumanchi	Careermonk Publications		2015
4.	Fundamentals of Python: Data Structures	Kenneth Lambert	Delmar Cengage Learning		

Course Code	Course Title
BNBUSCS2T5	Calculus

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Calculus: Early transcendental	Howard Anton, Irl Bivens, Stephen Davis	John Wiley & sons	10^{th}	2012
2.	Calculus and analytic geometry	George B Thomas, Ross L Finney,	Addison Wesley	9^{th}	1995
3.	Calculus: Early Transcendental	James Stewart,	Brooks Cole	8^{th}	2015
4.	Calculus	Ron Larson, Bruce H. Edwards	Cengage Learning	10^{th}	2013
5.	Thomas' Calculus	George B. Thomas, Maurice D. Weir, Joel R. Hass	Pearson	13^{th}	2014

Course Code	Course Title
BNBUSCS2T6	Statistical Methods and Testing of Hypothesis

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Probability, Statistics, Design of Experiments and Queuing theory, with applications of Computer Science	Trivedi, K.S.	Prentice Hall of India		2009
2.	A First course in probability	Ross, S.M.	Pearson	6th	2006
3.	Common statistical tests	Kulkarni, M.B., Ghatpande, S.B. and Gore, S.D.	Satyajeet Prakashan		1999
4.	Fundamentals of Mathematical Statistics	Gupta, S.C. and Kapoor, V.K.	S. Chand and Sons		2002
5.	Applied Statistics	Gupta, S.C. and Kapoor, V.K.	S. Chand and Sons	4th	
6.	Planning and Analysis of Experiments	Montgomery, D.C.	Wiley		2001

Course Code	Course Title
BNBUSCS2T7	Green Technologies

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1	Harnessing Green IT: Principles and Practices	San Murugesan, G. R. Ganadharan	Wiley, IEEE		
2.	Green IT	Deepak Shikarpur	Vishwakarma Publication		2014
3.	Green Communications: Principles, Concepts and Practice	Samdanis et al.,	Wiley Publication		
4.	Green IT for Sustainable Business Practice: An ISEB Foundation Guide	Mark G. O'Neill	The Charted institute for IT		2010

Evaluation Scheme
Internals

Class Test	Active Participation & Leadership qualities	Total
30	**10**	**40**
Certification of Swayam / NPTEL in concern course		

Internal Examination : Based on Unit 1 / Unit 2 / Unit 3
Duration : 1 Hour **Total Marks : 30**

	Answer the following	**30**
Q. 1		
Q. 2		
Q. 3		
Q. 4		
Q. 5		
Q. 6		

Theory Examination : Suggested Format of Question paper
Duration : 2 Hours **Total Marks : 60**

- **All questions are compulsory**

Q. 1	Answer ***any two*** of the following		**16**
	a	Based on Unit I	
	b	Based on Unit I	
	c	Based on Unit I	
	d	Based on Unit I	
Q. 2	Answer ***any two*** of the following		**16**
	a	Based on Unit II	
	b	Based on Unit II	
	c	Based on Unit II	
	d	Based on Unit II	
Q. 3	Answer ***any two*** of the following		**16**
	a	Based on Unit III	
	b	Based on Unit III	
	c	Based on Unit III	
	d	Based on Unit III	
Q. 4	Answer ***any two*** of the following		**12**
	a	Based on Unit I	
	b	Based on Unit II	
	c	Based on Unit III	

** (4 questions of 8 marks each / 8 questions of 4 marks can be asked with 50% options)

Practical Examination

F.Y.B.Sc. (Computer Science) Semester I/II Practical Examination "Month & Year "

Paper Code :- _____

Duration :- 03.00 hrs. Total Marks :- 100

Q. No	Question's	Marks
Q. 1.	Program 1.	20
Q. 2.	Program 2.	20
Q. 3.	Program 3.	20
Q. 4.	Program 4.	20
Q. 5.	Viva-Voce	10
Q. 6.	Journal	10

Marks Distribution and Passing Criterion for Each Semester

Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSCS1T1	**40**	**16**	**60**	24	BNBUSCS1P1	**100**	**40**
BNBUSCS1T2	**40**	**16**	**60**	24			
BNBUSCS1T3	**40**	**16**	**60**	24	BNBUSCS1P2	**100**	**40**
BNBUSCS1T4	**40**	**16**	**60**	24			
BNBUSCS1T5	**40**	**16**	**60**	24	BNBUSCS1P3	**100**	**40**
BNBUSCS1T6	**40**	**16**	**60**	24			
BNBUSCS1T7	**40**	**16**	**60**	24			

Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSCS2T1	**40**	**16**	**60**	24	BNBUSCS2P1	**100**	**40**
BNBUSCS2T2	**40**	**16**	**60**	24			
BNBUSCS2T3	**40**	**16**	**60**	24	BNBUSCS2P2	**100**	**40**
BNBUSCS2T4	**40**	**16**	**60**	24			
BNBUSCS2T5	**40**	**16**	**60**	24	BNBUSCS2P3	**100**	**40**
BNBUSCS2T6	**40**	**16**	**60**	**24**			
BNBUSCS2T7	**40**	**16**	**60**	**24**			

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