

BABU BANARASI DAS UNIVERSITY, LUCKNOW

Department of Mathematics & Computer Science School of Basic Sciences

B.Sc. (Hons./Hons. with research) Computer Science

(Effective from Academic Session 2023-24, as per NEP-2020)

Semester	Major Core Course (DSC) 4 Credits	Major Elective Course (DSE) 4 Cr	Minor Course (GE) 4 Credits	Co-Curricular Course (CC) 3 Credits	Vocational Course (VC) 2 Credits	Apprenticeship/ Internship/ Project/ Community Outreach/ MOOC (AIPCM) 2 Credits	Major Project/ Dissertation/ Academic Project 6 Credits	General Proficiency (GP) / Seminar 1 Credit	Total Credit
I	DSC1 DSC2 DSC3		GE1	CC1	VC1			1	22
II	DSC4 DSC5 DSC6		GE2	CC2	VC2			1	22
III	DSC7 DSC8 DSC9		GE3	CC3	VC3 Or AIPCM			1	22
IV	DSC10 DSC11 DSC12		GE4	CC4	VC4 Or AIPCM			1	22
V	DSC13 DSC14 DSC15	DSE1	GE5	VC5 Or AIPCM					22
VI	DSC16 DSC17 DSC18	DSE2	GE6			Project/ Dissertation 2 Credit			22
VII	DSC19	Three DSE or Two DSE and One GE or One DSE and Two GE					Dissertation/ Academic Project/ Internship		22
VIII	DSC20	Three DSE or Two DSE and One GE or One DSE and Two GE					Dissertation/ Academic Project/ Internship		22

List of Discipline Specific Core (DSC) Courses

DSC	Course Code	Course Name	Contact Hours			Marks			Cr	Exam Hrs.
			L	T	P	CIA	ESE	Total		
DSC1	NBSC3101	Computer Fundamentals & Programming Technique	3	1	-	40	60	100	4	3
DSC2	NBSC3102	Programming using C	3	-	-	40	60	100	3	3
	NBSC3151	Programming using C LAB	-	-	2	40	60	100	1	3
DSC3	NBSC3103	Computer Organisation & Architecture	3	1	-	40	60	100	4	3
DSC4	NBSC3201	Data Structure using C	3	-	-	40	60	100	3	3
	NBSC3251	Data Structure using C LAB	-	-	2	40	60	100	1	3
DSC5	NBSC3202	Operating System	3	1	-	40	60	100	4	3
DSC6	NBSC3203	Computer Networks	3	1	-	40	60	100	4	3
DSC7	NBSC3301	Java Programming	3	-	-	40	60	100	3	3
	NBSC3351	Java Programming LAB	-	-	2	40	60	100	1	3
DSC8	NBSC3302	Discrete Structures	3	1	-	40	60	100	4	3
DSC9	NBSC3303	Design & Analysis of Algorithms	3	1	-	40	60	100	4	3
DSC10	NBSC3401	Database Management System	3	-	-	40	60	100	3	3
	NBSC3451	Database Management System LAB	-	-	2	40	60	100	1	3
DSC11	NBSC3402	Programming Concept with Python	3	-	-	40	60	100	3	3
	NBSC3452	Python Programming LAB	-	-	2	40	60	100	1	3
DSC12	NBSC3403	Artificial Intelligence	3	1	-	40	60	100	4	3
DSC13	NBSC3501	Web Technologies	3	-	-	40	60	100	3	3
	NBSC3551	Web Technologies LAB	-	-	2	40	60	100	1	3
DSC14	NBSC3502	Information Security and Cyber Law	3	1	-	40	60	100	4	3
DSC15	NBSC3503	Software Engineering	3	1	-	40	60	100	4	3
DSC16	NBSC3601	Machine Learning	3	1	-	40	60	100	4	3
DSC17	NBSC3602	Cloud Computing	3	1	-	40	60	100	4	3
DSC18	NBSC3603	Soft Computing	3	1	-	40	60	100	4	3
DSC19	NBSC3701	Internet of Things	3	1	-	40	60	100	4	3
DSC20	NBSC3801	Digital Image Processing	3	1	-	40	60	100	4	3

List of Discipline Specific Elective (DSE) Courses

DSE	Course Code	Course Name	Contact Hours			Marks			Cr	Exam Hrs.
			L	T	P	CIA	ESE	Total		
DSE1A	NBSCE3501	Fundamental of Data Science	3	1	-	40	60	100	4	3
DSE1B	NBSCE3502	Computer Vision	3	1	-	40	60	100	4	3
DSE1C	NBSCE3503	Block chain Technology	3	1	-	40	60	100	4	3
DSE2A	NBSCE3601	E-Commerce	3	1	-	40	60	100	4	3
DSE2B	NBSCE3602	Management Information System	3	1	-	40	60	100	4	3
DSE2C	NBSCE3603	Research Methodologies	3	1	-	40	60	100	4	3
DSE3A	NBSCE3701	Big Data Analysis	3	1	-	40	60	100	4	3
DSE3B	NBSCE3702	Data mining & Ware Housing	3	1	-	40	60	100	4	3
DSE3C	NBSCE3703	Distributed Data Base System	3	1	-	40	60	100	4	3
DSE3D	NBSCE3704	Mobile Computing	3	1	-	40	60	100	4	3
DSE4A	NBSCE3801	Sentiment Analysis	3	1	-	40	60	100	4	3
DSE4B	NBSCE3802	Augmented & Virtual Reality	3	1	-	40	60	100	4	3
DSE4C	NBSCE3803	Neural Networks	3	1	-	40	60	100	4	3
DSE4D	NBSCE3804	Expert System	3	1	-	40	60	100	4	3

List of Minor Course (GE)

GE	Course Code	Course Name	Contact Hours			Marks			Cr	Exam Hrs.
			L	T	P	CIA	ESE	Total		
GE1A	NBSM3103	Calculus	3	1	-	40	60	100	4	3
GE1 B	NBBA5102	Business Environment	3	1	-	40	60	100	4	3
GE1 C	NBSE1101	Descriptive Statistic	3	1	-	40	60	100	4	3
GE2 A	NBSM3202	Ordinary Differential Equations	3	1	-	40	60	100	4	3
GE2 B	NBBA5203	Business Organisation	3	1	-	40	60	100	4	3
GE2 C	NBSE1201	Probability & Distribution	3	1	-	40	60	100	4	3
GE3 A	NBSM3303	Partial Differential equations	3	1	-	40	60	100	4	3
GE3 B	NBBA5302	Rural Management	3	1	-	40	60	100	4	3
GE3 C	NBSE1301	Statistical Inference	3	1	-	40	60	100	4	3
GE4 A	NBSM3403	Graph Theory	3	1	-	40	60	100	4	3
GE4 B	NBBA5402	Human Resource Management and Development	3	1	-	40	60	100	4	3
GE4 C	NBSE1401	Survey Sampling	3	1	-	40	60	100	4	3
GE5 A	NBSM3503	Numerical Analysis	3	1	-	40	60	100	4	3
GE5 B	NBBA5501	Business Policy and Strategies	3	1	-	40	60	100	4	3
GE5 C	NBSE1501	Analysis of Variance & Design of Experiment.	3	1	-	40	60	100	4	3
GE6 A	BSME3602	Boolean Algebra & Automata Theory	3	1	-	40	60	100	4	3
GE6 B	NBBA5602	Entrepreneurship & Small business Management	3	1	-	40	60	100	4	3
GE6 C	NBSE1601	Operations Research	3	1	-	40	60	100	4	3
GE7 A	NBSM3701	Discrete Mathematics	3	1	-	40	60	100	4	3
GE7 B	NBBA5703	Income tax Law & Practices	3	1	-	40	60	100	4	3
GE7 C	NBSE1701	Optimization Techniques	3	1	-	40	60	100	4	3
GE8 A	NBSM3801	Ordinary and Partial Differential Equations	3	1	-	40	60	100	4	3
GE8 B	NBBA5801	Banking Insurance	3	1	-	40	60	100	4	3
GE8 C	NBSE1801	Applied Statistics	3	1	-	40	60	100	4	3

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester	I		
Course Name	Computer Fundamentals & Programming Techniques				
Code	NBSC3101				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations	3	1	-	4
Course Objectives	The main objective of the course is to provide basic concept of computer hardware and Software. Students also able to solve various kinds of real life problems using various problem solving Techniques and understand the concept of basics of programming.				
Course Outcomes					
CO1	To understand basic concepts of hardware technologies				
CO2	To understand basic concepts of System Software and Applications Software.				
CO3	To understand and solve the problem using various types of problem solving techniques.				
CO4	To understand the basic concept of Programming Techniques.				
Module	Course Contents			Contact Hrs.	Mapped CO
1	Introduction to computer: Introduction, Basic block diagram and functions of various components of computer, Concept of Hardware: Input/output Devices, Computer Memories: Primary Memory and Secondary Memory, CPU Registers. Concepts Of Machine Level, Assembly Level And High Level Programming, ([1] Chapter 2).			15	CO1
2	Software: Software and its needs, Types of Software. System Software: Operating System, Utility Programs Programming Language: Machine Language, Assembly Language, High Level Language their advantages & disadvantages. Application of Software and its types: Word Processing, Spread Sheets Presentation, Graphics, DBMS software. ([3] Chapter 6).			15	CO2
3	Problem Solving Techniques: Problem Definition, Problem Solving Using Divide And Conquer, Brain Storming And Trial & Error, Steps In Problem Solving: Define Problem Analyze Problem And Explore Solution.			15	CO3
4	Algorithms, Building Blocks Of Algorithms, Statements, Control Flow, Characteristics of Algorithms, Examples. Pseudo Code, Flow Chart, Notations, Examples. ([2] Chapter 1). Introduction To Programming: Basic Difference Between			15	CO4

	Procedure Oriented Language And Object Oriented		
--	---	--	--

Suggested Readings

1. Computer Fundamentals by P.K.Sinha.
2. Jeri R. Hanly, Elliot B.Koffman, Problem Solving and Program Design in C Peardon
3. Object-Oriented Programming in C++ By Robert Lafore · 1997

Online Resources

1. <https://nptel.ac.in/courses/106105171>
2. https://onlinecourses.swayam2.ac.in/cec21_cs15/preview

PO- PS O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1		1			1		1			2		2	1
CO 2	1							1			1		2	1
CO 3						1		1					2	
CO 4	1	1				1		1					2	1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester		I	
Course Name	Programming using C				
Code	NBSC3102				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations	3		-	3
Course Objectives	The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future				
Course Outcomes					
CO1	To learn and develop simple algorithms to solve various types of problems and develop problem solving skills coupled with Top-Down design principles.				
CO2	To learn the strategies of writing efficient and well-structured computer programs and develop the skills for formulating Iterative solutions to various problems.				
CO3	To learn various types of Operators and Functions in C programming and learn the concept of single and multi-dimensional Arrays & various Searching and Sorting techniques.				
CO4	To enhance the learning of C programming by using Pointers & various types of Dynamic Memory Allocation functions.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Introduction to Programming Languages: Concept of Assembler, Compiler, Interpreter ([1] Chapter 1).The Role of Programming Languages, HLL, LLL, Programming Paradigms, Programming Environments. ([1] Chapter 1).Programming Basics: Structure of C Program, Writing and Executing the first C program, Syntax and Logical Errors in Compilation, Object and Executable Code. Components of C language: Standard I/O in C, Fundamental Data Types, Variables and Memory Locations, Storage Classes ([1] Chapter 1,2).	15	CO1
2	Arithmetic expressions & Conditional Branching: Arithmetic Expressions and Precedence, Operators and Expression using Numeric and Relational Operators, Mixed-mode Operations, Type Conversion, Logical Operators, Bit-wise Operators, Assignment Operators, Operator Precedence and Associativity. Conditional Branching: Applying if-else and Switch-case Statements, Nesting If-Else([1] Chapter 6). Loops & Functions: Iteration and Loops, While, Do-while and for Loops, Multiple Loop Variables, Break and Continue Statements ([1] Chapter 6). Functions: Introduction,	15	CO2

	Types of Functions, Functions with Array, Passing Parameters to Functions, Call by value, Call by Reference([1] Chapter 7).		
3	Arrays and Structures: Array Notation and Representation, Manipulating Array Elements, Arrays Using Multi-Dimensional, Character Arrays and Strings, Structure, Union, Enumerated Data Types, Array of Structures, Passing Arrays to Functions ([1] Chapter 9).Basic Algorithms: Searching & Basic Sorting Algorithms (Bubble and Selection).	15	CO3
4	Pointers & File Handling: Pointers: Pointers &Memory Allocation in C, Pointer to Pointer, Pointers to Structures, Problems with Pointers, Passing Pointers as Function Arguments, Using Arrays with Pointers, Passing Arrays to Functions. Static and Dynamic Memory Allocation: use of malloc(), calloc() and free() functions, Storage of Variables In Static and Dynamic Memory Allocation ([1] Chapter 10). File handling: Creating Files, various File handling modes, File I/O functions, Standard C Pre-processors, defining and calling Macros([1] Chapter 1-2).	15	CO4

Suggested Readings

1. Schaum's Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M, Pearson Education.
3. Computer Basics and C Programming by V.Rajaraman, PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House.

Online Resources

1. <https://nptel.ac.in/courses/106104128>
2. <https://nptel.ac.in/courses/106105151>

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1				1					1	1
CO2	1		1	1				1					1	2
CO3	1	1	1					1					1	1
CO4	1	1	1					1					1	1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester		I	
Course Name	Programming using C Lab				
Code	NBSC3152				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations			2	1
Course Objectives	The course is designed to provide Practical knowledge of C language. Students will be able to develop C language programs on various mathematical and computational problems which will help them to create applications in C.				
Course Outcomes					
CO1	To learn the basic terminology of C language, Structure of C program and writing user friendly programs.				
CO2	To learn the various kind of operators, data types, character sets which will help to create basic program of c language.				
CO3	To develop logical C language program using array loops, functions, structure and union.				
CO4	To create programs using concept of pointers, dynamic memory allocation and file handling.				

- 1.WAP to print the sum and product of digits of an Integer.
 - 2.WAP to reverse a number.
 - 3.WAP to compute the Sum of the first n terms of the following series $S = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots$
 - 4.WAP to compute the Sum of the first n terms of the following series $S = 1 - 2 + 3 - 4 + 5 - \dots$
 - 5.Write a function that checks whether a given string is Palindrome or not.
 - 6.Write a function to find whether a given no. is Prime or not. Use the same to generate the Prime numbers less than 100.
 - 7.WAP to compute the factors of a given number.
 - 8.Write a macro that Swap two numbers.
 9. WAP to perform following actions on an Array entered by the User:
 - i) Print the Even-valued elements.
 - ii) Print the Odd-valued elements.
 - iii) Calculate and print the Sum and Average of the elements of Array.
 - iv) Print the Maximum and Minimum elements of Array.
 - v) Remove the duplicates from the Array.
 - vi) Print the Array in Reverse Order.
- The Program should present a Menu to the User and ask for one of the Options.
The Menu should also include options to re-enter Array and to quit the Program.
10. WAP that prints a table indicating the number of occurrences of each alphabet in the text entered as Command line Arguments.
 11. Write a program that Swap two numbers using Pointers.
 12. Write a program in which a Function is passed address of two variables and then alter its contents.

13. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
14. Write a program to find Sum of n elements entered by the user. To write this program, Allocate memory dynamically using malloc() /calloc() functions or new Operator.
15. Write a Menu driven program to perform following Operations on strings:
 - a) Show address of each character in String.
 - b) Concatenate two strings without using strcat() function.
 - c) Concatenate two strings using strcat() function.
 - d) Compare two Strings.
 - e) Calculate length of the string (use Pointers).
 - f) Convert all Lowercase characters to Uppercase.
 - g) Convert all Upper case characters to Lowercase.
 - h) Calculate number of Vowels.
 - i) Reverse the String
16. Given two ordered Arrays of Integers, Write a program to merge the two-Arrays to get an ordered Array.
17. WAP to display Fibonacci series:
 - (i) Using Recursion.
 - (ii) Using Iteration.
18. WAP to calculate Factorial of a number:
 - (i) Using Recursion.
 - (ii) Using Iteration.
19. Create a Structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 such Students and store them in a file.
20. Copy the contents of one text file to another file, after removing all Whitespaces.
21. Write a function that reverses the elements of an Array in place. The function must accept only one Pointer value and return void.
22. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order.
23. Write a Program to create a file & store information.
24. Write a C Program to illustrate reading of data from a File.
25. Write a C Program delete a specific Line from a text File.

PO- PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	2	1		2	1	3	1		1		1	1
CO2	1	1	3	1		2	2	3	1		1		1	2
CO3	1	1	2	1		3	1	3	2		1		1	1
CO4	1	1	3	1		3	2	3	2		1		2	1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science					
Year	1		Semester		I	
Course Name	Computer Organisation & Architecture					
Code	NBSC3103					
Course Type	DSC	L	T	P	Credit	
Pre-Requisite	Basic knowledge of computer and its operations	3	1	-	4	
Course Objectives	To study of the basic structure and operation of a digital computer system. To understand how computer are constructed by a set of functional units. To Analyzing fundamental issues in architecture design and their impact on application performance					
Course Outcomes						
CO1	To Identify the basic structure and function unit of a digital Computer.					
CO2	To understanding and analyze the effect of addressing modes and instructions.					
CO3	To understand Control Unit and ALU					
CO4	To understand Interrupts and I/O					
Module	Course Contents				Contact Hrs.	Mapped CO
1	Computer Evolution and Arithmetic: A historical evolution of computers: Von Neumann Architecture, Hardware Architecture, Bus Interconnection, Register Transfer Language, Bus and Memory Transfers, Bus Architecture, Bus Arbitration Techniques, Arithmetic Logic, Shift Micro Operation, Arithmetic Logic Shift Unit, Arithmetic Algorithms(Addition, Subtraction, Both Multiplication, Division) ([1] Chapter 4).				15	CO1
2	Control Unit: Control Design: Hardwired and Soft wired logic, Micro programmed logic, Performing of Arithmetic and Logical Operations, Multiple Bus Organization, Hardwired Control, Micro Programmed Controlled, Micro-Instructions, Micro Programmed Sequencing, Wide-Branch Addressing, Micro Instruction with next- Address Field, Pre-fetching, Micro Instruction, Block diagram of Microprocessor, Pipelining, Pipeline Control Instructions Pipeline, Pipeline Performance. ([1] Chapter 8).				15	CO2
3	Processor Organisation and Input/ Output Organisation: Processor Design: General Register Organisation, Stack Organisation, Addressing Modes, Instruction Format, Data Transfer and manipulations, Programmed controlled, Reduced Instruction Set, ([2] Chapter13). Computer Memory Organisation: Basic				15	CO3

	Concept and Hierarchy, Semi-Conductor memories, Concept and Design Issues and Performance, Address Mapping and Replacement, Auxiliary Memories: Magnetic Disk, Magnetic Tape, Optical Disk, Virtual Memory, concept Implementation. ([2] Chapter 5-6).		
4	Interrupts: Interrupt Hardware, Types of Interrupts and Exceptions, Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O, Direct Memory Access: I/O Channels and Processors, Serial Communication: Synchronous & Asynchronous Communication, Standard Communication Interfaces. ([2] Chapter 7).	15	CO4

Suggested Readings

1. Computer System Architecture, by Moris Mano
2. Computer Organization And Architecture Designing For Performance, By William Stallings

Online Resources

1. <https://nptel.ac.in/courses/106103068>
2. <https://nptel.ac.in/courses/106104073>

PO- PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1							1					1	1
CO2	1	1						1			1		1	1
CO3	1							1					1	
CO4	1							1					1	1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester		II	
Course Name	Data Structures using C				
Code	BSC3201				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations	3		-	3
Course Objectives	Allow to assess how the choice of data structures and algorithm design methods impacts the performance of programs. To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.				
Course Outcomes					
CO1	To be familiar with fundamental Data Structures and with the manner in which these Data Structures can best be implemented, become accustomed to the description of Algorithms in both functional and procedural styles.				
CO2	To have knowledge of Complexity of basic Operations like Insert, Delete, Search on these Data Structures. Ability to choose a Data Structure to suitably model any data used in Computer Applications.				
CO3	To design programs using various Data Structures including Hash tables, Binary and general Search Trees, Heaps, Graphs etc.				
CO4	Ability to assess efficiency trade-offs among different Data Structure implementations. Implement and know the applications of Algorithms for Sorting, Pattern-matching etc.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Basic concepts: Algorithm Specification-Introduction, Recursive Algorithms, Data Abstraction Performance analysis ([1] Chapter 1).Linear and Non Linear Data Structures. Linked Lists: Creating and Traversing linked-lists, Circularly Linked Lists: Operations for Circularly Linked Lists, Doubly Linked Lists-operations ([1] Chapter 4).Representation of Single, Two Dimensional Arrays, Sparse Matrices-Array and Linked Representations.([2] Chapter 4).	15	CO1
2	Stack: Operations, Array and Linked Implementations, Applications- Infix to Postfix Conversion, Postfix Expression Evaluation, Recursion implementation. Queue: Definition and Operations, Array and Linked implementations, Circular Queues-Insertion and Deletion Operations, Deque(Double Ended Queue) Priority Queue- Implementation ([2] Chapter 6).	15	CO2

3	Trees: Representation of Trees, Binary Trees, Properties of Binary Trees, Binary Tree Representations- Array and Linked Representations, Binary Tree Traversals, Threaded Binary Trees, Heap-Definition, Insertion, Deletion. Search Trees: Binary Search Trees, AVL Trees- Definition, creation and traversing. ([2] Chapter 7).	15	CO3
4	Graphs: Graph ADT, Graph Representations: Adjacency Matrix, Incidence Matrix, Graph Traversals ([2] Chapter 8). Sorting Methods, Comparison of Sorting Methods. Hashing: Introduction, Hash Tables, Hash Functions, Overflow Handling ([2] Chapter 9).	15	CO4

Suggested Readings

1. Fundamentals of Data structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press.
2. Lipschutz, Schaum's outline series Data structures Tata McGraw-Hi
3. Data structures and Algorithm Analysis in C, 2nd edition, M. A. Weiss, Pearson.
4. .Data structures using C and S. Tanenbaum, Y. Langsam, and M. J. Augenstein.

Online Resources

1. <https://nptel.ac.in/courses/106103069>
2. <https://nptel.ac.in/courses/106102064>

PO- PS O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1	1						1					1	1
CO 2	1			1				1					1	1
CO 3	1	1	1			2		1					1	1
CO 4	1	1	1	1		1		1					1	1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester		Second	
Course Name	Data Structures using C Lab				
Code	NBSC3251				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations	-	-	2	1
Course Objectives	To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.				
Course Outcomes					
CO1	Student will be able to develop programs using various kinds of data structure like array and linked list				
CO2	To develop and implement programs of stack and queue data structure using array and linked list.				
CO3	Student will be able to develop logic using heterogeneous data structure like tree BST, AVL tree etc.				
CO4	Student will be able to create and implement various algorithms using graph theory.				

1. Write a program to perform Insertion and Deletion operations in an Array.
2. Write a program to multiply two 2D Matrices.
3. Write a program to Display non-zero elements from Sparse Matrix.
4. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
5. Write a program to Search an element from a list. Give user the option to perform Linear or Binary search.
6. WAP using templates to Sort a list of elements. Give user the option to perform sorting using Insertion Sort, Bubble sort or Selection sort.
7. Write a program to create Queue and perform Insertion and Deletion operations.
8. Write a program to create Deque and perform Insertion and Deletion operations.
9. Write a program to create Priority Queue and perform Insertion and Deletion operations.
10. Implement Linked List using templates. Include functions for Insertion, Deletion and search of a number, Reverse the list and concatenate two Linked Lists.
11. Implement Doubly Linked-List using templates. Include functions for Insertion, Deletion and search of a number, reverse the list.
12. Implement Circular Linked List using templates. Include functions for Insertion, Deletion and search of a number, reverse the list.
13. Perform Stack operations using Linked List implementation.
14. Perform Stack operations using Array implementation.
15. Perform Queues operations using Circular Array implementation.
16. Create and perform different operations on Double-ended Queues using Linked-list implementation.
17. WAP to calculate factorial and to compute the factors of a given no. (i) using Recursion (ii) Using Iteration.
18. WAP to display Fibonacci series (ii) Using Recursion, (iii) Using Iteration

19. WAP to create a Binary Search Tree and include following operations in Tree:
20. Insertion (Recursive and Iterative Implementation).
21. Search a number in BST.
22. Display its pre-order, post-order and in-order traversals Recursively.
23. Display its pre-order, post-order and in-order traversals Iteratively.
24. Display its level-by-level traversals.
25. Count the non-leaf nodes and Leaf Nodes.
26. Display Height of Tree.
27. WAP to reverse the order of the elements in the Stack using additional Stack.
28. WAP to reverse the order of the elements in the Stack using additional Queue.
29. WAP to implement Lower Triangular Matrix using One-dimensional Array.
30. WAP to implement Upper Triangular Matrix using One-dimensional Array.
31. WAP to implement Symmetric Matrix using one-dimensional array.
32. WAP to Create a Threaded Binary Tree as per in-order Traversal, and Implement operations.

PO- PS O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1	1	2	1		2	1	3	1		1		2	1
CO 2	2	1	3	1		2	2	3	1		1		1	2
CO 3	1	2	2	2		3	1	3	2		1		1	1
CO 4	1	1	3	2		3	2	3	2		1		2	1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester	II		
Course Name	Operating System				
Code	NBSC3202				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations	3	1	-	4
Course Objectives	To learn how Operating System is Important for Computer System, make aware of different types of Operating System and their services, To learn different process scheduling algorithms, synchronization and secondary memory management				
Course Outcomes					
CO1	To understand the basic concept and types of Operating System.				
CO2	To learn Operating System organization i.e. concept of process, process synchronization etc.				
CO3	To learn the various kinds of process scheduling algorithms.				
CO4	To learn file management, I/O management and protection and security policies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Module I: Introduction: Definition of operating system, History of Operating Systems , Single user/Multi User and Single and Multitasking OS; types of operating systems–multiprogramming systems, batch systems, time sharing systems, Distributed System, real time systems; Functions of operating system: Memory management, process management, device management, file management etc.	15	CO1
2	Operating System Organization: System calls and system programs. Process Management: System view of the process and resources, process abstraction, process hierarchy, threads; Process synchronization: concurrent processes, critical sections, methods for inter-process communication; classical two process and n-process solutions, hardware primitives for synchronization, semaphores, monitors, classical problems in synchronization (producer-consumer, readers-writer, dining philosophers etc.).	15	CO2
3	Process Scheduling: non-pre-emptive and pre-emptive scheduling algorithms-FCFS, SJF, SRTF, Round Robin etc., Semaphores. Memory Management: Memory address, Physical and virtual address space; memory allocation strategies –fixed and variable partitions, Concept of paging, segmentation, demand paging, virtual	15	CO3

	memory, page replacement algorithms, virtual memory		
4	Deadlocks: prevention and avoidance, detection and recovery. File and I/O Management File concepts, Access methods, Directory structure, File system structure, files operations, files allocation methods, device management, Protection and Security , Policy mechanism, Authentication	15	CO4

Suggested Readings

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley
2. Publications 2008.G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.
3. W. Stallings, Operating Systems, Internals & Design Principles , 5th Edition, Prentice Hall of India. 2008.
4. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

Online Resources

1. <https://archive.nptel.ac.in/courses/106/105/106105214/>
2. https://onlinecourses.nptel.ac.in/noc20_cs04/preview

PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1		1	1				2						1
CO 2	1	1	1	1				1						1
CO 3	1		1					2						1
CO 4	1	1	1	1				2						1

Program	B.Sc. (Hons./ Hons. with Research) Computer Science				
Year	1	Semester	II		
Course Name	Computer Networks				
Code	NBSC3203				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	Basic knowledge of computer and its operations	3	1	-	4
Course Objectives	Student will be able to learn the concept of computer networking, it's various types, reference models, layers of TCP/IP and OSI Model and various services.				
Course Outcomes					
CO1	Describe how Computer Networks are organized with the concept of layered Approach.				
CO2	Implement a simple LAN with Hubs, Bridges and Switches. Learn basic routing mechanisms, IP addressing scheme and internetworking concepts.				
CO3	Student will be able to learn the concept of multiple access control, network layer functions and protocols.				
CO4	To learn the various kind of protocols and services provided by application layer and transport layer.				
Module	Course Contents			Contact Hrs.	Mapped CO
1	Fundamentals of Computer Networks: Network Definition, Network Topologies, Network Classifications, Network Protocol, Layered Network Architecture, Reference Models: OSI Reference Model, TCP/IP Reference model ([1] Chapter 1-2), Comparison of OSI and TCP/IP Models ([1] Chapter 2).			15	CO1
2	TCP/IP Protocol Suite: TCP/Ip layers and Protocols, ([1] Chapter 2). Networks Switching Techniques and Access Mechanisms: Circuit Switching, Packet switching- Connectionless Datagram Switching, Connection-Oriented virtual Circuit Switching, Dial-up Modems, Digital Subscriber Line, Cable TV for Data transfer([1] Chapter 8).Data Link Layer Functions and Protocol: Error Detection and Error Correction Techniques, Data-link Control-Framing and Flow Control, Error Recoveries Protocols- Stop and Wait ARQ, Go-back-n ARQ, Point to Point Protocol on Internet ([1] Chapter 10-11).			15	CO2
3	Multiple Access Protocol and Networks: CSMA/CD Protocols; Ethernet LANS; Connecting LAN and Back-Bone Networks-			15	CO3

	Repeaters, Hubs, Switches, Bridges, Router and Gateways([1] Chapter 12). Networks Layer Functions and Protocols: Routing, Routing Algorithms: Distance Vector, Shortest Path Routing Algorithm, Network Layer Protocols: IP protocol, Internet Control Message Protocol, IGMP, ARP, RARP([1] Chapter 19-22).		
4	Transport Layer Functions and Protocols: Transport services- Error control and Flow Control, Reliability, TCP and UDP, Connection Establishment and Release: Three way Handshaking, Concept of Socket and Ports ([1] Chapter 23-24). Application layer Protocol: Overview of WWW, URL, HTTP, SMTP, FTP, POP, TELNET. Domain Name System, Domain Name Servers, DNS Space ([1] Chapter 25-28).	15	CO4

Suggested Readings

1. B. A. Forouzan: Data Communications and Networking, Fourth edition, THM, 2007.
2. Computer Network and Internet by Douglas E Comer.
3. A. S. Tanenbaum: Computer Networks, Fourth edition, PHI, 2002.
4. William Stallings, “Data and Computer Communication”, Prentice Hall.

Online Resources

1. <https://nptel.ac.in/courses/106105183>
2. <https://nptel.ac.in/courses/106106091>

PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1	1	1				1	1			1		1	1
CO 2	1	1	1			1	1	1			1		1	1
CO 3	1	1	1			1	1	2			2		1	1
CO 4	1	1	1			2	1	2			2		1	1

Program	B.Sc. (Hons./ Hons. with Research)				
Year	1	Semester	1		
Course Name	Calculus				
Code	NBSM3103				
Course Type		L	T	P	Credit
Pre-Requisite	10+2 Mathematics	3	1	-	4
Course Objectives	The objective of the course is to provide the concept of limit, continuity and differentiability and to apply the knowledge to solve problems.				
Course Outcomes					
CO1	To understand continuity and differentiability in terms of limits and graphs of certain functions.				
CO2	To understand the consequences of various mean value theorems for differentiable functions.				
CO3	To understand the concepts of asymptotes and inflexion points in curve tracing.				
CO4	To be able to compute the reduction formulae of standard transcendental functions with applications.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	$\varepsilon - \delta$ definition of a limit, Infinite limits, Continuity and types of discontinuities ([1] Chapter 2); Differentiability of a function ([1] Chapter 3), Successive differentiation: Calculation of the nth derivatives, Leibnitz theorem ([1] Chapter 5). Partial differentiation, Euler's theorem on homogeneous functions ([1] Chapter 12).	15	CO1
2	Rolle's theorem, Mean value theorems, Taylor's and Maclaurin's series expansions of one variable ([1] Chapter 7). Indeterminate forms ([1] Chapter 16).	15	CO2
3	Asymptotes ([1] Chapter 9), Curvature, Concavity and inflexion points ([1] Chapter 10), Singular points, Tangents at the origin and nature of singular points, Curve tracing ([1] Chapter 11).	15	CO3
4	Integration of irrational algebraic functions and transcendental functions, Reduction formulae for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$, $\int \sin^m x \cos^n x \, dx$, $\int x^n \sin mx \, dx$, $\int x^n \cos mx \, dx$ and $\int x^n (\log x)^m \, dx$ ([2] Chapter 3&4). Definite integral as a limit of sum ([2] Chapter 5),	15	CO4

Suggested Readings

1. Prasad, Gorakh (2016). Differential Calculus (19th ed.). Pothishala Pvt. Ltd. Allahabad.
2. Prasad, Gorakh (2015). Integral Calculus. Pothishala Pvt. Ltd. Allahabad.

Online Resources

1. <https://archive.nptel.ac.in/courses/111/106/111106146/>
2. <https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=&course%5B%5D=Calculus&domain%5B%5D=Physical+%26+Basic+Sciences>

Course Articulation Matrix														
PO- PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1				2			1		2	1
CO2	2	2	2	1				2			2		2	2
CO3	1	2	1	1				1			1		1	1
CO4	1	1	2	1				2					1	1

Program	B.Sc. (Hons./ Hons. with Research)				
Year	1	Semester	2		
Course Name	Ordinary Differential Equations				
Code	NBSM3202				
Course Type		L	T	P	Credit
Pre-Requisite	10+2 Mathematics	3	1	-	4
Course Objectives	The objective of this course is to introduce the students to understand and solve of Differential Equations, create various Mathematical models and their applications in everyday life.				
Course Outcomes					
CO1	To understand the genesis of ordinary differential equations of first order and first degree.				
CO2	To learn various techniques of getting exact solutions of linear differential equations of Second and higher order.				
CO3	To develop the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.				
CO4	To formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation ([2] Chapter 1, Part I), Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor ([2] Chapter 2, Part I), First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions ([2] Chapter 4, Part I).	15	CO1
2	Second Order Linear Differential Equations: Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients ([1] Chapter 2), Euler-Cauchy's linear differential equations, Legendre's linear differential equations. Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters ([2] Chapter 10, Part I), Reduction of order ([1] Chapter 2). Higher Order Linear Differential Equations: Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties.	15	CO2
3	Power series method ([2] Chapter 7, Part II), Frobenius method ([2] Chapter 8, Part II), Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials ([2] Chapter 9, Part II), Bessel's equation, Bessel	15	CO3

	functions and their properties, Recurrence relations ([2] Chapter 11, Part II).		
4	Application of first order differential equations to acceleration-velocity model ([5] Chapter 2), Growth and Decay model ([4] Chapter 2). Introduction to compartmental models ([4] Chapter 2), Lake pollution model (with case study of Lake Burley Griffin) ([4] Chapter 2), Drug Assimilation models ([4] Chapter 2), population models (with limited growth, exponential growth) Epidemic models ([5] Chapter 2 or [4] Chapter 3).	15	CO4

Suggested Readings

1. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
2. M. D. Raisinghania, Advanced Differential Equations, Eighteenth Edition 2013, S. Chand.
3. H. I. Freedman (1980). Deterministic Mathematical Models in Population Ecology. Marcel Dekker Inc.
4. Barnes, Belinda & Fulford, Glenn R. (2015). Mathematical Modelling with Case Studies, Using Maple and MATLAB (3rd ed.). CRC Press, Taylor & Francis Group.
5. Edwards, C. Henry, Penney, David E., & Calvis, David T. (2015). Differential Equation and Boundary Value Problems: Computing and Modeling (5th ed.). Pearson Education

Online Resources

1. <https://archive.nptel.ac.in/courses/111/106/111106100/>

Course Articulation Matrix														
PO- PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1		2			1					1	2
CO2	1	2	2		3			3					2	3
CO3	2	2	1		2			1					2	2
CO4	2	3	2	1	3			2					3	3

Program					
Year	First	Semester		First	
Course Name	Business Environment				
Code	NBBA5102				
Course Type		L	T	P	Credit
Pre-Requisite	10+2 in any discipline	4	0	0	4
Course Objectives	To Familiarize students with: Various external and internal factors that impact business and understand the economic, cultural, legal and political issues associated with national and international business.				
Course Outcomes					
CO1	Explain the types of business environment viz Political, Economic, Socio-cultural, Legal, Technological and Global environment.				
CO2	Analyse the existence of business under various Policies Framework laid by legal environment.				
CO3	Examine the role of public sector along with various government regulatory acts and policies regarding business environment including industrial, monetary and fiscal policies.				
CO4	Analyse and evaluate global business environment in terms of Global Trade Policies by respective Institutions along with determining the impact and prospects of Technology in shaping Business.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Module I: Introduction Business Environment: Nature, dimensions and meaning. Components of business environment: economic, political, technological and social environment. Consumerism and consumer protection in India. A brief study of capitalism, socialism and mixed economy.	15	1
2	Module II: Industrial and Legal Environment Industrial Growth and policy, industrial licensing policy. MRTP. Economic planning: aims, objectives and framework of development planning in India. Legal Environment. India's Fiscal and Monetary Policies.	15	2
3	Module III: Public Sector and Economic Organizations Public Sector: Concept, Rationale, Government Programme, Role of Public Sector in India. Foreign Trade	15	3

	Policies. Development Banks: IFCI, IDBI, SIDBI, IIBI.		
4	Module IV: Recent Economic Trends Recent Economic Trends Economic Liberalization, Privatization and Globalization. Foreign investment policy. Export Promotion councils and boards. Import Control. EXIM policy, FEMA, IPR (International and Indian Patent Rights Acts). Anti-Pollution Act. Environmental Groups and Bodies. Euro I, II and III Norms, Introduction to Goods and Services Tax.	15	4

Suggested Readings

1. Mishra S. K. And Puri V. K., Economic Environment of Business, Himalaya Publication.
2. Paul, Justin., Business Environment Text and Cases, Tata McGraw Hill.
3. Shaikh and Saleem, Business Environment, Pearson, 1st Edition.

Online Resources

1. eGyanKosh: Business Environment online available at <https://egyankosh.ac.in/handle/123456789/2898>
2. NPTEL: Introduction to Business environment available at https://onlinecourses.swayam2.ac.in/imb22_mg02/preview

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1									2	2	2
CO2	3	2	2	1	2							2	2	2
CO3	3	3	3	3	3	1	2			1		3	3	2
CO4	1	1	1	2	2	2	2	1				3	3	2

Program					
Year	First	Semester		Second	
Course Name	Business Organisation				
Code	NBBA5203				
Course Type		L	T	P	Credit
Pre-Requisite	10+2 from any discipline	3	1	0	4
Course Objectives	To familiarize students with: Management and business concepts and practices. Emerging challenges of managing resources, managing business processes and managing managers.				
Course Outcomes					
CO1	Understand the concept of business organization and principles of organization.				
CO2	Examine the role of sole proprietorship, Partnership firm, joint stock concerns and companies.				
CO3	Analyse the sources and methods of Business Finance and analyse working of financial institutions like IFCI, SFC, ICICI, IDBI and security market.				
CO4	Assessing market structure and applying it to different industries to understand the four P's of marketing structure of these industries. Applying the concepts of advertisement and sales promotion to real life situations.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Module I: Introduction to Organization Concepts and objectives of business organization, establishment of a new business, pre-establishment considerations and social responsibility of business. Meaning, objective and principles of organization, line and staff, functional organization, concept of scalar chain.	15	1
2	Module II: Forms of Business Organization Sole Proprietorship: Meaning, characteristics and legal requirements. Partnership firms: Meaning, partnership deed and legal requirements as per Partnership Act 1932. Joint stock concerns: Meaning, features, kinds of companies, legal requirements as per Companies Act 2013.	15	2
3	Module III: Business Finance Business Finance: Concept, need and significance. Methods of financing: long term, medium term and short term. National finance and international finance. Financial institutions: Brief introduction to IFCI, SFC, ICICI, IDBI. Security market: An introduction to primary and secondary market.	15	3
4	Module IV: Marketing	15	4

	Marketing: Concept of marketing, four P's of Marketing. Distribution channel: Meaning, importance, and significance of middlemen. Advertisement and sales promotion: Meaning and objectives. Introduction to Consumer Behaviour.		
--	--	--	--

Suggested Readings

1. Tulsian P. C. and Pandey V., Business Organization and Management, Pearson Education.
2. Bhushan Y. K., Fundamentals of Business Organization and Management, Sultan Chand and Sons.
3. Chhabra T.N., Business Organisation, Dhanpat Rai and Sons.
4. Robert., Modern Business Administration, McMillan India.

Online Resources

1. SWAYAM: Business Organization and Management online available at https://onlinecourses.swayam2.ac.in/nou21_mg03/preview
2. eGyanKosh: Business Organisation online available at <https://egyankosh.ac.in/handle/123456789/3592>

Course Articulation Matrix														
PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1				1	1	1			2	2	1
CO2	3	1	2	1	2							2	2	1
CO3	3	3	3	3	3	1	2					3	3	1
CO4	1	1	1	2	2	2	2	1				3	3	1

Program	For all UG Programs				
Year	1	Semester		1	
Course Name	Descriptive Statistics				
Code	NBSE1101				
Course Type	GE	L	T	P	Credit
Pre-Requisite	10+2 in any discipline	3	1	0	4
Course Objectives	The general objectives of the course are to: Understand Statistics, its scope and importance in various fields. Learn difference between sample population data and its types. Understand graphical representation of different types of data. Differentiate between measures of central tendency & dispersion.				
Course Outcomes:					
CO1	To understand concept of sample vs. population and difference between different types of data.				
CO2	To be able to apply different methods for summarising data sets, Interpret histograms and ogives etc.				
CO3	To describe data with measures of central tendency and measures of dispersion.				
CO4	To understand measures of skewness, kurtosis and their utility.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Concept of statistical population, Attributes and variables (discrete and Continuous) ([2] Chapter 1); Primary data – designing a questionnaire and schedule, collection of primary data, Secondary data ([2] Chapter 3); Presentation of data: classification, tabulation ([2] Chapter 5).	15	CO1
2	Diagrammatic & graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representations, histogram, frequency polygon and ogives ([3] Chapter 3).	15	CO2
3	Measure of central tendency: Average or arithmetic mean, median, mode, geometric mean & harmonic mean for grouped and ungrouped data with their merits and demerits ([3] Chapter 4).	15	CO 3
4	Dispersion, merits and demerits of these measures ([1] Chapter 7); Moments, Shephard's correction for moments ([2] Chapter 9); Skewness and Kurtosis and their Measures ([1] Chapter 8); Measures based on quartiles (Quartiles, Deciles and percentiles) ([1] Chapter 7).	15	CO4

Suggested Readings

1. Beri, G.C. (2011). Business Statistics (3rd ed.), TMH Education Pvt. Ltd. New Delhi.
2. Gupta, S.P. (2011). Statistical Methods (41st ed.), Sultan Chand and Sons New Delhi.

3. Tulsian, P.C. and Tulsian, Bharat. (2019). Business Statistics (2nd ed.), Sultan Chand and Company Ltd. New Delhi.

Online Resources

1. <https://heecontent.upsdc.gov.in/Home.aspx>
2. <https://www.edx.org/search?q=statistics>

Course Articulation Matrix														
PO- PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1			1	1	1					1	1
CO2	1	1	1			2		1					1	1
CO3	1	1	1			2		1					1	1
CO4	1	1	1			2		1					1	1

Program	For all UG Programs				
Year	1	Semester		2	
Course Name	Probability & Distributions				
Code	NBSE1201				
Course Type	GE	L	T	P	Credit
Pre-Requisite	10+2 in any discipline	3	1	0	4
Course Objectives	The general objectives of the course are to: understand concept of probability along with basic laws and axioms of probability. understand Addition & Multiplication theorems of probability. understand the concept of random variable (discrete and continuous), concept of probability distribution. knowledge of discrete & continuous distributions.				
Course Outcomes:					
CO1	To apply the concept of different terms used in probability.				
CO2	To apply basic probability principles to solve real life problems.				
CO3	To differentiate & apply different types of distributions.				
CO4	To understand applications of discrete & continuous distributions to solve the problems.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Basic Concepts of probability, Random Experiment, Trial, Sample Point, Sample space, events, Definitions of Mutually Exclusive, Exhaustive and Equally Likely events, Definitions of Probability: Classical, relative frequency and axiomatic approaches and their limitations ([2] Vol. 2, Chapter 1).	15	CO1
2	Theorems on Probability: Addition theorem of Probability for n Events, Theorem of Total Probability for n Events, Conditional Probability, Multiplication Theorem of Probability for n events, Independent Events. Bayes' Theorem and its Applications ([2] Vol. 2, Chapter 1).	15	CO2
3	Random variables – discrete and continuous, ([1], Chapter 10); probability mass function (pmf) and probability density function (pdf), Cumulative distribution function (cdf), Joint distribution of two random variables, marginal and conditional distributions, Independence of random variables ([3], Chapter 5); Expectation of a random variable and its properties, expectation of sum of random variables and product of independent random variables ([3], Chapter 6).	15	CO 3
4	Probability Distributions: Binomial, Poisson, Normal distribution and their properties ([1], Chapter 10).	15	CO4

Suggested Readings

1. Beri, G.C. (2011). Business Statistics (3rd ed.), TMH Education Pvt. Ltd. New Delhi.
2. Gupta, S.P. (2011). Statistical Methods (41st ed.), Sultan Chand and Sons New Delhi.
3. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons, New Delhi.

Online Resources

1. <https://www.coursera.org/search?query=statistics&>
2. <https://www.edx.org/search?q=statistics>

Course Articulation Matrix														
PO- PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1			1		1					1	1
CO2	1	2	1			1		1					1	1
CO3	1	2	2			2		1					1	1
CO4	1	2	2			2		1					1	1