

BABU BANARASI DAS UNIVERSITY, LUCKNOW

Department of Mathematics & Computer Science School of Basic Sciences

B.Sc. (Hons./Hons. with research) Mathematics

(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	NBSM3101	Algebra	3	1	-	40	60	100	4	3
DSC2	NBSM3102	Elementary Real Analysis	3	1	-	40	60	100	4	3
DSC3	NBSM3103	Calculus	3	1	-	40	60	100	4	3
DSC4	NBSM3201	Theory of Real Functions	3	1	-	40	60	100	4	3
DSC5	NBSM3202	Ordinary Differential Equations	3	1	-	40	60	100	4	3
DSC6	NBSM3203	Geometry and Vector Calculus	3	1	-	40	60	100	4	3
DSC7	NBSM3301	Group Theory	3	1	-	40	60	100	4	3
DSC8	NBSM3302	Multivariate Calculus	3	1	-	40	60	100	4	3
DSC9	NBSM3303	Partial Differential equations	3	1	-	40	60	100	4	3
DSC10	NBSM3401	Ring Theory and Vector Spaces	3	1	-	40	60	100	4	3
DSC11	NBSM3402	Riemann Integration & Series of Functions	3	1	-	40	60	100	4	3
DSC12	NBSM3403	Graph Theory	3	1	-	40	60	100	4	3
DSC13	NBSM3501	Linear Algebra	3	1	-	40	60	100	4	3
DSC14	NBSM3502	Set Theory and Metric Spaces	3	1	-	40	60	100	4	3
DSC15	NBSM3503	Numerical Analysis	3	1	-	40	60	100	4	3
DSC16	NBSM3601	Complex Analysis	3	1	-	40	60	100	4	3
DSC17	NBSM3602	Integral Transform and Fourier Analysis	3	1	-	40	60	100	4	3
DSC18	NBSM3603	Differential Geometry & Tensor Analysis	3	1	-	40	60	100	4	3
DSC19	NBSM3701	Discrete Mathematics	3	1	-	40	60	100	4	3
DSC20	NBSM3801	Ordinary and Partial Differential Equations	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	NBSME3501	Mathematical Modelling	3	1	-	40	60	100	4	3
DSE1B	NBSME3502	Mechanics	3	1	-	40	60	100	4	3
DSE1C	NBSME3503	Number Theory	3	1	-	40	60	100	4	3
DSE2A	NBSME3601	Boolean Algebra & Automata Theory	3	1	-	40	60	100	4	3
DSE2B	NBSME3602	Analytical Geometry	3	1	-	40	60	100	4	3
DSE2C	NBSME3603	Module Theory	3	1	-	40	60	100	4	3
DSE3A	NBSME3701	Abstract Algebra	3	1	-	40	60	100	4	3
DSE3B	NBSME3702	Topology	3	1	-	40	60	100	4	3
DSE3C	NBSME3703	Real Analysis	3	1		40	60	100	4	3
DSE3D	NBSME3704	Fuzzy Mathematics	3	1	-	40	60	100	4	3
DSE4A	NBSME3801	Advance Algebra	3	1	-	40	60	100	4	3
DSE4B	NBSME3802	Advance Real Analysis	3	1		40	60	100	4	3
DSE4C	NBSME3803	Functional Analysis	3	1		40	60	100	4	3
DSE4D	NBSME3804	Computational Fluid Dynamics	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	ES E	Total		
GE1 A	NBSC3102	Programming using C	3	-	-	40	60	100	3	3
	NBSC3151	Programming using C Lab	-	-	2	40	60	100	1	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	NBSC3201	Data Structure using C	3	-	-	40	60	100	3	3
	NBSC3251	Data Structure using C Lab			2	40	60	100	1	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	NBSC3301	Java Programing	3	-	-	40	60	100	3	3
	NBSC3351	Java Programing Lab	-	-	2	40	60	100	1	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	NBSC3401	Database Management System	3	-	-	40	60	100	3	3
	NBSC3451	Database Management System (Lab)	-	-	2	40	60	100	1	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	NBSC3501	Web Technologies	3	1	-	40	60	100	4	3
	NBSC3551	Web Technologies (Lab)	-	-	2	40	60	100	1	3
GE5 B	NBBA5501	Business policy and strategic	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	NBSC3603	Soft Computing	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	NBSCE3701	Big Data Analysis	3	1	-	40	60	100	4	3
GE7 B	NBBA5703	Income tax Law & Practice	3	1	-	40	60	100	4	3
GE7 C	NBSE1701	Optimization Techniques	3	1	-	40	60	100	4	3
GE8 A	NBSCE3801	Augmented & Virtual Reality	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) Mathematics				
Year	1	Semester		I	
Course Name	Algebra				
Code	NBSM3101				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	10+2 Mathematics	3	1	-	4
Course Objectives	The objective of the course is to introduce the basic concepts of theory of equations, number theory, group theory, symmetry group of a plane figure, cyclic groups, classification of subgroups of cyclic groups and matrices.				
Course Outcomes :					
CO1	To be able to solve cubic and quartic polynomial equations with special condition on roots and in general.				
CO2	To understand the basic concepts of modular arithmetic and basic properties of congruences.				
CO3	To be able to recognize the algebraic structure, namely groups, and classify subgroups of cyclic groups.				
CO4	To be able to recognize consistent and inconsistent systems of linear equations using matrix method.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	General properties of polynomials and equations. Fundamental theorem of algebra, Relations between the roots and the coefficients ([2] Chapter 3). Newton's method for integral roots, Descartes' rule of signs; De-Moivre's theorem for integer and rational indices and their applications ([2] Chapter 4). The nth roots of unity, Synthetic division method ([2] Chapter 3), Cardan's solution of the cubic, Descartes' solution of the quartic equation; ([3] Chapter 13).	15	CO1
2	Division algorithm in \mathbb{Z} , Divisibility and the Euclidean algorithm ([1] Chapter 4), Fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences ([1] Chapter 4).	15	CO2
3	Groups, Basic properties, Symmetries of a square, Dihedral group, Order of a group, Order of an element, Subgroups, Center of a group, Centralizer of an element, Cyclic groups and properties ([4] Chapter 2).	15	CO3
4	Rank of a matrix, Rank and elementary operations, Row reduction and echelon forms ([2] Chapter 6) System of linear equations, Solution of the matrix equation $AX = B$ ([2] Chapter 7), Solution sets of linear systems, linear independence, The Characteristic equation and Cayley-Hamilton Theorem ([2] Chapter 8), Eigenvalues and Eigenvectors ([2] Chapter 8).	15	CO4

Suggested Readings

1. Goodaire, Edgar G., & Parmenter, Michael M. (2006). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2018.
2. MK Singal, Asha Rani Singal, (2020); Algebra (31st Ed) R Chand & Co, New Delhi.
3. Chandrika Prasad, (1963). Text Book on Algebra and Theory of Equations Pothishala

Pvt. Ltd.

4. Gallian, Joseph. A. (2017). Contemporary Abstract Algebra (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint 2021.

Online Resources

1. <https://nptel.ac.in/courses/111107112>
2. <https://nptel.ac.in/courses/111105112>
3. <https://archive.nptel.ac.in/courses/111/101/111101137/>
4. https://onlinecourses.swayam2.ac.in/cec21_ma07/preview

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

Program	B.Sc. (Hons./ Hons. with Research) Mathematics				
Year	1	Semester		1	
Course Name	Elementary Real Analysis				
Code	NBSM3102				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	10+2 Mathematics	3	1	-	4
Course Objectives	The object of the course is to understanding of real number system and the concepts of convergence and divergence of sequences and series of real numbers.				
Course Outcomes					
CO1	To understand the fundamental properties of the real numbers, including completeness, Archimedean and density property of rational numbers in \mathbb{R}				
CO2	To understand nested interval property, neighbourhood of a point in \mathbb{R} and learn to define sequences in terms of functions from \mathbb{N} to a subset of \mathbb{R} and find the limit, recognize convergent, divergent and monotonic sequences.				
CO3	To recognize sub-sequences, calculate limit superior and inferior of a bounded sequence. Learn to identify infinite series and its convergence.				
CO4	To be able to apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Algebraic and order properties of \mathbb{R} , Absolute value of a real number, Bounded above and bounded below sets, Supremum and infimum of a non-empty subset of \mathbb{R} , The completeness property of \mathbb{R} , Archimedean property, Density of rational numbers in \mathbb{R} ([1] Chapter 2).	15	CO1
2	Definition and types of intervals, nested interval property ([1] Chapter 2), Neighbourhood of a point in \mathbb{R} , open and closed set in \mathbb{R} ([1] Chapter 11). Sequences: Sequences and their limits, Convergent sequence, Limit theorems, Monotone sequences, Monotone convergence theorem ([1] Chapter 3).	15	CO2
3	Subsequences, Bolzano-Weierstrass theorem for sequences. Limit superior and limit inferior for bounded sequence, Cauchy sequence, Cauchy's convergence criterion ([1] Chapter 3). Infinite Series: Convergence and divergence of infinite series of real numbers, Necessary condition for convergence ([3] Chapter 8).	15	CO3
4	Cauchy criterion for convergence, Tests for convergence of positive terms series, Integral test, Basic comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test, Alternating series, Leibniz test, Absolute and conditional convergence ([3] Chapter 8).	15	CO4

Suggested Readings

1. Bartle, Robert G., & Sherbert, Donald R. (2011). Introduction to Real Analysis (4th ed.). John Wiley & Sons. Wiley India Edition 2015.

2. Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). An Introduction to Analysis (2nd ed.). Jones and Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.
3. Denlinger, Charles G. (2011). Elements of Real Analysis. Jones and Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

Online Resources

1. <https://nptel.ac.in/courses/122104017>
2. <https://nptel.ac.in/courses/111106142>

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

Program	B.Sc. (Hons./ Hons. with Research) Mathematics				
Year	1	Semester	1		
Course Name	Calculus				
Code	NBSM3103				
Course Type	DSC	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) Mathematics				
Year	1	Semester		2	
Course Name	Theory of Real Functions				
Code	NBSM3201				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	10+2 Mathematics	3	1	-	4
Course Objectives	The objective of the course is to provide a knowledge and the key concepts of calculus, namely, limits, continuity, differentiability and their applications.				
Course Outcomes: Upon successful completion of syllabus, a student will be able to					
CO1	To be able to calculate the limit and examine the continuity of a function at a point.				
CO2	To understand the concept of differentiability and chain rule of differentiability.				
CO3	To understand the concept behind various mean value theorems for differentiable functions.				
CO4	To be able to find expansions for algebraic & transcendental function with the help of Taylor's & Maclaurin's theorem.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Limits of functions, limit theorems ([1]: Chapter 4). Continuous functions, algebra of continuous functions, continuous functions on interval, Boundedness theorem, Maximum- minimum theorem, location of roots theorem, Bolzano intermediate value theorem, preservation of intervals theorem, uniform continuity, non-uniform continuity criteria, uniform continuity theorem. ([1]: Chapter 5).	15	CO1
2	Differentiability of a function at a point and in an interval, The Chain Rule, Caratheodory's theorem, algebra of differentiable functions, Interior extremum theorem. ([1]: Chapter 6).	15	CO2
3	Rolle's theorem, First mean value theorem. Intermediate value property for derivatives, Darboux's theorem, Cauchy's mean value theorem, Application of mean value theorems([1]: Chapter 6).	15	CO3
4	Taylor's theorem with Lagrange's and Cauchy's form of remainders, Taylor series, Maclaurin series, Expansions of exponential, Logarithmic and Trigonometric functions. ([1]: Chapter 6).	15	CO4

Suggested Readings

1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis (4th Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2010.
2. K. A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
3. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.

4. S. R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

Online Resources

1. <https://vidyamitra.inflibnet.ac.in/index.php/search?subject%5B%5D=&course%5B%5D=A+basic+course+in+real+analysis&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	3	2	1				3	2				2	2
CO2	2	2	2	1				3	2				2	2
CO3	2	3	2	1				2	2				2	1
CO4	2	3	2	1				2	2				2	1

Program	B.Sc. (Hons./ Hons. with Research) Mathematics				
Year	1	Semester	2		
Course Name	Ordinary Differential Equations				
Code	NBSM3202				
Course Type	DSC	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 functions and their properties, Recurrence relations ([2] Chapter 11, Part II).	15	CO3
4	Application of first order differential equations to acceleration-	15	CO4

	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).		
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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	B.Sc. (Hons./ Hons. with Research) Mathematics				
Year	1	Semester	2		
Course Name	Geometry and Vector Calculus				
Code	NBSM3203				
Course Type	DSC	L	T	P	Credit
Pre-Requisite	10+2 Mathematics	3	1	-	4
Course Objectives	The objective of the course is to introduce the basic tools of vector calculus and geometric properties of different conic sections which are helpful in understanding their applications in Planetary motion and real-world problems.				
Course Outcomes					
CO1	To understand the geometrical terminology and have a detailed clear cut idea of planes and straight lines.				
CO2	To be able to explain the geometrical and theoretical concept of Sphere with its properties.				
CO3	To be able to explain the concept of three dimensional spaces				
CO4	To understand the calculus of vector valued functions and apply the knowledge to solve various problem.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	Planes: Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes, Straight lines: Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane, ([4] Chapter III).	15	CO1
2	Spheres: Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy ([4] Chapter V).	15	CO2
3	Space curves, Algebraic curves, Ruled surfaces, Some standard surfaces, Classification of quadric surfaces, Cone, Cylinder, Central conicoids. Tangent plane, Normal, Polar planes and Polar lines. ([4] Chapter VI,VII).	15	CO3
4	Vector valued functions and their graphs, Limits and continuity of vector functions, Differentiation and integration of vector functions, Projectile motion, Unit tangent, Normal and binormal vectors, Curvature and Torsion ([5] Chapter 13)	15	CO4

Suggested Readings

1. Leonard Eugene Dickson (2009). First Course in the Theory of Equations. The Project Gutenberg E Book (<http://www.gutenberg.org/ebooks/29785>).
2. Edgar G. Goodaire & Michael M. Parmenter (2015). Discrete Mathematics with Graph Theory (3rd edition). Pearson Education Pvt. Ltd. India.
3. David C. Lay, Steven R. Lay & Judi J. McDonald (2016). Linear Algebra and its Applications (5th edition). Pearson Education Pvt. Ltd. India.
4. Robert J. T. Bill (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.

5. Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). Thomas' Calculus
6. (13thed.)Pearson Education, Delhi. Indian Reprint 2017.
7. B. C. Das, B. N. Mukherjee. Differential Calculus (55th Edition), U.N.Dhur& Sons Private Ltd., Kolkata (2015)

Online Resources

1. <https://nptel.ac.in/courses/111104095>
2. <https://archive.nptel.ac.in/courses/111/105/111105122/>

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	2
CO2	1	1	1	1					1				1	1
CO3	1	1	1	1					1				1	1
CO4	1	2	1	1	1			1	1				2	2

Program	B.Sc. (Hons./ Hons. with Research)				
Year	1	Semester		I	
Course Name	Programming using C				
Code	NBSC3102				
Course Type		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, Types of Functions, Functions with Array, Passing Parameters to Functions, Call by value, Call by Reference([1] Chapter 7).	15	CO2
3	Arrays and Structures: Array Notation and	15	CO3

	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).		
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)				
Year	1	Semester		I	
Course Name	Programming using C Lab				
Code	NBSC3152				
Course Type		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 Uppercasecharacters 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)				
Year	1	Semester		II	
Course Name	Data Structures using C				
Code	BSC3201				
Course Type		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,	15	CO3

	Deletion. Search Trees: Binary Search Trees, AVL Trees- Definition, creation and traversing. ([2] Chapter 7).		
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)				
Year	1	Semester		Second	
Course Name	Data Structures using C Lab				
Code	NBSC3251				
Course Type		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					
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 Policies. Development Banks: IFCI, IDBI, SIDBI, IIBI.	15	3
4	Module IV: Recent Economic Trends Recent Economic Trends Economic Liberalization, Privatization and Globalization.	15	4

	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.		
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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 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.	15	4

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