Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	B030101T/MT136	**Title of the Course**	**Differential Calculus & Integral Calculus**	**L**	**T**	**P**	**C**
Year	**First**	**Semester**	First	4	0	0	4
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives		The purpose of this undergraduate course is to impart details and key knowledge of Differential Calculus & Integral Calculus. After successfully completion of course, the student will able to explore subject into their respective dimensions.					

	Course Outcomes
CO1	The students will be able to know about Indian Ancient Mathematics and Mathematicians. The students also will be able to know about sequences and their convergences/divergences.
CO2	The students will be able to define Limit, continuity and differentiability of function of single variable. Also, they will be able to prove some theorem e.g. Borel's theorem, boundedness theorem, Bolzano's theorem, Intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem, Rolle's theorem, Lagrange and Cauchy Mean value theorems, Leibnitz theorem, Maclaurin's and Taylor's series, Partial differentiation, Euler's theorem on homogeneous function.
CO3	The students will be able to find about Tangent and normals, Asymptotes, Curvature, Envelops and evolutes. They will be able o trace tracing of curves in Cartesian and Polar forms.
CO4	The students will be able to solve finite integrals as limit of the sum, Riemann integral, Fundamental theorem of integral calculus, Mean value theorems of integral calculus,. Also they will be able to find Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals.
CO5	The students will be able to solve/find Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes and related problems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Indian Ancient Mathematics and Mathematicians: Aryabhatt, Brahmagupt, Mahavir Acharya, Varahmihir, Bhaskaracharaya, Madhavan, Parmeshvaran, Baudhayana. Definition of a sequence, theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic test, de Morgan and Bertrand's tests, alternating series, Leibnitz's theorem, absolute and conditional convergence.	9	1
2		Limit, continuity and differentiability of function of single variable, Cauchy's definition, Heine's definition, equivalence of definition of Cauchy and Heine, Uniform continuity, Borel's theorem, boundedness theorem, Bolzano's theorem, Intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem for derivatives, Chain rule, indeterminate forms.	7	2
3		Rolle's theorem, Lagrange and Cauchy Mean value theorems, mean value theorems of higher order, Taylor's theorem with various forms of remainders, Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Partial differentiation, Euler's theorem on homogeneous function.	7	2
4		Tangent and normals, Asymptotes, Curvature, Envelops and evolutes, Tests for concavity and convexity, Points of inflexion, Multiple points, Parametric representation of curves and tracing of parametric curves, Tracing of curves in Cartesian and Polar forms.	7	3
5		Definite integrals as limit of the sum, Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration.	9	4
6		Improper integrals, their classification and convergence, Comparison test, μ-test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions.	7	4
7		Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals.	7	5
8		Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes and related problems.	7	5

Reference Books:

R.G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons

T.M. Apostal, Calculus Vol. I, John Wiley & Sons Inc.

S. Balachandra Rao & C. K. Shantha, Differential Calculus, New Age Publication.

H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc.,2002.

G.B. Thomas and R.L. Finney, Calculus, Pearson Education,2007.

Bhartiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

T.M. Apostal, Calculus Vol. II, John Wiley Publication

Shanti Narayan & Dr. P.K. Mittal, Integral Calculus, S.Chand

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						2	3	3	3	3	2
CO2	3						3	3	3	2	2	3
CO3	3						3	3	2	3	3	3
CO4	3						3	3	2	2	3	2
CO5	3						1	2	1	3	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	B030102P/MT137	Title of the Course	Practical Using Mathematica/MATLAB	L	T	P	C
Year	First	Semester	First	0	0	4	2
Pre-Requisite	10+2 with Mathematics	Co-requisite					
Course Objectives	The main objective of the course is to equip the student to plot the different graph and solve the different types of equations by plotting the graph using different computer software such as Mathematica /MATLAB /Maple /Scilab/Maxima etc.						

Course Outcomes	
CO1	The students will be able to plot the different graphs of the functions: ax, [x] , x^{2n} , $x = e^x$, $x^2 + 1 = e^x$, $1 - x^2 = e^x$, $x = \log 10(x)$, $\cos(x) = x$, $\sin(x) = x$, $\cos(y) = \cos(x)$, $\sin(y) = \sin(x)$ etc . Also they will be able to plot the graphs of polynomial of degree 2,3, 4 and 5, and their first and second derivatives and tracing of conic in Cartesian coordinates.
CO2	After completion of this course student would be able to know the convergence of sequences through plotting, verify Bolzano-Weierstrass theorem through plotting the sequence, Cauchy's root test by plotting n^{th} roots and Ratio test by plotting the ratio of nth and $(n + 1)^{th}$ term.
CO3	Student would be able to plot Complex numbers and their representations, Operations like addition, substraction, Multiplication, Division, Modulus and Graphical representation of polar form.
CO4	Student would be able to perform following task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigenvectors, Eigen values, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations.
CO5	The students will be able to know about study the convergence/divergence of infinite series by plotting their sequences of partial sum.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Plotting the graphs of the following functions: ax , [x] (greatest integer function) , x^{2n} ; n ∈ N, x^{2n-1} ; n ∈ N, n ∈ N, **; n ∈ N, , |ax + b|, c ± |ax + b|, sin (, xsin (,for, e^{ax+b}, log(ax + b) , ,** sin(ax + b), cos(ax + b) , |sin(ax + b)|, |cos(ax + b)|., Observe and discuss the effect of changes in the real constants **a** and **b** on the graphs	4	1
2		By plotting the graph find the solution of the equations $x = e^x$, $x^2 + 1 = e^x$, $1 - x^2 = e^x$, $x = \log 10(x)$, $\cos(x) = x$, $\sin(x) = x$, $\cos(y) = \cos(x)$, $\sin(y) = \sin(x)$ etc	4	1
3		Plotting the graphs of polynomial of degree 2,3, 4 and 5, and their first and second derivatives.	4	1
4		Sketching parametric curves, e.g., Trochoid, Cycloid, Epicycloid and Hypocycloid etc.	4	1
5		Tracing of conic in Cartesian coordinates.	4	1
6		Graph of circular and hyperbolic functions.	4	1
7		Obtaining surface of revolution of curves	4	1
8		Complex numbers and their representations, Operations like addition, Multiplication, Division, Modulus. Graphical representation of polar form.	4	3
9		Find numbers between two real numbers and plotting of finite and infinite subset of R.	4	3
10		Matrix Operations: Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigen vectors, Eigen values, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations.	4	4
11		Study the convergence of sequences through plotting.	4	5
12		Verify Bolzano-Weierstras's theorem through plotting of sequences and hence identify convergent subsequences from the plot.	4	2
13		Study the convergence/divergence of infinite series by plotting their sequences of partial sum.	4	5
14		Cauchy's root test by plotting n-th roots.	4	5
15		Ratio test by plotting the ratio of n-th and $(n + 1)$-th term.	4	5

Reference Books:

1. Suggested Readings: A Guide to MATLAB®: For Beginners and Experienced Users 3rd Edition, Kindle Edition by Brian R. Hunt

e-Learning Source:

Teaching Calculus with MATLAB - MATLAB & Simulink (mathworks.com)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						2	3	2	3	3	3
CO2	3						3	3	3	2	2	2
CO3	3						3	3	3	2	3	3
CO4	3						3	3	3	3	3	3
CO5	3						2	3	2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	MT143/ I030103V	**Title of the Course**	Introduction to LaTeX	**L**	**T**	**P**	**C**
Year	**First**	**Semester**	First	2	0	2	3
Pre-Requisite	Basic usage of a Windows PC or a Mac	**Co-requisite**					
Course Objectives	The course aims to teach the basic features. By attending the course students should acquire all necessary skills to be able to prepare a moderate scientific paper and a short mathematical presentation using LaTeX.						

Course Outcomes	
CO1	Introduction of LaTeX, Basic commands of LaTeX, understanding of different types of fonts.
CO2	Create sectional units, texts alignment, tiles, mini pages, foot notes, new paragraph.
CO3	Create and interpret the page layout, page style, running header, page numbering.
CO4	Find and interpret the listing texts, numbered listing, unnumbered listing, nesting, Tabbing texts.
CO5	Find and interpret the table environment, adjusting column width in tables, table wrapped by texts, footnotes in tables.
CO6	Find and interpret the command and environments of inserting simple figure, side by side figures, figures drawing.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	LaTeX, LaTeX input file, compilation, LaTeX syntax; commands, environment, packages, keyboard characters, Font selection; Text – mode fonts, Math – mode fonts, Emphasized fonts, coloured fonts.	9	1
2	Formatting Texts	Sectional units, labelling and referring numbered items, texts alignment, quoted texts, new lines and paragraph; filling blank spaces, preventing lines break, increasing depth of sectional units, titles, multiple columns, mini pages, foot notes, marginal notes.	7	2
3	Page Layout and Style	Page layout; standard page layout, formatting page layout, increasing the height of a page, page style, running header and footer, page breaking and adjustment, page numbering.	7	2
4	Listing and Tabbing Texts	Listing Texts; numbered listing, unnumbered listing, nesting, Tabbing texts; Adjusting column width, Adjusting alignment of column	7	3
5	Table Preparation	Table through tabular environment, tabular environment, vertical positioning, side ways texts, adjusting column width in tables, marging rows and columns, table wrapped by texts, table with colour background, nested tables, side by side tables, side ways table, long table, footnotes in tables.	9	5
6	Figure Insertion	Command and environments, inserting simple figure, side by side figures, sub – numbering a group of figures, figure wrapped by texts, rotated figures, mathematical notations in figures, figures in table, figures in multi – column documents, figures drawing; circle, circular arcs, straight lines, vector curves and oval boxes, texts in figures, compound figures.	7	6

Reference Books:

1. Stefen Kottwitz, LaTeX – Beginner's Guide, Packt Publishing, Birmingum (2011).

2. H. Kopka and P. W. Daly, A Guide to LaTeX, Addison Wesley Publishing.

3. Dilip Dutta: LaTeX in 24 Hours, Springer.

e-Learning Source:

1. https://www.overleaf.com/learn/latex/Free_online_introduction_to_LaTeX_(part_1)
2. https://spoken-tutorial.org/tutorial-search/?search_foss=LaTeX&search_language=English
3. https://swayam.gov.in/explorer?searchText=LaTeX

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						2	3	3	3	3	2
CO2	3						3	3	3	2	2	3
CO3	3						3	3	2	3	3	3
CO4	3						3	3	2	2	3	2
CO5	3						1	2	1	3	2	1
CO6	3						1	2	1	3	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	B030103T / MT158	**Title of the Course**	Trigonometry and Set theory	**L**	**T**	**P**	**C**
Year	First	**Semester**	First	**5**	**1**	**0**	**6**
Pre-Requisite		**Co-requisite**	None				
Course Objectives	The objective of the course is to develop the skills to apply the basic knowledge of trigonometry. The course will further develop understanding the Sets function and relations. Also they will understand cardinality of sets, ordering of the sets and lattices. After successfully completion of course, the student will able to explore subject knowledge into their respective dimensions.						

Course Outcomes	
CO1	Students will be able to understand the concepts of expiation of trigonometric functions.
CO2	Students will able to find and interpret Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, logarithmic function, Gregory's series, Summation of series
CO3	Students will be able to learn about sets, set operations and related topics. Also they will be able to understand relation and functions on sets.
CO4	Students will be able to understand equipotency of sets, ordering of set. They will also learn lattices.

Unit No.	Content of Unit	Contact Hrs.	Mapped CO
I	Expansions of $\cos^n \theta$, $\sin^n \theta$, $\cos^m \theta \sin^n \theta$, Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, Expansions of $\tan(\theta_1 + \theta_2 + \cdots + \theta_n)$, Expansions of $\sin x$, $\cos x$, $\tan x$ in terms of x.	11	1
II	Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, logarithmic function, Gregory's series, Summation of series.	11	2
III	Sets, subsets, Set operations, the laws of set theory and Venn diagrams Finite sets and counting principle. Empty set, properties of empty set, Standard set operations, Classes of sets, Power set of a set.	11	3
IV	Product set, Relations, Types of relations, Composition of relations, Partitions, Equivalence Relations with example of congruence modulo relation	11	3
V	Functions, Composition of Functions, One-to-One, Onto, and Invertible Functions, Mathematical Functions, Exponential and Logarithmic Functions, Recursively Defined Functions.	11	3
VI	Equipotent Sets, Denumerable and Countable Sets, Real Numbers and the Power of the Continuum, Cardinal Numbers, Ordering of Cardinal Numbers, Cardinal Arithmetic.	11	4
VII	Ordered Sets, Set Constructions and Order, Partially Ordered Sets and Hasse Diagrams, Minimal and Maximal Elements, First and Last Elements	12	4
VIII	Consistent Enumeration, Supremum and Infimum, Isomorphic (Similar) Ordered Sets, Order Types of Linearly Ordered Sets, Lattices, Bounded, Distributive, Complemented Lattices	12	4

Reference Books: Part-A
1. Trigonometry, T.K. Manickavachagam Pillay, Viswanathan, S., Printers & Publishers Pvt Ltd
2. Elements Of Set Theory, Herbert B. Enderton, ACADEMIC PRESS
3. Set Theory and related topics, Seymour Lipschutz, Schaum's series outlines, McGraw Hill Press
4. Mathematics-I, Z Khan, SA Khan, QSA, Anne Books Pvt. Ltd. India
4. Suggested digital platform: NPTEL/SWAYAM/MOOCS.

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	1	1	-	3	3	2	2	2	2
CO2	3	1	2	1	1	-	3	3	2	2	2	2
CO3	3	1	2	1	1	-	3	3	3	2	2	2
CO4	3	1	2	1	1	-	3	3	3	2	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Effective from Session:2024-25							
Course Code	HM101	Title of the Course	RASHTRA GAURAV	L	T	P	C
Year	I	Semester	I	2	0	0	0
Pre-Requisite	Intermediate (Any Stream)	Co-requisite	None				
Course Objectives	The objective of the course on "Rashtra Gaurav" is to explore and critically analyze the multifaceted dimensions of national pride and glory, as depicted in the paper. Participants will delve into the historical, cultural, social, and political aspects that contribute to the concept of "Rashtra Gaurav" (National Pride) in the context of the specific themes and perspectives presented in the paper. Through in-depth discussions, readings, and interactive sessions, participants will gain a comprehensive understanding of the factors that shape and define a nation's sense of pride, and how these factors influence individual and collective identities. The course aims to foster a nuanced appreciation for the significance of "Rashtra Gaurav" in contemporary society, encouraging participants to critically evaluate its implications and applications within diverse global contexts.						

Course Outcomes	
CO1	To understand the basics of Indian Society and culture.
CO2	To understand the literature, science and astrology.
CO3	To understand Indian heritage.
CO4	To examine the philosophical and spiritual developments in India.
CO5	To evaluate the contributions of Major National Characters and Personalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Indian Society & Culture	• Unity in Diversity: Cultural & Religious Harmony • Indian Diaspora • Ancient Indian Civilization. • National and International Awards & Awardees	05	01
2	Literature, Science, Astrology	• Indian Epics: Ramayan & Mahabharata • Prominent litterateur: Shudrak, Kalidas, Amir Khusru, • Kautilya's Arthashastra • Panini's Ashtadhyayi	05	02
3	Indian Heritage	• Cultural Heritage in India: Buddhist Monuments at Sanchi, Ajanta & Ellora Caves, Khajuraho, Taj Mahal • Tourist Places in India: Red Fort, Ambar Palace, Kaziranga National Park	04	03
4	Philosophical and Spiritual Developments	• Sufism & Bhakti Movement:Bulleh Shah, Data Ganj Baksh, Khwaja Moinuddin Chishti, and Nizamuddin Auliya.Tulsidas, Surdas, Meera, Nanak & Kabir • Jainism: Mahavir's Biography and Education • Buddhism: The life of Buddha, Contributions of Buddhism to India's Culture	05	04
5	Major National Characters And Personalities	• Ashoka the Great and His Dhamma • Raja Ram Mohan Roy& Brahmo Samaj • Swami Vivekanand and his philosophies • Mahatma Gandhi: Role of Gandhi in Indian National Movement • Dr. Bhimrao Ambedkar: A Chief architect of the Indian Constitution	06	05

Reference Books:

Jawaharlal Nehru - "The Discovery of India"
B.R. Ambedkar - "Annihilation of Caste"
Ramachandra Guha - "India After Gandhi: The History of the World's Largest Democracy"
Mahatma Gandhi – "My Experiment with Truth"
S C Dubey- "Indian Society"
Nadeem Hasnain –"Indian Society and Culture"
G Shah- "Social Movements in India"

Course Articulation Matrix: (Mapping of COs with POs and PSOs)									
PO-PSO CO	PO1	PO2	PO3	PO4	P05	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	3	2	2	3	2	1	2
CO2	3	2	2	3	1	2	3	1	2	1
CO3	1	2	2	2	2	3	2	3	3	2
CO4	1	3	2	3	2	3	2	3	1	3
CO5	2	3	1	2	2	3	1	3	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign and seal of HoD

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	B030201T/MT138	Title of the Course	Matrices and Differential Equations & Geometry	L	T	P	C
Year	First	Semester	First	6	0	0	6
Pre-Requisite	10+2 with Mathematics	Co-requisite					
Course Objectives	The purpose of this undergraduate course is to impart details and key knowledge of Matrices and Differential Equations & Geometry. After successfully completion of course, the student will able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	The students will be able to define types of Matrices, Rank of a Matrix, System of linear homogeneous and non-homogeneous equations, Theorems on consistency of a system of linear equations. Also, students will be able to find Eigen values, Eigen vectors , Cayley-Hamilton theorem, real and imaginary parts, Exponential and Logarithmic functions Inverse trigonometric and hyperbolic functions.
CO2	The student will be able to learn and visualize the fundamental ideas about formation of differential equations, Geometrical meaning of a differential equation
CO3	The students will be to learn and visualize first order higher degree equations solvable for x, y, p, Clairaut's equation and singular solutions, orthogonal trajectories, Linear differential equation of order greater than one with constant coefficients.
CO4	On successful completion of the course students have gained knowledge about to trace of conics, Confocal conics, Polar equation of conics and its properties, Three-Dimensional Coordinates system.
CO5	The student will be able to describe Sphere, Cone and Cylinder, Central conicoids, Paraboloids, lines, Confocal conicoids, Reduction of second degree equations.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Types of Matrices, Elementary operations on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, Inverse of a Matrix by elementary operations, System of linear homogeneous and non-homogeneous equations, Theorems on consistency of a system of linear equations.	12	1
2		Eigen values, Eigen vectors and characteristic equation of a matrix, Cayley-Hamilton theorem and its use in finding inverse of a matrix, Complex functions and separation into real and imaginary parts, Exponential and Logarithmic functions Inverse trigonometric and hyperbolic functions.	11	1
3		Formation of differential equations, Geometrical meaning of a differential equation, Equation of first order and first degree, Equation in which the variables are separable, Homogeneous equations, Exact differential equations and equations reducible to the exact form, Linear equations.	11	2
4		First order higher degree equations solvable for x, y, p, Clairaut's equation and singular solutions, orthogonal trajectories, Linear differential equation of order greater than one with constant coefficients, Cauchy- Euler form.	11	3
5		General equation of second degree, System of conics, Tracing of conics, Confocal conics, Polar equation of conics and its properties.	12	4
6		Three-Dimensional Coordinates, Projection and Direction Cosine, Plane (Cartesian and vector form), Straight line in three dimension (Cartesian and vector form).	11	4
7		Sphere, Cone and Cylinder.	11	5
8		Central conicoids, Paraboloids, Plane section of conicoids, Generating lines, Confocal conicoids, Reduction of second degree equations.	11	5

Reference Books:

1. Stephen H. Friedberg, A.J Insel & L.E. Spence, Linear Algebra, Person

2. B. Rai, D.P. Choudhary & H. J. Freedman, A Course in Differential Equations, Narosa

3. D.A. Murray, Introductory Course in Differential Equations, Orient Longman

4 Robert J.T Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd.

5. P.R. Vittal, Analytical Geometry 2d & 3D, Pearson.

6. S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company,London.

7. R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.

e-Learning Source:

Suggestive digital platforms web links/platform: NPTEL/SWAYAM/MOOCS

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						2	3	3	2	3	3
CO2	3						3	3	2	3	3	2
CO3	3						3	2	2	3	3	2
CO4	3						3	3	3	2	3	3
CO5	3						2	3	2	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2022-23								
Course Code	B060201T/ MT141	**Title of the Course**	Descriptive Statistics (Bivariate) & Probability Distributions	**L**	**T**	**P**	**C**
Year	**First**	**Semester**	Second	4	0	0	4
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives			The objective of this course is to develop an understanding of descriptive statistics and to introduce the basic elements of probability and probability distributions**.**				

	Course Outcomes
CO1	Knowledge of the method of least squares for curve fitting to theoretically describe experimental data with a function or equation and to find the parameters associated with the model.
CO2	Knowledge of the concepts of correlation and linear regression.
CO3	Knowledge of the concept of regression analysis and attributes
CO4	Knowledge of discrete distributions. Discuss appropriate distribution negative binomial, Poisson, etc. with their properties and application of discrete distribution models to solve problems.
CO5	Knowledge of continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1		Bivariate data, Principles of least squares, Most plausible values, Meaning of curve fitting, Fitting of straight line, parabola, logarithmic, power curves and other simple forms by method of least squares.	6	1
2		Bivariate frequency table, Correlation, Types of relationships, Scatter diagram, Karl-Pearson's Correlation Coefficient and its properties. Spearman's Rank correlation and its coefficient.	8	2
3		Regression analysis through both types of regression equations for X and Y variables, Regression coefficients and its properties, coefficient of determination.	8	3
4		Attributes: Notion and Terminology, Contingency table, Class frequencies and Ultimate class frequencies, Consistency, Association of Attributes, Independence, Measures of association for 2X2 table, Chi-square, Karl Pearson's Coefficient of Association.	8	3
5		Discrete Probability Distributions: Binomial distribution, Poisson distribution, Hyper-geometric, Geometric and Negative Binomial distributions, fitting of Binomial, Poisson distributions.	8	4
6		Continuous Probability Distributions: Normal distribution and its properties, Standard Normal variate, Normal distribution as limiting case of Binomial distribution, fitting of Normal distribution Exponential, Uniform, Gamma, Beta distributions.	8	4
7		Moments, Moment generating function (m.g.f) & their properties, Characteristic function, Uniqueness and inversion theorems (without proof) along with applications Continuity theorem for m.g.f. (without proof).	8	5
8		Chebyshev's inequality, Weak law of large numbers for a sequence of independently and identically distributed random variables and their applications (Statement Only). Order Statistics: Discrete & continuous joint and marginal distribution of order statistics, distribution of range, distribution of censored sample.	8	5

Reference Books:

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

2. Hanagal, D. D.: Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.

3. Miller, I. and Miller, M.: John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

4. Mood, A.M. Gray bill, F.A. and Boes, D.C.: Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.

5. Weather burn, C.E.: A First Course in Mathematical Statistics, the English Lang. Book Society and Cambridge Univ. Press.

6. Mukhopadhyay, P.: Mathematical Statistics, New Central Book Agency Pvt. Ltd.

7. Rohatgi, V.K. and Saleh, A.E.: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO / **CO**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						3	3	3	2	3	3
CO2	3						1	3	3	3	3	2
CO3	3						2	3	3	2	2	3
CO4	3						2	3	2	2	3	3
CO5	33						3	3	3	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2022-23								
Course Code	B060202P/ MT142	Title of the Course	Descriptive Data Analysis Lab (Bivariate)	L	T	P	C
Year	First	Semester	Second	0	0	4	2
Pre-Requisite	10+2 with Mathematics	Co-requisite					
Course Objectives			The objective of this course is to develop an understanding of basics of descriptive statistics and apply basic probability principles to solve real life problems.				

Course Outcomes	
CO1	Ability to deal with the problems based on fitting of curves by Method of least squares e.g., fitting of straight line, second degree polynomial, etc.
CO2	Ability to deal with problems based on determination of Correlation coefficient – grouped and ungrouped data.
CO3	Ability to deal with the problems based on determination of Rank correlation.
CO4	Ability to deal with problems based on determination of Regression lines.
CO5	Ability to fit Binomial and Poisson distribution for given data.

Experiment No.	Title of the Experiment	Content of Experiment	Contact Hrs.	Mapped CO
1		Problems based on fitting of curves by Method of least squares e.g. fitting of straight line. second degree polynomial, power curve, exponential curve etc.	4	2
2		Problems based on determination of Correlation coefficient of grouped data.	4	1
3		Problems based on determination of Correlation coefficient of ungrouped data.	4	2
4		Problems based on determination of Rank correlation.	4	3
5		Problems based on determination of Regression lines	4	2
6		Fitting of Binomial distribution.	4	3
7		Fitting of Poisson distribution.	4	4

Reference Books:

Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						3	3	3	3	3	2
CO2	3						2	3	2	2	3	3
CO3	3						3	3	3	3	3	2
CO4	3						3	3	3	2	3	2
CO5	3						3	3	3	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	MT144/ I030202V	**Title of the Course**	LaTeX – Scientific Writing	**L**	**T**	**P**	**C**
Year	**First**	**Semester**	Second	2	0	2	3
Pre-Requisite	Basic knowledge of LaTeX	**Co-requisite**					
Course Objectives	The course aims to teach the basic features. By attending the course students should acquire all necessary skills to be able to prepare a moderate scientific paper and a short mathematical presentation using LaTeX.						

Course Outcomes	
CO1	Create and interpret the mathematical notations, mathematical operators, mathematical expressions.
CO2	Create and interpret the bibliography, citing bibliographic, BIBTEX, natbib package.
CO3	Create and interpret the list of Contents and Index, rules, dots, hyperlinking, watermarking.
CO4	Create and interpret the letter writing, article preparation, preparation of book, report writing.
CO5	Create and interpret frames in presentation, presentation structure, environments in Beamer class.
CO6	Understand and interpret the Error messages, removal of errors, warning messages, tips for debugging

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Equation Writing	Basic mathematical notations and delimiters, mathematical operators, mathematical expressions, simple equations, equation numbering, array equations, left aligning, sub – numbering, texts and blank spaces, splitting an equation, vector and matrix, overlining and underlining, stacking terms, side by side equations.	9	1
2	Bibliography	Preparation of bibliography, citing bibliographic reference, bibliography with the BIBTEX program, BIBTEX compatible reference database, standard bibliography styles, natbib package, multiple bibliography.	7	2
3	List of Contents and Index	Lists of contents; Information to the list of contents, formatting list of contents, multiple list of contents, making index, rotated items, rules, dots, hyperlinking, current date and time, highlighted texts, verbatime, watermarking, logo in header and footer, paragraph in different forms.	7	2
4	Letter, Article, Books and Report	Letter writing, Article preparation, list of authors, title and abstract, left aligned title, article in multiple columns, section wise numbering, dividing an article, template of a book, preparation of book, dividing a book into parts, report writing.	8	3
5	Slide Preparation	Frames in presentation, sectional units, presentation structure; title page, appearance of a presentation, themes, frame customization, piece wise presentation, environments in Beamer class, table and figures, dividing frame column wise, repeating slides, jumping to other slides.	8	5
6	Error and Warning Messages	Error messages, removal of errors, warning messages, error without any message, tips for debugging, commonly generated errors, errors due to packages, errors in equation environment.	6	6

Reference Books:

1. Stefen Kottwitz, LaTeX – Beginner's Guide, Packt Publishing, Birmingum (2011).

2. H. Kopka and P. W. Daly, A Guide to LaTeX, Addison Wesley Publishing.

3. Dilip Dutta: LaTeX in 24 Hours, Springer.

e-Learning Source:

1. https://www.overleaf.com/learn/latex/Free_online_introduction_to_LaTeX_(part_1)
2. https://spoken-tutorial.org/tutorial-search/?search_foss=LaTeX&search_language=English
3. https://swayam.gov.in/explorer?searchText=LaTeX

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3						2	3	3	3	3	2
CO2	3						3	3	3	2	2	3
CO3	3						3	3	2	3	3	3
CO4	3						3	3	2	2	3	2
CO5	3						1	2	1	3	2	1
CO6	3						1	2	1	3	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023 - 24

Course Code	B060203T / MT153	Title of the Course	Applications of Artificial Intelligence for Mathematical Sciences	L	T	P	C
Year	First	Semester	Second	2	0	0	0
Pre-Requisite	10+2 with Mathematics	Co-requisite					
Course Objectives			This curriculum aims to equip mathematical sciences graduate students with the mathematical foundations necessary to understand and contribute to the rapidly evolving field of artificial intelligence.				

Course Outcomes	
CO1	Understanding of History and evolution of AI
CO2	Students will be able to understand machine learning basics.
CO3	Understanding of some concepts for studying machine learning and AI.
CO4	Students will be able to understand optimization and differential equations in contexts of AI. Time series analysis and Forecasting with AI

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to artificial intelligence & Problem solving through AI	History and evolution of AI, comparison of human and computer skill, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. Defining problem as a state space search, analyzing the problem, solving problem by searching, informed search and Uninformed Search	8	1
2	Machine Learning Basics & Natural Language Processing	Neural networks and deep learning, Supervised and unsupervised learning, feature selection and engineering, learning from observation, knowledge in learning. Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system.	7	2
3	Foundations of AI/ML for Mathematicians	Introduction to artificial intelligence and its mathematical underpinnings, overview of neural networks and deep learning, Mathematical principles behind machine learning algorithms, Statistical Learning, and Inference: Statistical concepts in machine learning, Inference, and hypothesis testing in the contexts of AI.	7	3
4	Optimization Techniques in AI	Mathematical Optimization for machine learning, convex optimization and its applications, Algebraic Structures in AI: Linear Algebra for machine learning, Group theory and its relevance in AI, Differential Equations in AI, Applications of differential equations in machine learning. Time series analysis and Forecasting with AI: Time series modeling using machine learning.	8	4

Reference Books:

1. S. Russel, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson India.

2. N. K. Vishnoi, Algorithms for Convex Optimization, Cambridge University Press.

e-Learning Source:

https://www.youtube.com/watch?v=JMUxmLyrhSk

https://www.youtube.com/watch?v=fpL5fMmJHqk

https://www.youtube.com/watch?v=JO9jNe6BemE&list=PLLy_2iUCG87D1CXFxE-SxCFZUiJzQ3IvE

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	2	1	3	2	2	1	2	2
CO2	2	1	2	1	2	1	3	2	2	1	2	2
CO3	3	2	2	1	2	2	3	2	3	3	2	2
CO4	3	2	2	1	2	2	3	2	3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD

Integral University, Lucknow

Effective from Session: 2024-25								
Course Code	B030202T / MT159	**Title of the Course**	Vector Analysis and Vector Calculus	**L**	**T**	**P**	**C**	
Year	First	**Semester**	Second					
Pre-Requisite		**Co-requisite**	None	**5**	**1**	**0**	**6**	

Course Objectives	The objective of the course is to develop the skills to gain the basic knowledge of vector analysis and vector calculus. The course will further develop the understanding of differentiation and integration of vector functions, along with different coordinate systems. After successful completion of course, the student will be able to explore subject knowledge into their respective dimensions.

Course Outcomes	
CO1	Students will be able to understand the concepts of scalar and vector quantities along with the operations on them. They will also be able to understand and apply the differentiation on vector functions.
CO2	Students will gain the knowledge of gradient, divergence and curl along with vector integration.
CO3	Students will be able to understand the concepts of curvilinear coordinates and its application.
CO4	Students will gain the knowledge of different coordinate systems and their conversions.

Unit No.	Content of Unit	Contact Hrs.	Mapped CO
I	**Vectors and Scalars:** Vectors. Scalars. Vector algebra. Laws of vector algebra. Unit vectors. Rectangular unit vectors. Components of a vector. Scalar fields. Vector fields.	11	1
II	**Dot and Cross Product:** Dot or scalar products. Cross or vector products. Triple products. Reciprocal sets of vectors. Product of four vectors.	11	1
III	**Vector Differentiation:** Ordinary derivatives of vectors. Space curves. Continuity and differentiability. Differentiation formulas. Partial derivatives of vectors Differentials of vectors.	11	1
IV	**Gradient, Divergence and Curl:** Vector differential operator del. Gradient, Divergence, Curl and their properties.	11	2
V	**Vector Integration**: Ordinary integrals of vectors. Line integrals. Surface integrals. Volume integrals.	11	2
VI	**Theorems on Vector Integrations**: The divergence theorem of Gauss. Stokes' theorem. Green's theorem in the plane.	11	2
VII	**Curvilinear Coordinates**: Transformation of coordinates. Orthogonal curvilinear coordinates. Unit vectors in curvilinear systems. Arc length and volume elements.	12	3
VIII	**Cylindrical, Spherical and Elliptic Coordinates:** Cylindrical coordinates. Spherical coordinates. Parabolic cylindrical coordinates. Paraboloidal coordinates. Elliptic cylindrical coordinates.	12	4

Reference Books:

1. Schaum's Outline of Vector Analysis, 2ed, Murray R. Spiegel, Seymour Lipschutz

2. A Text Book Of Vector Analysis : Narayan Shanti, Mittal P.K., S. Chand Publications, New Delhi

3. Vector Analysis: Vector Algebra & Vector Calculus, J. G. Chakravorty and P. R. Ghosh, U. N. Dhur & Sons Pvt. Ltd.

4. Vector Calculus, Paul C. Matthews, Springer Science & Business Media

5. Suggested digital plateform:NPTEL/SWAYAM/MOOCs

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	3	3	2	3	3
CO2	3	1	2	2	2	3	1	1	2
CO3	2	1	1	1	2	1	2	1	1
CO4	2	2	1	1	2	2	1	1	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**