(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (6)

Course Code	US06MAMTH01	Title of the Course	Real Analysis-2
Total Credits of the Course	4	Hours per Week	4 hours

Course Objectives:	1. To introduce fundamentals of Limit, Continuity and Differentiability of functions of one variable. 2. To understand important theorems and series expansion of functions. 3. To introduce various classes of elementary functions. 4. To introduce point wise convergence of sequence and series of functions.

Course Content		
Unit	Description	Weightage* (%)
1.	Limit and Continuity for Functions of one Variable, Uniqueness of Limit, Algebra of Limits, Continuous Functions on Closed and Bounded Intervals, Uniform Continuity, Derivability of a Function, Properties of Derivable Functions.	25%
2.	Increasing and Decreasing Functions, Darboux Theorem, Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorem, Taylor's Theorem with Lagrange's Form of Remainder and Cauchy's Form of Remainder, Maclaurin's Theorem, Generalised Mean Value Theorem, Taylor's and Maclaurin's Series Expansions of Exponential and Trigonometric Functions, $\ln(1+x)$ and $(1+x)^m$.	25%
3.	Elementary Functions: Exponential Functions, Logarithmic Functions, Generalized Power Functions, Trigonometric Functions, Inverse Trigonometric Functions.	25%
4	Pointwise Convergence, Uniform Convergence on an Interval, Tests for Uniform Convergence, Properties of Uniformly Convergent Sequences and Series, The Weierstrass Approximation Theorem.	25%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use ofICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	understand fundamentals of limit, continuity and differentiability of real-valued functions of real variables.
2.	understand Mean Value theorem and Taylor's theorem for series expansion of functions and their applications.
3.	understand various classes of elementary functions, their expansions and properties.
4.	understand pointwise and uniform convergence of sequence and series of functions and various tests for convergence.

Suggested References:	
Sr. No.	References
1.	S. C. Malik, Principles of Real Analysis, Fifth Edition, New Age International, New Delhi, 2021.
2.	S. C. Malik and Savita Arora, Mathematical Analysis, Fifth Edition, New Age International Pvt. Ltd., New Delhi, 2019.
3.	R. G. Bartle, D. R. Sherbert, Introduction to Real Analysis, Fourth Edition, Wiley India Pvt. Ltd., New Delhi, 2011.
4.	S. R. Ghorpade and B. V. Limaye, A course in Calculus and Real Analysis, Springer, 2006.
5.	Dipak Chatterjee, Real Analysis, Second Edition Prentice-Hall India Pvt. Ltd., New Delhi, 2012.

On-line resources to be used if available as reference material

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (6)

Course Code	US06MAMTH02	Title of the Course	Linear Algebra
Total Credits of the Course	4	Hours per Week	4 hours

Course Objectives:	1. To understand the concepts of vector spaces, subspaces, bases, dimension and their properties. 2. To study linear transformation and representation of linear transformation by matrices. 3. To learn properties of inner product spaces and to determine the orthogonality in inner product spaces.

Course Content		
Unit	Description	Weightage* (%)
1.	Vector Spaces, Subspaces, Linear Combination, Span, Linear Dependence, Independence, Bases and Dimension for Vector Space and its Examples.	25%
2.	Linear Transformation and its Examples, Kernel and Range of Linear Transformation, Nullity, Rank, Rank-nullity Theorem for Linear Transformation, Non-singular....., Composition of Linear Transformation and its Examples.	25%
3.	Matrices, Matrix associated with a Linear Map, Linear Map associated with a Matrix, Rank, Nullity, Dimension Theorem for Matrix and its Examples.	25%
4	Inner Product Spaces and its Properties, Orthogonal Set, Orthonormal Set, Gram Schmidt Theorem and its Examples.	25%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	recognize and make a use of basic properties of vector spaces, subspaces and determine a basis and the dimension of a finite-dimensional space.
2.	compute linear transformations, kernel and range, inverse linear transformations and to find matrices of general linear transformations.
3.	create orthogonal and orthonormal bases by Gram-Schmidt process.

Suggested References:	
Sr. No.	References
1.	V. Krishnamurthy, V. P. Mainra, J. L. Arora, An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi, 2013.
2.	N. S. Gopalkrishnan, University Algebra, 2nd Edition, New Age International Publisher, 2016.
3.	I. N. Herstein, Topics in Algebra, 2nd Edition, Wiley Eastern Ltd., New Delhi, 1975.
4.	S. Kumaresan, Linear Algebra-A Geometric Approach, Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
5.	A. Ramchandra Rao, P. Bhimashankaram, Linear Algebra, 2nd Edition, Tata McGraw-Hill, New Delhi,1992.

On-line resources to be used if available as reference material

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (6)

Course Code	US06MAMTH03	Title of the Course	Mathematical Algorithms with Python-2
Total Credits of the Course	4	Hours per Week	08 hours

Course Objectives:	1. To provide basic knowledge of some machine libraries that are used in Data Science, Machine learning and Artificial intelligent. 2. To develop skills in creating, manipulation and performing operations on arrays and matrices. 3. To equip students with the ability to visualize mathematical data and functions using Matplotlib.

Course Content		
PAYTHON		
Parts	**Parts**	**Parts**
Part-1	**Python: Numpy library** Introduction to python libraries, introduction and importance of Numpy library, creating array, editing array, different array operations, matrices and its operations, eigenvalues and eigenvectors using Numpy library.	100% (50 Marks)
Part-2	**Python: Matplotlib library** Introduction to matplotlib, graph titles, axes labels, legends, Line and Bar graphs, Pie and Polar graphs, plotting well-known graphs like, cartesian, trigonometric, parametric, etc	100% (50 Marks)

Teaching-Learning Methodology	Classroom teaching, Practical on Computers, Use of ICT whenever required.

Evaluation Pattern (In Each Part)		
Sr. No.	Details of the Evaluation	Weightage%
1.	Internal Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce,	25%

	Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	
3.	University Practical Examination	50%

NOTE:

1. There would be a batch of problem solving session will be of four hours per week and they will be conducted in batches of students of size 15 to 20 per batch.
2. The candidate shall have to produce at the time practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

Course Outcomes: Having completed this course, the learner will be able to	
1.	compute eigenvalues, eigenvectors and many other problems of linear algebra using NumPy library.
2.	visualise important mathematical and statistical data by different types of graphs.
3.	create and customize plots, including cartesian, trigonometric and parametric graphs.

Suggested References:	
Sr. No.	Suggested References:
1.	https://www.py4e.com/book
2.	Python: The Complete Reference, by Martin C. Brown , McGraw Hill Education
3.	https://numpy.org/learn/#beginners
4.	https://matplotlib.org/stable/tutorials/index
On-line resources to be used as reference material	

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (6)

Course Code	US06MIMTH01	Title of the Course	Numerical Analysis-2
Total Credits of the Course	2	Hours per Week	2 hours

Course Objectives:	1. To introduce students Numerical Analysis and to apply wherever it can be useful. 2. To teach students various Numerical Methods for solving differential equations. 3. To teach students how to use Numerical Methods for solving certain problems in Calculus.

Course Content		
Unit	Description	Weightage* (%)
1.	Interpolation with Unequally spaced Points, Lagrange's Interpolation Formula (Without proof), Divided Difference and Their Properties, Newton's General Interpolation Formula, Interpolation by Iteration, Inverse Interpolation, Method of Successive Approximations, Numerical Differentiation: Newton's Forward and Backward Method, Gauss's Method, Maximum and Minimum Values of Tabulated Value.	50%
2.	Numerical Integration: Trapezoidal Rule, Simpson's $\left(\frac{1}{3}\right)^{rd}$ and $\left(\frac{3}{8}\right)^{th}$ Rules, Numerical Solution of Ordinary Differential Equation by Taylor's series, Picard's Method, Euler's Method, Modified Euler's Method, Range-Kutta Method.	50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%

3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand various methods for approximating roots of equations.
2.	interpolate through a given set of data and to find an approximating value of the function.
3.	find numerical solution of differential equations and approximate integrals.

Suggested References:	
Sr. No.	References
1.	S. S. Sastry, Introductory methods of Numerical Analysis, 4th Ed., Prentice hall of india, 2010. Chapter : 3(3.9.1, 3.10, 3.11), 5(5.1, 5.2, 5.3, 5.4.1, 5.4.2, 5.4.3, 5.4.6), 7(7.1 to 7.5)
2.	G. Sankar Rao, Numerical Analysis
3.	B. S. Grewal, Numerical Analysis, Khanna Publiication.
4.	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New Age Int. Publisher, India 2007

On-line resources to be used if available as reference material

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (6)

Course Code	US06MIMTH02	Title of the Course	Problems and Exercises in Numerical Analysis-2
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To develop problem solving skills of students through interactive teaching and supervised practice. 2. To teach students various methods of solving and applying results of Numerical Analysis.

Course Content

(NUMERICAL ANALYSIS)

Unit	Description	Weightage* (%)
1.	Interpolation with Unequally spaced Points, Lagrange's Interpolation Formula, Divided Difference and Their Properties, Newton's General Interpolation Formula.	10%
2.	Interpolation by Iteration, Inverse Interpolation, Method of Successive Approximations	10%
3.	Numerical Differentiation: Newton's Forward and Backward Method, Gauss's Method, Maximum and Minimum Values of Tabulated Value.	10%
4.	Numerical Integration: Trapezoidal Rule, Simpson's $\left(\frac{1}{3}\right)^{rd}$ and $\left(\frac{3}{8}\right)^{th}$ Rules,	10%
5.	Numerical Solution of Ordinary Differential Equation by Taylor's series, Picard's Method, Euler's Method, Modified Euler's Method, Range-Kutta Method.	10%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Practical Examination	50%

NOTE:

1. There shall be a batch of problem solving session of four hours per week and they will be conducted in batches of students of size 15 to 20 per batch.
2. The candidate shall have to produce at the time practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Interpolate a given set of data to find an interpolating function.
2.	Numerically approximate Derivatives and Integrals
3.	Apply knowledge of Numerical Analysis to solve certain problems.

Suggested References:	
Sr. No.	References
1.	S. S. Sastry, Introductory methods of Numerical analysis,4th Ed., Prentice hall of India,2010.
2.	G. Sankar Rao, Numerical analysis.
3.	B. S. Grewal, Numerical Analysis, Khanna Publication.
4.	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New Age International Publisher, India 2007.

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (6)

Course Code	US06MIMTH03	Title of the Course	Ordinary Differential Equations-2
Total Credits of the Course	2	Hours per Week	2 hours

Course Objectives:	1. To teach Laplace Transform and their properties. 2. To apply Ordinary Differential Equations in real life problem.

Course Content		
Unit	Description	Weightage* (%)
1.	Laplace Transform, Properties of Laplace Transform, Laplace Transform of Derivatives, Laplace Transform of Integrals, Inverse Laplace Transforms, and Properties of Inverse Laplace Transforms, Solution of ODE with Constant Coefficients, Solution of ODE with Variable Coefficients.	50%
2.	Application of Differential Equations: Newton's law of cooling, Rate of growth or decay, Chemical solution, Motion of particle falling under gravity, Electric Circuits, Orthogonal Trajectories.	50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use ofICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	to learn Laplace Transforms and their properties.
2.	apply the knowledge of Ordinary Differential Equations in real life problems.

Suggested References:	
Sr. No.	References
1.	B. S. Grewal, Higher Engineering Mathematics, 35th Edition, Khanna Publications. Chapter 21.
2.	Nita Shah, Ordinary and Partial Differential Equations – Theory and Applications, PHI Learning Pvt. Ltd., New Delhi Chapter: 16 (Except 16.10,16.11)
3.	Zafar Ahsan, Differential Equations and Their Applications, 2nd Ed., Prentice – Hall of India Pvt. Ltd., New Delhi
4.	D J Karia, N Y Patel, B P Patel, M L Patel, Introduction to calculus and differential equations, Roopal Prakashan.

On-line resources to be used if available as reference material

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (6)

Course Code	US06MIMTH04	Title of the Course	Problems and Exercises in Ordinary Differential Equations-2
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To develop problem solving skills of students through interactive teaching and supervised practice. 2. To teach students various methods of solving and applying results of Ordinary Differential Equations.

Course Content		
ORDINARY DIFFERENTIAL EQUATIONS		
Unit	Description	Weightage* (%)
1.	Laplace Transform, Properties of Laplace Transform	10%
2.	Laplace Transform of Derivatives, Laplace Transform of Integrals, Inverse Laplace Transforms, Properties of Inverse Laplace Transforms	10%
3.	Solution of ODE with Constant Coefficients, Solution of ODE with Variable Coefficients	10%
4.	Application of Differential Equations	10%
5.	Orthogonal Trajectories in Cartesian Co-ordinates	10%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%

2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Practical Examination	50%

NOTE:

1. There shall be a batch of problem solving session of four hours per week and they will be conducted in batches of students of size 15 to 20 per batch.
2. The candidate shall have to produce at the time practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

Course Outcomes: Having completed this course, the learner will be able to	
1.	identify and categorize an Ordinary Differential Equations.
2.	solve Ordinary Differential Equations.
3.	apply knowledge of Ordinary Differential Equation to solve certain problems.

Suggested References:	
Sr. No.	References
1.	Shanti Narayan, Integral Calculus, 14th Edition, S. Chand & Company Ltd., New Delhi, 1996
2.	Zafar Ahsan, Differential Equations and Their Applications, 2nd Ed., Prentice – Hall of India Pvt. Ltd., New Delhi
3.	B. S. Grewal, Higher Engineering Mathematics, 35th Edition, Khanna Publications
4.	D J Karia, N Y Patel, B P Patel, M L Patel, Introduction to calculus and differential equations, Roopal Prakashan.

On-line resources to be used if available as reference material

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (6)

Course Code	US06MIMTH05	Title of the Course	Partial Differential Equations-2
Total Credits of the Course	2	Hours per Week	2 hours

Course Objectives:	1. To teach Partial Differential Equations in more depth. 2. To make practice of solving Partial Differential Equations. 3. To teach Applications of Various results of Partial Differential Equations.

Course Content

Unit	Description	Weightage* (%)
1.	Non-linear Partial Differential Equations of First Order, Compatible System of First Order Equations, Charpit's Method, Special Types of First Order Equations, Solutions Satisfying Given Conditions.	50%
2.	Applications of First Order Equations, The Origin of Second Order Equations, Linear Partial Differential Equations with Constant Coefficients, Equations with Variable Coefficients, Solution of Equation by Separation of Variable.	50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand Different Methods of Solving Partial Differential Equations.
2.	understand and apply these solving techniques of Partial Differential Equations to the real-world problems.

Suggested References:

I. Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, International Student Edition. Chapter 2 (2.7, 2.9, 2.10, 2.11, 2.12, 2.14), Chapter 3 (3.1, 3.4, 3.5, 3.9)

Sr. No.	References
1.	Shanti Narayan, Integral Calculus, 14th Edition, S. Chand & Company Ltd., New Delhi, 1996
2.	Nita Shah, Ordinary and Partial Differential Equations – Theory and Applications, PHI Learning Pvt. Ltd., New Delhi.
3.	Zafar Ahsan, Differential Equations and Their Applications, 2nd Ed., Prentice – Hall of India Pvt. Ltd., New Delhi
4.	M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Ltd., New Delhi.

On-line resources to be used if available as reference material

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (6)

Course Code	US06MIMTH06	Title of the Course	Problems and Exercises in Partial Differential Equations-2
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To develop problem solving skills of students through interactive teaching and supervised practice. 2. To teach students various methods of solving and applying results of Partial Differential Equations.

Course Content

PARTIAL DIFFERENTIAL EQUATIONS

Unit	Description	Weightage* (%)
1.	Non-linear Partial Differential Equations of First Order , Compatible Systems of First Order Equations	10%
2.	Finding solutions using Charpit's Method.	10%
3.	Special Types of First Order Equations , Solutions Satisfying Given Conditions	10%
4.	Applications of First Order Equations , The Origin of Second Order Equations.	10%
5.	Linear Partial Differential Equations with Constant Coefficients, Equations with Variable Coefficients, Solution of Equation by Separation of Variable.	10%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%

2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Practical Examination	50%

NOTE:

1. There shall be a batch of problem solving session of eight hours per week and they will be conducted in batches of students of size 15 to 20 per batch.
2. The candidate shall have to produce at the time practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

Course Outcomes: Having completed this course, the learner will be able to	
1.	identify and categorize Partial Differential Equations.
2.	solve Partial Differential Equations.
3.	apply knowledge of Partial Differential Equations to solve certain problems.

Sr. No.	Suggested References:
1.	I. Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, International Student Edition .
2.	Shanti Narayan, Integral Calculus, Fourteenth Edition, S. Chand & Company Ltd., New Delhi, 1996
3.	M. D. Raisinghania, Ordinary and Partial differential equations, S. Chand & Company Ltd., New Delhi.
4.	Nita Shah, Ordinary and Partial Differential Equations - Theory and Applications , PHI Learning Pvt. Ltd. , New Delhi
5.	Zafar Ahsan, Differential Equations and Their Applications, Prentice - Hall of India Pvt. Ltd., New Delhi.

On-line resources to be used if available as reference material

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(Bachelor of Science)(Mathematics)
(B.Sc.)(Mathematics)Semester (6)

Note: The students who have studied US05MIMTH05 in Semester-5 cannot take this course.

Course Code	US06MIMTH07	Title of the Course	Partial Differential Equations-1
Total Credits of the Course	2	Hours per Week	2 hours

Course Objectives:	1. To teach Partial Differential Equations in more depth. 2. To make practice of solving Partial Differential Equations.

Course Content		
Unit	Description	Weightage* (%)
1.	Surfaces and Curves in Three Dimensions, Methods of solving $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Orthogonal Trajectories of a System of Curves on Surface, Pfaffian Forms and Equations, Solution of Pfaffian Differential Equations in Three Variables.	50%
2.	Partial Differential Equations, Origin of First Order Partial Differential Equations, Linear Equations of First Order, Integral Surfaces Through a Given Curve, Surfaces Orthogonal to a Given System of Surfaces.	50%

Teaching- Learning Methodology	Class room teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand Different Methods of Solving Partial Differential Equations.
2.	Understand the concepts so that they can apply to the applications of the Partial Differential Equations.

Suggested References:

I. Sneddon, Elements of Partial Differential Equations, Mc Graw Hill Book Company, International Student Edition. Chapter 1 (1.1, 1.3, 1.4, 1.5(excluding Thm.6), 1.6), Chapter2 (2.1,2.2, 2.4(Thm.3without proof),2.5, 2.6)

Sr. No.	References
1.	I. Sneddon, Elements of Partial Differential Equations, Mc Graw Hill Book Company, International Student Edition.
2.	M.D. Raisinghania, Ordinary and Partial Differential Equations, 20th edition, S. Chand & Company Ltd., New Delhi, 2024.
3.	Zafar Ahsan, Differential Equations and Their Applications, 2ndEd., Prentice – Hall of India Pvt. Ltd., New Delhi, 2006.
4.	Shanti Narayan, Integral Calculus, 35th Edition, S. Chand & Comp any Ltd., New Delhi.
5.	Nita Shah, Ordinary and Partial Differential Equations–Theory and Applications, PHI Learning Pvt. Ltd., New Delhi.

On-line resources: https://nptel.ac.in/courses/111107111

Ordinary and Partial Differential Equations and Applications, IIT Roorkee

Prof. P.N. Agrawal Prof. D. N Pandey

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(Bachelor of Science)(Mathematics)
(B.Sc.)(Mathematics)Semester (6)

Note: The students who have studied US05MIMTH06 in Semester-5 cannot take this course.

Course Code	US06MIMTH08	Title of the Course	Problems and Exercises in Partial Differential Equations-1
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To develop problem solving skills of students through interactive teaching and supervised practice. 2. To teach students various methods of solving and applying results of Partial Differential Equations.

Course Content

PARTIAL DIFFERENTIAL EQUATIONS-1

Unit	Description	Weightage* (%)
1.	Surfaces and Curves in Three Dimensions, Methods of solving $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.	10%
2.	Orthogonal Trajectories of a system of curves on Surface	10%
3.	Pfaffian Forms and Equations, Solution of Pfaffian Differential Equations in Three Variables.	10%
4.	Partial Differential Equations, Origin of First Order Partial Differential Equations, Linear Equations of the First Order	10%
5.	Integral Surfaces Through Given Curve, Surfaces Orthogonal to a Given System of Surfaces.	10%

Teaching- Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Practical Examination	50%

NOTE:

1. There would be a batch of problem-solving session will be of eight hours per week and they will be conducted in batches of students of size 15 to 20 per batch.
2. The candidate shall have to produce at the time practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Identify and categorize Partial Differential Equations.
2.	Solve Partial Differential Equations.
3.	Apply knowledge of Partial Differential Equations to solve certain problems.

Sr. No.	Suggested References:
1.	I. Sneddon, Elements of Partial Differential Equations, Mc Graw Hill Book Company, International Student Edition.
2.	M. D. Raisinghania, Ordinary and Partial Differential Equations, 20th edition, S. Chand & Company Ltd., New Delhi, 2024.
3.	Zafar Ahsan, Differential Equations and Their Applications, 2ndEd., Prentice – Hall of India Pvt. Ltd., New Delhi, 2006.
4.	Shanti Narayan, Integral Calculus, 35th Edition, S. Chand & Comp any Ltd., New Delhi.
5.	Nita Shah, Ordinary and Partial Differential Equations–Theory and Applications, PHI Learning Pvt. Ltd., New Delhi.

On-line resources: https://nptel.ac.in/courses/111107111

Ordinary and Partial Differential Equations and Applications, IIT Roorkee

Prof. P.N. Agrawal Prof. D. N Pandey

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (6)

Course Code	US06AEMTH01	Title of the Course	Python Language (Practical)
Total Credits of the Course	2	Hours per Week	02 hours

Course Objectives:	1. To provide basic knowledge of some libraries that are used in Data Science, Machine learning and Artificial intelligent. 2. To develop skills in creating, manipulation and performing operations on arrays and matrices. 3. To equip students with the ability to visualize mathematical data and functions using Pandas Library..

Course Content	
PYTHON (Mathematical Language)	
Python: Pandas Library Introduction and importance of Pandas library, Read and write tabular data, Creating Data frames, Manipulating Data frames, Reading tables, Reshape and Combine data from multiples tables, Create plots in Pandas.	100% (25 Marks)

Teaching-Learning Methodology	Classroom teaching, Practical on Computers, Use of ICT whenever required.

Evaluation Pattern (In Each Part)		
Sr. No.	Details of the Evaluation	Weightage%
1.	Internal Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Practical Examination	50%

NOTE:

1. There would be a batch of problem solving session will be of two hours per week and they will be conducted in batches of students of size 15 to 20 per batch.
2. The candidate shall have to produce at the time practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

Course Outcomes: Having completed this course, the learner will be able to	
1.	use Python – Pandas Library for mathematical data types to plot/draw graph.
2.	learn some primary codes using Pandas Library which can be used in data science, machine learning and Artificial Intelligence.
3.	get benefits in different competitive examinations of Mathematics.

Suggested References:	
Sr. No.	Suggested References:
1.	https://www.py4e.com/book
2.	Python: The Complete Reference, by Martin C. Brown , McGraw Hill Education
3.	https://panda.org/learn/#beginners

On-line resources to be used if available as reference material
On-line Resources: NPTEL/Swayam

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