(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (7)

Course Code	US07HMAMTH01	Title of the Course	Complex Analysis
Total Credits of the Course	4	Hours per Week	4 hours

Course Objectives:	1. To introduce fundamental and detailed knowledge of complex functions. 2. To study the techniques of complex variables and functions together with their continuity and differentiability. 3. To explain different transformations with examples.

Course Content		
Unit	Description	Weightage* (%)
1.	Complex functions: Exponential, Trigonometric, Hyperbolic and Logarithmic functions, Limit of complex functions, Continuity of complex functions, Chain rule and Differentiability of complex functions.	25%
2.	Cauchy-Riemann equations, Connections between C-R equations and Differentiability of complex functions, Sufficient conditions for differentiability, Analytic functions, Harmonic functions, Harmonic conjugate.	25%
3.	Properties of exponential, trigonometric and logarithmic functions, Derivatives of exponential, trigonometric and logarithmic functions, Inverse trigonometric functions and hyperbolic functions.	25%
4	Linear transformations, Bilinear transformation, Fixed points of bilinear transformation, The transformations $w = \frac{1}{z}, sinz, e^z$.	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.	Apply the basic knowledge of Complex Analysis in their future courses in Advanced Complex Analysis, Differential equations, Functional analysis, etc.
2.	Analyze the limit, continuity and differentiability of a function of Complex variables and understand Conformal Mapping.
3.	Knowing complex analysis, students can understand many topics in signal processing and control theory.

Suggested References:	
Sr. No.	References
1.	Brown, J. W., and Churchill, R. V. Complex Variables and Applications, Ninth Edition, McGraw-Hill Book Company, 2013.
2.	Conway J. B., Functions of One Complex Variable, Second Edition Narosa publ. House, New Delhi, 1996.
3.	Joseph B. and Donald J. N., Complex Analysis: Undergraduate texts in Mathematics, Third Edition, Springer-Verlag, New York, Inc., New York, 2010.

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

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (7)

Course Code	US07HMAMTH02	Title of the Course	Real Analysis-3
Total Credits of the Course	4	Hours per Week	4 hours

Course Objectives:	1. To introduce students to Riemann Integral and various classes of integrable functions. 2. To introduce fundamentals of Limit, Continuity, and Differentiability of functions of one variable. 3. To introduce the function of severable variables to find limit, continuity and differentiability. 4. To find extreme values of functions of two variables.

Course Content		
Unit	Description	Weightage* (%)
1.	Riemann Integrals: Definitions and Existance, Inequalities for Integrals, Refinement of Partitions, Darboux's Theorem for Integrals, Conditions for Integrability, Integrability of the Sum, Difference, Product, Quotient and Modulus functions.	25%
2.	Integral as the limit of sums (Riemann Sums), Some Integrable functions, Integration and Differentiation, The Premitive, The Fundamental Theorem of Integral Calculus, Mean Value Theorems of Integral and Second Mean Value Theorem.	25%
3.	Functions of Severable Variables: Expicit and Impicit Functions, Neighbourhood of a Point, Limit and Continuity, Partial Derivatives, Differentiability, Partial Derivatives of higher order, Differentials of Higher Order, Functions of Function.	25%
4	Change of variables, Taylor's Theorem and Maclaurin's Theorem for Functions of two variables, Extreme Values of Functions of two variables.	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.	understand Riemann Integral and various conditions for the integrability of a function.
2.	understand Riemann Integral as the limit of sum, the Fundamental Theorem of Integral Calculus and Mean Value Theorems.
3.	understand the limit, continuity and partial differentiability of functions of two variables and their respective properties.
4.	Understand important theorems: Mean Value Theorems and Taylor's theorem for series expansion of functions and their applications.

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 (7)

Course Code	US07HMAMTH03	Title of the Course	Problems and Exercises in Complex Analysis & Real Analysis-3
Total Credits of the Course	4	Hours per Week	8 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 Complex Analysis. 3. To teach students various methods of solving and applying results of Real Analysis-3.

Course Content		
PART-I(COMPLEX ANALYSIS)		
Unit	Description	Weightage* (%)
1.	Complex functions: Exponential, Trigonometric, Hyperbolic and Logarithmic functions, Limit of complex functions, Continuity of complex functions	10%
2.	Chain rule and Differentiability of complex functions. Cauchy-Riemann equations, Connections between C-R equations and Differentiability of complex functions, Sufficient conditions for differentiability.	10%
3.	Analytic functions, Harmonic functions, Harmonic conjugate. Properties of exponential, trigonometric and logarithmic functions	10%
4	Derivatives of exponential, trigonometric and logarithmic functions, Inverse trigonometric functions and hyperbolic functions.	10%
5.	Linear transformations, Bilinear transformation, Fixed points of bilinear transformation, The transformations $w = \frac{1}{z}, sinz, e^z$.	10%

PART- II (REAL ANALYSIS-3)		
Unit	Description	Weightage* (%)
1.	Riemann Integrals: Definitions and Existance, Inequalities for Integrals, Refinement of Partitions, Darboux's Theorem for Integrals, Conditions for Integrability	10%
2.	Integrability of the Sum, Difference, Product, Quotient and Modulus functions. Integral as the limit of sums (Riemann Sums), Some Integrable functions, Integration and Differentiation	10%
3.	The Premitive, The Fundamental Theorem of Integral Calculus, Mean Value Theorems of Integral and Second Mean Value Theorem. Functions of Severable Variables: Expicit and Impicit Functions.	10%
4.	Neighbourhood of a Point, Limit and Continuity, Partial Derivatives, Differentiability, Partial Derivatives of higher order, Differentials of Higher Order, Functions of Function.	10%
5.	Change of variables, Taylor's Theorem and Maclaurin's Theorem for Functions of two variables, Extreme Values of Functions of two variables.	10%

Teaching- Learning Methodology	Class room teaching, Presentation by students, Use of ICT whenever required.
NOTE:	1. Use of the standard text books may be permitted at the time of Practical Examination. 2. Use of non-programmable Scientific Calculators Allowed. 3. There would be a batch of problem solving session of eight hours per week and they will be conducted in batches of students of size 20 to25 per batch. 4. The candidate shall have to produce at the time of practical Examination the record of their prescribed Laboratory work, certified by the Head of the Department.

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

3.	**University Examination: Practical Examination of each PART will be conducted separately, each of 50% weightage.**	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Analyze the limit, continuity and differentiability of a function of Complex variables.
2.	Apply knowledge of Complex Analysis to solve certain problems in Science.
3.	Identify and categorize Riemann Integral.
4.	understand Riemann Integral and various conditions for the integrability of a function.
5.	Apply results of Real Analysis-3 to solve certain problems in Science.

Suggested References:

Sr. No.	References
1.	Brown, J. W., and Churchill, R. V. Complex Variables and Applications, Ninth Edition, McGraw-Hill Book Company, 2013.
2.	Conway J. B., Functions of One Complex Variable, Second Edition Narosa publ. House, New Delhi, 1996.
3.	Joseph B. and Donald J. N., Complex Analysis: Undergraduate texts in Mathematics, Third Edition, Springer-Verlag, New York, Inc., New York, 2010.
4.	S. C. Malik, Principles of Real Analysis, Fifth Edition, New Age International, New Delhi, 2021.
5.	S. C. Malik and Savita Arora, Mathematical Analysis, Fifth Edition, New Age International Pvt. Ltd., New Delhi, 2019.
6.	R. G. Bartle, D. R. Sherbert, Introduction to Real Analysis, Fourth Edition, Wiley India Pvt. Ltd., New Delhi, 2011.
7.	S. R. Ghorpade and B. V. Limaye, A course in Calculus and Real Analysis, Springer, 2006.
8.	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 (7)

Note: The students who have studied US05MIMTH01 in Semester-5 cannot take this course.

Course Code	US07HMIMTH01	Title of the Course	Numerical Analysis-1
Total Credits of the Course	2	Hours per Week	2 hours

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

Course Content		
Unit	Description	Weightage* (%)
1.	Errors and Their Computations, A General Error Formula, Errors in a Series Approximation, Solution of Algebraic and Transcendental Equations: Bisection Method, Iteration Method, Aitken's Δ^2 process, Method of False Position, Newton – Raphson Method.	50%
2.	Interpolation: Finite Differences, Forward, Backward and Central Differences, Symbolic Relations of Operators, Detection of Errors by Using Difference Tables, Differences of Polynomials, Newton's Forward and Backward Formulae, Gauss Forward and Backward Formulae, Stirling's, Bessel's and Everett's Formulae.	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.

Suggested References:	
Sr. No.	References
1.	S. S. Sastry, Introductory Methods of Numerical Analysis, 4th Ed., Prentice Hall of India, 2010. Chapter : 1(1.3,1.4,1.5), 2(2.1 to 2.6), 3(3.3.1, 3.3.2, 3.3.3, 3.6, 3.7)
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 (7)

Note: The students who have studied US05MIMTH02 in Semester-5 cannot take this course.

Course Code	US07HMIMTH02	Title of the Course	Problems and Exercises in Numerical Analysis-1
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	4. To develop problem solving skills of students through interactive teaching and supervised practice. 5. To teach students various methods of solving and applying results of Numerical Analysis.

Course Content

(NUMERICAL ANALYSIS)

Unit	Description	Weightage* (%)
1.	Inherent Errors and truncated errors; Errors in a series approximation. Solution of algebraic and transcendental equations: Bisection method,	10%
2.	Solution of algebraic and transcendental equations: Iteration method, Aitken's Δ^2 process, method of false position, Newton Raphson's method	10%
3.	Interpolation: Finite Differences, Forward, Backward and Central Differences, Symbolic Relations of Operators, Detection of Errors by Use of Difference Tables, Differences of a Polynomial.	10%
4.	Newton's Forward and Backward Formulae, Gauss Forward and Backward Formulae	10%
5.	Stirling's, Bessel's and Everett's Formula.	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.	Find error in function and series.
2.	Numerically approximate root of an equation.
3.	Interpolate a given set of data to find an interpolating function.

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 (7)

Note: The students who have studied US05MIMTH03 in Semester-5 cannot take this course.

Course Code	US07HMIMTH03	Title of the Course	Ordinary Differential Equations-1
Total Credits of the Course	2	Hours per Week	2 hours

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

Course Content		
Unit	Description	Weightage* (%)
1.	Differential Equations. Exact Differential Equations, Integrating Factors, Differential Equations of the First Order and of Higher Degree, Differential Equation Solvable for p, for y and for x, Clairaut's Equation	50%
2.	Linear Differential Equations with Constant Coefficients, Complimentary Function and Particular Integral, Operators, Products of Operators, Determination of Complimentary Function, Inverse Operators, Determination of Particular Integral and Working rules for f(D)y=X where, $X = e^{mx}, \sin mx, \cos mx, x^m, e^{ax}V, xV$ (V is a function of x only). Homogeneous Linear Differential Equations.	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.	realize the importance of Ordinary Differential Equations
2.	solve the problems of Ordinary Differential Equations.

Suggested References:	
Sr. No.	References
1.	Shanti Narayan, Integral Calculus, 14th Edition, S. Chand & Company Ltd., New Delhi, 1996 Chapter: 11(11.8,11.9 Only), 12,14
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 (7)

Note: The students who have studied US05MIMTH04 in Semester-5 cannot take this course.

Course Code	US07HMIMTH04	Title of the Course	Problems and Exercises in Ordinary Differential Equations-1
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	6. To develop problem solving skills of students through interactive teaching and supervised practice. 7. To teach students various methods of solving and applying results of Ordinary Differential Equations.

Course Content		
ORDINARY DIFFERENTIAL EQUATIONS		
Unit	Description	Weightage* (%)
1.	Differential Equations, Exact Differential Equations; Integrating Factors.	10%
2.	Differential Equations of the First Order and of Higher Degree Differential Equation Solvable for p, for x and for y.	10%
3.	Clairaut's Equation, Linear Differential Equations with Constant Coefficients, Complimentary Function and Particular Integral,	10%
4.	Determination of Particular Integral and Working rules for f(D)y = X where X = e^{mx} , sinmx, cosmx, x^m	10%
5.	Determination of Particular Integral and Working rules for f(D)y = X, where X = $e^{ax}V$, xV (where V is a function of x only). Homogeneous Linear Differential Equations	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:

3. 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.
4. 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 Equation.
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 (7)

Note: The students who have studied US05MIMTH05 in Semester-5 and US06MIMTH07 in Semester-6 cannot take this course.

Course Code	US07HMIMTH05	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	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 the concepts so that they can be applied to the applications of the Partial Differential Equations.

Suggested References:

I.Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, International Student Edition. Chapter 1 (1.1, 1.3, 1.4, 1.5(excluding Thm.6), 1.6), Chapter 2 (2.1, 2.2, 2.4(Thm.3 without proof), 2.5, 2.6)

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 (7)

Note: The students who have studied US05MIMTH06 in Semester-5 and US06MIMTH08 in Semester-6 cannot take this course.

Course Code	US07HMIMTH06	Title of the Course	Problems and Exercises in Partial Differential Equation-1
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	8. To develop problem solving skills of students through interactive teaching and supervised practice. 9. To teach students various methods of solving and applying results of Partial Differential Equations.

Course Content

PARTIAL DIFFERENTIAL EQUATIONS

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 a 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:

5. 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.
6. 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 (7)

Note: The students who have studied US06MIMTH01 in Semester-6 cannot take this course.

Course Code	US07HMIMTH07	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,	25%

	Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	
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 (7)

Note: The students who have studied US06MIMTH02 in Semester-6 cannot take this course.

Course Code	US07HMIMTH08	Title of the Course	Problems and Exercises in Numerical Analysis-2
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	10. To develop problem solving skills of students through interactive teaching and supervised practice. 11. 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:

7. 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.
8. 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.

(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (7)

Note: The students who have studied US06MIMTH03 in Semester-6 cannot take this course.

Course Code	US07HMIMTH09	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 (7)

Note: The students who have studied US06MIMTH04 in Semester-6 cannot take this course.

Course Code	US07HMIMTH10	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:	12. To develop problem solving skills of students through interactive teaching and supervised practice. 13. 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:

9. 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.
10. 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.

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (7)

Note: The students who have studied US06MIMTH05 in Semester-6 cannot take this course.

Course Code	US07HMIMTH11	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.

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (7)

Note: The students who have studied US06MIMTH06 in Semester-6 cannot take this course.

Course Code	US07HMIMTH12	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:	14. To develop problem solving skills of students through interactive teaching and supervised practice. 15. 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:

11. 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.
12. 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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