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

Course Code	US04CMTH51	Title of the Course	PARTIAL DIFFERENTIAL EQUATIONS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To introduce students to Partial Differential Equations and their various origins. 2. To teach students various types of Partial Differential Equations. 3. To teach students how to identify and solve Partial Differential Equations of certain

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	25%
2.	Partial Differential Equations, Origin of First Order Partial Differential Equations, Linear Equations of the First Order, Integral Surfaces Through a Given Curve, Surfaces Orthogonal to a Given System of Surfaces	25%
3.	Non-linear Partial Differential Equations of First Order , Compatible Systems of First Order Equations, Charpit's Method , Special Types of First Order Equations, Solutions Satisfying Given Conditions	25%
4.	Jacobi's Method, Applications of First Order Equations, The Origin of Second Order Equations, Linear Partial Differential Equations with Constant Coefficients.	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)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand basic concepts of Partial Differential Equations.
2.	identify and solve Partial Differential Equations.
3.	take up an advance course in Partial Differential Equations.

Suggested References:	
Sr. No.	References
1.	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),2.5,2.6,2.7,2.9,2.10,2.11 , 2.12 , 2.13 , 2.14), Chapter 3 (3.1,3.4,3.5,3.9)
2.	M.D.Raisinghania, Ordinary and Partial differential equations,S.Chand & Company Ltd., New Delhi.
3.	Nita Shah ,Ordinary and Partial Differential Equations-Theory and Applications , PHI Learing Pvt. Ltd. , New Delhi.
4.	T. Amaranath ,An Elementary Course in Partial Differential Equations , Narosa Publishing House , 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
On-line Resources

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

Course Code	US04CMTH52	Title of the Course	NUMERICAL METHODS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To introduce students to Numerical Methods and where they 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, Solutions of Algebraic and Transcendental Equations: Bisection Method, Iteration Method, Aitken's Δ^2 Process, Method of False Position, Newton-Raphson Method.	25%
2.	Interpolation: Finite Differences, Forward, Backward and Central Differences, Symbolic Relations of Operators, Detection of Errors by Use of Difference Tables, Differences of a Polynomial, Newton's Forward and Backward Formulae, Gauss Forward and Backward Formulae, Stirling's, Bessel's and Everett's Formulae.	25%
3.	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, Gauss's Method, Maximum and Minimum Values of a Tabulated	25%
4.	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, Picards' Method , Euler's Method, Modified Euler's Method, Range-Kutta Method .	25%

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

Methodology	

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

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 to find an approximating 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 : 1(1.3,1.4,1.5) , 2(2.1 to 2.6), (3.3.1,3.32,3.3.3,3.6,3.7,3.9.1,3.10,3.11), 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.Grawal , Numerical analysis , Khanna pub.
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
On-line Resources

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

Course Code	US04CMTH53	Title of the Course	PROBLEMS AND EXERCISES IN PARTIAL DIFFERENTIAL EQUATIONS & NUMERICAL METHODS.
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To develop problem solving skills of students through interactive teaching and supervised practice. 2. To develop problem solving skills of students in solving problems in Partial Differential Equations. 3. To develop problem solving skills of students in solving problems in Numerical methods.

Course Content

PART- I (PARTIAL DIFFERENTIAL EQUATIONS)

Unit	Description	Weightage* (%)
1.	Surfaces and Curves in Three Dimensions , Methods of Solving $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Orthogonal Trajectories of a System of Curves on Surface	10%
2.	Pfaffian Forms and Equations , Solution of Pfaffian Differential Equations in Three Variables, Partial Differential Equations , Origin of First Order Partial Differential Equations , Linear Equations of the First Order	10%
3.	Integral Surfaces Through a Given Curve ,Surfaces Orthogonal to a Given System of Surfaces, Non-linear Partial Differential Equations of First Order , Compatible Systems of First Order Equations	10%
4.	Finding solutions using Charpit's Method. , Special Types of First Order Equations , Solutions Satisfying Given Conditions	10%
5.	Jacobi's Method , Applications of First Order Equations , The Origin of Second Order Equations, Linear Partial Differential Equations With Constant Coefficients	10%

PART- II (NUMERICAL METHODS)

Unit	Description	Weightage*

		(%)
1.	Inherent Errors and truncated errors; 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's method	10%
2.	Interpolation: Finite Differences, Forward, Backward and Central Differences, Symbolic Relations of Operators, Detection of Errors by Use of Difference Tables, Differences of a Polynomial, Newton's Forward and Backward Formulae, Gauss Forward and Backward Formulae. Stirling's, Bessel's, Newton's General and Lagrange's formulae.	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, Newton's Forward and Backward Formulae, Gauss Forward and Backward Formulae. Stirling's, Bessel's, Newton's General and Lagrange's formulae.	10%
4.	Numerical differentiation: Differentiation of Newton's forward and backward, Gauss's Method, Maximum and Minimum Values of a Tabulated Function. 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 equations: Solution by Taylor's series , Picard's method, Euler's Method , Modified Euler's method , Runge-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)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	---
3.	**University Examination: Practical Examination of each PART will be conducted <u>separately, each of 50% weightage</u>.**	100%

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 20 to 25 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 categorise Partial Differential Equations.
2.	solve Partial Differential Equations.
3.	apply knowledge of Partial Differential Equations to solve certain problems.
4.	Numerically approximate root of an equation.
5.	Interpolate a given set of data to find an interpolating function.
6.	Interpolate a given set of data to find and interpolating function.
7.	Numerically approximate Derivatives and Integrals

Suggested References:	
Sr. No.	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
6.	Zafar Ahsan ,Differential Equations and Their Applications , Prentice - Hall of India Pvt. Ltd.,New Delhi .
7.	S.S.Sastry, Introductory methods of Numerical analysis,4th Ed., Prentice hall of India,2010.
8.	G. Sankar rao , Numerical analysis.
9.	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 .

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

On-line Resources

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

Course Code	US04SMTH51	Title of the Course	NUMBER THEORY - 2
Total Credits of the Course	2	Hours per Week	2

PREREQUISITE : Prerequisite to opt for this course is that the student must have opted the course US03SMTH51 (NUMBER THEORY-1) in Sem - 3

Course Objectives:	1. To teach students Elementary Number Theory. 2. To teach students types of fundamental operations and functions in Elementary Number Theory. 3. To teach students various properties of Congruences and their applications.

Course Content		
Unit	Description	Weightage* (%)
1.	Linear indeterminate equations and its solution ,General solution of Linear indeterminate equation with three unknown , Pythagoras (Shang-gao indeterminate) equation and its solution.	25%
2.	Congruences : Definition and examples , Properties of congruences ,Necessary and sufficient condition for a positive integer can be divided by 3,9,4,7,11 or 13 .	25%
3.	Complete residue system(mod m) and its properties , Reduced residue system(mod m) and its properties , Euler's theorem, Fermat's theorem , Properties of Euler's function .	25%
4.	Congruence in one unknown , Solution of Linear congruence in one unknown and two unknown, Chinese theorem ,Solution of system of congruences.	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)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	---
3.	University Examination	100% (50 Marks)

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand elementary concepts of Number Theory.
2.	use various operations and functions in Elementary Number Theory to solve problems.
3.	take up an Intermediate course in Number Theory

Suggested References:	
Sr. No.	References
1.	C.Y.Hsiung, Elementary Theory of numbers, Allied publishers Ltd.(1992)
2.	D.Burton , elementary Number Theory, 6th Ed , Tata McGraw-Hill Edition,Indian reprint.
3.	I.Niven And H.Zuckermar , An Introduction to the theory of Numbers, Wiley-Eastern Publication.
4.	Neville Robinns, Beginning Number Theory , 2nd Ed.,Narosa Publishing House Pvt.Ltd. Delhi,2007

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

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

Course Code	US04SMTH52	Title of the Course	GRAPH THEORY – 2
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	1. To teach students Elementary Graph Theory. 2. To teach students certain advanced operations on graphs. 3. To teach students fundamental properties of various types of graphs.

PREREQUISITE : Prerequisite to opt for this course is that the student must have opted the course US03SMTH52 (GRAPH THEORY-1) in Sem – 3

Course Content		
Unit	Description	Weightage* (%)
1.	Planer graphs, Kuratowski's Two graphs, Different representations of a planar graphs, Detection of Planarity geometric and combinatorial dual.	25%
2.	Matrix representation of graphs,Incidence matrix, Sub matrices, Circuit matrix, Fundamental circuit matrix.	25%
3.	Cut set matrix , Path matrix , Adjancency matrix , Relation amongs A_f ; B_f ; and C_f	25%
4.	Directed graph, Some types of digraphs, Digraphs and Binary relations.	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)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	---
3.	University Examination	100% (50 Marks)

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand elementary concepts of Graph Theory.
2.	identify types of graphs and use various operations on graphs to solve problems.
3.	take up an advanced course in Graph Theory

Suggested References:	
Sr. No.	References
1.	Narsingh Deo, Graph theory with application to engineering and Computer science, Fourth printing, prentice Hall of India, 1987. chapter 5 (except 5.1,5.8,5.9), chapter 7 (except 7.5,7.7), chapter 8 (only 8.1,8.4,8.6), chapter 9 (only 9.1 to 9.6)
2.	J.Clark and A.D.Holton, A first look at Graph Theory, First Indian Reprint. Allied Publishers,1995
3.	D.B.West, Introduction to graph theory, Prentice Hall of India, New Delhi, 1999.

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

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

Course Code	US04SMTH53	Title of the Course	MECHANICS - 2
Total Credits of the Course	2	Hours per Week	2

PREREQUISITE : Prerequisite to opt for this course is that the student must have opted the course US03SMTH53 (MECHANICS - 1) in Sem - 3

Course Objectives:	1. To introduce students to intermidiate concepts of mechanics. 2. To teach students some intermidiate laws and results of motion of particles. 3. To teach students how to study how to apply laws and results of mechanics in specific situations in science and real life.

Course Content		
Unit	Description	Weightage* (%)
1.	Methods of plane dynamics, Motion of a particle, Motion of a system of particles.	25%
2.	Applications in plane dynamics projectile with and without resistance, Motion under central force, Planetary orbits.	25%
3.	Kinetic energy of rigid body, Angular momentum of rigid body, Moment of inertia of a rigid body.	25%
4.	Rotational motion about a fixed line, Impulsive motion, General theory of plane, Collision.	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)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	---
3.	University Examination	100% (50 Marks)

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand intermediate concepts of Mechanics.
2.	analyse and apply results of mechanics in specific situations.
3.	take up an advanced course in Mechanics.

Suggested References:	
Sr. No.	References
1.	J.L.Synge and B.A.Griffith , Principles of Mechanics. Chapter 5 (5.1,5.2),Chapter 6(6.1,6.2,6.4, 6.5), Chapter 7(7.1,7.2),Chapter 8(8.1,8.2)
2.	P.N.Chaterjee, Statics and Dynamics

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

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