Curriculum and Credit Framework for Undergraduate Programme

(Single Major) as per NEP-2020

B.Sc. MATHEMATICS

(Four Year Degree Programme)

5th & 6th Semesters

For Batch w.e.f Session: 2021-22

University School for Graduate Studies

Chaudhary Devi Lal University

Sirsa-125055

2023

B.Sc. Mathematics
(Four Year Degree Programme)
3rd and 4th Semester

Exit options and Credit requirements

SINGLE-MAJOR

Exit with	*Credit requirement*
Certificate in Mathematics: *After successful completion of First Year (Two Semesters) of the Four-Year Undergraduate Degree Programme.*	**48** (Including Internship of 4 Credits)
Diploma in Mathematics: *After successful completion of Two Year (Four Semesters) of the Four-Year Undergraduate Degree Programme.*	**94** (Including Internship of 4 Credits)
Bachelor of Science in Mathematics: *After successful completion of Three Year (Six Semesters) of the Four-Year Undergraduate Degree Programme.*	**136**
Bachelor of Science in Mathematics(Honours/Honours with Research): *After successful completion of Four Year (Eight Semesters) of the Four-Year Undergraduate Degree Programme.*	**184**

Exit options and Credit requirements

MULTI-DISCIPLINARY

Exit with	*Credit requirement*
Certificate in Mathematics: *After successful completion of First Year (Two Semesters) of the Four-Year Undergraduate Degree Programme.*	*48*
Diploma in Mathematics: *After successful completion of Two Year (Four Semesters) of the Four-Year Undergraduate Degree Programme.*	*92*
Bachelor of Science in Mathematics: *After successful completion of Three Year (Six Semesters) of the Four-Year Undergraduate Degree Programme.*	*132*
Bachelor of Science in Mathematics(Honours/Honours with Research): *After successful completion of Four Year (Eight Semesters) of the Four-Year Undergraduate Degree Programme.*	*180*

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Table: *Courses code and Title along with credit details*

Course Category	Course Code	CourseTitle	Level	Credits			Marks		
				L	P	Total	Int	Ext	Total
	SEMESTER-V								
1. DSC	BSC/SM/MAT/5/DSC/301	Real Analysis	300	4	-	**4**	30	70	**100**
	BSC/SM/MAT/5/DSC/302	Statics	300	4	-	**4**	30	70	**100**
2. MIC	BSC/SM/MAT/5/MIC/301	Sequences and Series	300	4	-	**4**	30	70	**100**
	BSC/SM/MAT/5/MIC/302	Group andRings	300	4	-	**4**	30	70	**100**
	BSC/SM/MAT/5/MIC/303	Differential Geometry	300	4	-	**4**	30	70	**100**
3. SEC	BSC/SM/MAT/5/SEC/301	Programming in C &Numerical Methods (Theory)	300	3	-	**3**	25	50	**75**
4. INTERN-SHIP	BSC/SM/MAT/5/INT	Summer Internship	300	-	4	**4**	-	100	**100**
TOTAL									**675**

Course Category	Course Code	CourseTitle	Level	Credits			Marks		
				L	P	Total	Int	Ext	Total
	SEMESTER-VI								
1. DSC	BSC/SM/MAT/6/DSC/303	Real and Complex Analysis	300	4	-	**4**	30	70	**100**
2. MIC	BSC/SM/MAT/6/MIC/304	Linear Algebra	300	4	-	**4**	30	70	**100**
	BSC/SM/MAT/6/MIC/305	Numerical Analysis	300	4	-	**4**	30	70	**100**
	BSC/SM/MAT/6/MIC/306	Dynamics	300	4	-	**4**	30	70	**100**
3. SEC	CDLU/SEC/MAT/6/301	Programming in C & Numerical (Practical)	300	-	3	**3**	-	75	**75**
4. VAC	CDLU/VAC/101	Communication Skills	300	2	-	**2**	-	-	**50**
	CDLU/VAC/105	Vedic Mathematics	300	2	-	**2**	-	-	**50**
TOTAL						**23**			**575**

BSC/SM/MAT/5/DSC/301
Real Analysis

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs.**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Get knowledge about Riemann Integrals and Integrability of continuous and monotonic functions.
2. Study of Improper integrals and their convergence, comparison test for convergence of the integral.
3. Know the definition and examples of metric spaces, different theorems regarding convergence of sequence.
4. Know the concept of functions and their continuity, compactness, boundedness, components and connectedness.

Unit- I

Riemann integral, Integrability of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

Unit- II

Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter. Continuity, Differentiability and integrability of an integral of a function of a parameter.

Unit- III

Definition and examples of metric spaces, neighborhoods, limit points, interior points, open and closed sets, closure and interior, boundary points, subspace of a metric space, equivalent metrics, Cauchy sequences, completeness, Cantor's intersection theorem, Baire's category theorem, contraction Principle

Unit- IV

Continuous functions, uniform continuity, compactness for metric spaces, sequential compactness, Bolzano-Weierstrass property, total boundedness, finite intersection property, continuity in relation with compactness, connectedness , components, continuity in relation with connectedness.

Books Recommended:

1. P.K. Jain and Khalil Ahmad, Metric Spaces, 2nd Ed., Narosa, 2004
2. Babu Ram, Metric Spaces, Vinayaka Publication
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
4. R.R. Goldberg, Real Analysis, Oxford & IBH publishing Co., New Delhi, 1970
5. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
6. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co., New Delhi
7. E.T. Copson, Metric Spaces, Cambridge University Press, 1968.
8. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, 1963.

BSC/SM/MAT/5/DSC/302

Statics

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Know about moments and couples.
2. Understand about analytical conditions of equilibrium of coplanar forces, friction and centre of gravity.
3. Give the idea of virtual work and forces in three dimensions.
4. Understand the concept of wrenches, null lines and null planes, concept of equilibrium.

Unit- I

Composition and resolution of forces. Parallel forces. Moments and Couples.

Unit- II

Analytical conditions of equilibrium of coplanar forces. Friction. Centre of Gravity.

Unit- III

Virtual work. Forces in three dimensions. Poinsots central axis.

Unit- IV

Wrenches. Null lines and planes. Stable and unstable equilibrium.

Books Recommended:

1. S.L. Loney, Statics, Macmillan Company, London
2. R.S. Verma, A Text Book on Statics, Pothishala Pvt. Ltd., Allahabad

BSC/SM/MAT/5/MIC/301
Sequences and Series

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Understand the concept of set of real numbers and interior points, limit points. Bolzano-Weiestrass theorem study of compact sets.
2. Know the concept of sequence and their convergence, concept of Bounded and monotonic sequences. Concept of convergence and divergence of series.
3. Concept of Infinite series and study about different test to check the convergence of the series.
4. Get knowledge about alternating series and product of series, convergence of infinite products.

Unit - I

Boundedness of the set of real numbers; least upper bound, greatest lower bound of a set, neighborhoods, interior points, isolated points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weiestrass theorem, Open covers, Compact sets and Heine-Borel Theorem.

Unit- II

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence, Cauchy general principle of convergence, Subsequences, Subsequential limits.

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, Cauchy's general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or p-series.

Unit- III

Infinite series: D-Alembert's ratio test, Raabe's test, Logarithmic test, de Morgan and Bertrand's test, Cauchy's nth root test, Gauss Test, Cauchy's integral test, Cauchy's condensation test.

Unit- IV

Alternating series, Leibnitz's test, absolute and conditional convergence, Arbitrary series: abel's lemma, Abel's test, Dirichlet's test, Insertion and removal of parenthesis, re-arrangement of terms in a series, Dirichlet's theorem, Riemann's Re-arrangement theorem, Pringsheim's theorem (statement only), Multiplication of series, Cauchy product of series, (definitions and examples only) Convergence and absolute convergence of infinite products.

Books Recommended:

1. R.R. Goldberg , Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik, Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
3. Shanti Narayan, A Course in Mathematical Analysis, S.Chand and Company, New Delhi

4. Murray, R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing Co., New York
5. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
6. Earl D. Rainville, Infinite Series, The Macmillan Co., New York

BSC/SM/MAT/5/MIC/302

Groups and Rings

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Understand the concept of Groups, properties of group and subgroups.
2. Understand the concept of Homomorphisms, automorphisms, isomophisms of groups, Concept of permutation group, alternating groups, Cayley's theorem.
3. Understand the concepts of rings, subrings and integral domain, Ring homomorphisms, Ideals theory.
4. Know about Euclidean rings, Polynomial rings and Unique factorization domain.

Unit- I

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, cyclic groups, Cosets, Left and right cosets, Index of a sub-group Coset decomposition, Largrage's theorem and its consequences, Normal subgroups, Quotient groups,

Unit- II

Homoomorphisms, isomophisms, automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group.

Unit- III

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphisms, ideals (principle, prime and Maximal) and Quotient rings, Field of quotients of an integral domain.

Unit- IV

Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain, R unique factorization domain implies so is $R[X_1, X_2, \ldots\ldots X_n]$

Books Recommended:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2nd edition).
3. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House.
4. I.S. Luther and I.B.S. Passi, Algebra, Vol.-II, Narosa Publishing House.

BSC/SM/MAT/5/MIC/303

Differential Geometry

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: This course enables the students:

1. To understand the basic knowledge of one and two parameter family of surface and their properties, envelopes, Characteristics, edge of regression.
2. To learn the concepts of curvilinear coordinates.
3. To understand the surface of revolution, Conjugate direction, conjugate systems, Asymptotic lines, curvatures and torsion.
4. To gain the knowledge of geodesics and the related concepts.

Unit-I

One Parameter family of Surfaces: Envelope, Characteristics, edge of regression , Developable surfaces.
Developables Associated with a Curve: Osculating developable, Polar developable, Rectifying developable.
Two- parameter Family of Surfaces: Envelope, Characteristics points,

Unit-II

Curvilinear coordinates, first order magnitudes, Directions on a surface, The normal, Second order magnitudes, Derivatives of **n**.

Unit-III

Curves on a Surface: Principal directions and curvatures, First and second curvatures, Euler's theorems, Dupin's indicatrix, The surfaces z = f(x,y), Surface of revolution. Conjugate directions, Conjugate systems. Asymptotic lines, Curvature and torsion, Isometric parameters, Null lines, or minimal curves.

Unit-IV

Geodesics and Geodesic Parallels: Geodesics: Geodesic property, Equation of Geodesics, Surface of revolution, Torsion of Geodesic.
Curves in Relation to Geodesics: Bonnet's theorem, Joachimsthal's theorems, Vector curvature, Geodesic curvature κg , Other formulae for κ_g , Bonnet's formula.

Books Recommended:

1. A.K. Singh and P.K. Mittal, A Textbook of Differential Geometry, Har-Anand Publications.
2. C.E. Weatherburn, Differential Geometry of Three Dimensions, Radhe Publishing House.
3. Erwin Kreyszig, Differential Geometry.

BSC/SM/MAT/5/SEC/301
Programming in C & Numerical Methods (Theory)

Marks (Theory) : 50 **Marks(Total) : 75**
Marks (Internal Assessment) : 25 **Time : 3 Hrs**
Credits: 03

Note for the Paper Setter: *The question paper will consist of* ***seven*** *questions in all. The first question will be compulsory and will consist of* ***four*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***six*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***three*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***three more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Understand the Programme Model of computer, Algorithms, Flow Charts, Input/Output functions.
2. To learn the Decision Control structure, Logical and Conditional Statements, Concepts of Functions, Preprocessors and Arrays.
3. Understand strings and structures, pointers, solution of algebraic and transcendental equations by different methods.
4. Understand the concept of solution of Simultaneous linear algebraic equations by different methods.

Unit- I

Programmer's model of a computer, Algorithms, Flow charts, Data types, Operators and expressions, Input / Output functions.
Decisions control structure: Decision statements, Logical and conditional statements, Implementation of Loops, Switch Statement & Case control structures. Functions, Preprocessors and Arrays.

Unit- II

Strings: Character Data Type, Standard String handling Functions, Arithmetic Operations on Characters. Structures: Definition, using Structures, use of Structures in Arrays and Arrays in Structures. Pointers: Solution of Algebraic and Transcendental equations: Bisection method, Regula-Falsi method, Secant method, Newton-Raphson's method. Newton's iterative method for finding pth root of a number.

Unit- III

Simultaneous linear algebraic equations: Gauss-elimination method, Gauss-Jordan method, Triangularization method (LU decomposition method). Crout's method, Cholesky Decomposition method. Iterative method, Jacobi's method, Gauss-Seidal's method, Relaxation method.

Books Recommended:

1. B.W. Kernighan and D.M. Ritchie, The C Programming Language, 2nd Edition
2. V. Rajaraman, Programming in C, Prentice Hall of India, 1994
3. Byron S. Gottfried, Theory and Problems of Programming with C, Tata McGraw-Hill Publishing Co. Ltd., 1998
4. Babu Ram, Numerical Methods, Pearson Publication.
5. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
6. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999
7. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill Publishing Co. Ltd.

BSC/SM/MAT/5/INT
INTERNSHIP

CREDIT: 4 **MAX MARKS: 100**
MIN. MARKS: 40

Each student will have to undergo an internship of credits having atleast 120 hours (1 Credit : 30 hours of engagement) with involvement/working with local Industry/Organization (Govt./Private), Business Organization, Artiest, Craft Persons and similar entities during summer vacations.

Student will have to submit a certificate in office within one month after the commencement of 5th semester, issued by the competent signatory of the Industry/Organization regarding their performance, discipline and activities during the courses of internship.

A panel of experts constituted by the Dean/Chairperson with conduct the Viva-Voce for the assessment of Internship.

Sixth Semester

BSC/SM/MAT/6/DSC/303
Real and Complex Analysis

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting at least one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Understand the concept of Jacobians, Beta, Gama fuctions, Dirichlets integrals and change of order.
2. Know about fourier series, Fourier coefficients, half range series.
3. Learn about sterographic projections of complex numbers, analytic functions and their properties.
4. Learn about diffent mappings nad Mobius transformations.

Unit- I

Jacobians, Beta and Gama functions, Double and Triple integrals, Dirichlets integrals, change of order of integration in double integrals.

Unit- II

Fourier's series: Fourier expansion of piecewise monotonic functions, Properties of Fourier Co-efficients, Dirichlet's conditions, Parseval's identity for Fourier series, Fourier series for even and odd functions, Half range series, Change of Intervals.

Unit- III

Extended Complex Plane, Stereographic projection of complex numbers, continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations. Harmonic functions.

Unit- IV

Mappings by elementary functions: Translation, rotation, Magnification and Inversion. Conformal Mappings, Mobius transformations. Fixed pints, Cross ratio, Inverse Points and critical mappings.

Books Recommended:

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
2. R.R. Goldberg, Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
4. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. R.V. Churchill and J.W. Brown, Complex Variables and Applications, 5th Edition, McGraw-Hill, New York, 1990.
6. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.

BSC/SM/MAT/6/MIC/304
Linear Algebra

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Understand about the vector spaces, subspaces and finitely generated vector space. Basis of a vector space and dimensions.
2. Learn about Homomorphism and Isomorphism, Concept of Linear transformation on vector spaces, Concept of Dual Spaces and Rank.
3. Know the concept of Linear transformations and its types, eigen values and eigen vectors of a linear transformations.
4. Learn about the inner product spaces, orthogonal sets, adjoint of a linear transformation, Gram-Schmidt process.

Unit- I

Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension.

Unit- II

Homomorphism and isomorphism of vector spaces, Linear transformations and linear forms on vector spaces, Vector space of all the linear transformations Dual Spaces, Bidual spaces, annihilator of subspaces of finite dimensional vector spaces, Null Space, Range space of a linear transformation, Rank and Nullity Theorem,

Unit- III

Algebra of Linear Transformation, Minimal Polynomial of a linear transformation, Singular and non-singular linear transformations, Matrix of a linear Transformation, Change of basis, Eigen values and Eigen vectors of linear transformations.

Unit- IV

Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthogonal complements, Orthogonal sets and Basis, Bessel's inequality for finite dimensional vector spaces, Gram-Schmidt, Orthogonalization process, Adjoint of a linear transformation and its properties, Unitary linear transformations.

Books Recommended:

1. I.N. Herstein,: Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2nd edition).
3. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House.
4. I.S. Luther and I.B.S. Passi, Algebra, Vol.-II, Narosa Publishing House.

BSC/SM/MAT/6/MIC/305
Numerical Analysis

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Learn about finite differences operators, concept of interpolation with equal and unequal intervals.
2. Learn about the Gauss forward and backward interpolation formulae, different methods to solve eigen value problems.
3. Know the concept of numerical differentiation, integration and different methods for differentiation and integration.
4. Learn about difference equation and numerical solution of ordinary differential equations.

Unit- I

Finite Differences operators and their relations. Finding the missing terms and effect of error in a difference tabular values, Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Interpolation with unequal intervals: Newton's divided difference, Lagrange's Interpolation formulae.

Unit- II

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. Eigen Value Problems: Power method, Jacobi's method, Given's method, House-Holder's method, QR method, Lanczos method.

Unit- III

Numerical Differentiation: Derivative of a function using interpolation formulae as studied in Sections –I & II. Numerical Integration: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one- third and three-eighth rule, Gauss Quadrature formula.

Unit- IV

Difference equation: Formation of difference equation, Linear difference equation, Difference equation reducible to linear form. Numerical solution of ordinary differential equations: Single step methods-Picard's method. Taylor's series method, Euler's method, Runge-Kutta Methods. Multiple step methods; Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.

Books Recommended:

1. Babu Ram, Numerical Methods: Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
4. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999

5. C. E. Froberg, Introduction to Numerical Analysis (2nd Edition).
6. Melvin J. Maaron, Numerical Analysis-A Practical Approach, Macmillan Publishing Co., Inc., New York
7. R.Y. Rubnistein, Simulation and the Monte Carlo Methods, John Wiley, 1981

BSC/SM/MAT/6/MIC/306

Dynamics

Marks (Theory) : 70 **Marks(Total) : 100**
Marks (Internal Assessment) : 30 **Time : 3 Hrs**
Credits: 04

Note for the Paper Setter: *The question paper will consist of* ***nine*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***2*** *marks each covering the whole syllabus. In addition,* ***eight*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***four*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***four more questions*** *selecting one question from each unit.*

Course Outcomes: The course will enable the students to:

1. Know the concept of velocity and acceleration along different directions, simple harmonic motion.
2. Know the concept of forces, learn about Newton Laws of motion, work, energy and power.
3. Get knowledge of motion on a rough and smooth plane, curves and projectile motion.
4. Learn the concept of Gereral motion of rigid body, central orbits and motion of particles in three-dimentions.

Unit- I

Velocity and acceleration along radial, transverse, tangential and normal directions. Relative velocity and acceleration. Simple harmonic motion. Elastic strings.

Unit- II

Mass, Momentum and Force. Newton's laws of motion. Work, Power and Energy. Definitions of Conservative forces and Impulsive forces.

Unit- III

Motion on smooth and rough plane curves. Projectile motion of a particle in a plane. Vector angular velocity.

Unit- IV

General motion of a rigid body. Central Orbits, Kepler laws of motion. Motion of a particle in three dimensions. Acceleration in terms of different co-ordinate systems.

Books Recommended:

1. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press, 1956
2. F. Chorlton, Dynamics, CBS Publishers, New Delhi
3. A.S. Ramsey, Dynamics Part-1&2, CBS Publisher & Distributors.

BSC/SM/MAT/6/SEC/302

Programming in C & Numerical Methods (Practical)

Marks (Practical): 75

Credits= 03 **Time: 3 Hrs.**

There will be a separate practical paper based on the theory paper BSC/SM/MAT/6/SEC/301.

CDLU/VAC/101
Communication Skills

Credits: 2 (Theory) | **Max. Marks: 50**

Lectures: 30 | **Final Term Exam: 35**

Duration of Exam: 2 Hrs. | **Internal Assessment: 15**

Note for the Paper Setter: The question paper will consist of **five** questions in all. The first question will be compulsory and will consist of **seven** short questions of **1** marks each covering the whole syllabus. In addition, **four** more questions of **14 marks each** will be set unit-wise comprising of **two** questions from each of the **two** units. The candidates are required to attempt **one compulsory question** and **two more questions** selecting at least one question from each unit.

Unit-1

Listening: Techniques of Effective Listening, Listening and Comprehension, Probing Questions Barriers to Listening.
Speaking: Pronunciation, Enunciation, Vocabulary, Fluency, Common Errors.
Reading: Techniques of Effective Reading, Gathering Ideas and Information from a Given Text, evaluating these Ideas and Information, Interpreting the Text.
Writing and Different Modes of Writing: The Writing Process, Effective Writing Strategies, Different Modes of Writing.
Digital Literacy and Social Media: Basic Computer Skills, Introduction to Microsoft (MS) Office Suite, Open Educational Resources, Basic Virtual Platforms, Trending Technologies, Machine Learning, Artificial Intelligence (AI), Internet of Things (IoT), Social Media, Introduction to Social Media Websites, Advantages of Social Media, Ethics and Etiquettes of Social Media, How to Use Google Search Better?, Effective Ways of Using Social Media, Digital Marketing, Introduction to Digital Marketing, Traditional Marketing versus Digital Marketing, Digital Marketing Tools, Social Media for Digital Marketing, Digital Marketing Analytics.

Unit-2

Digital Ethics and Cyber Security: Digital Ethics, Digital Literacy Skills, Digital Etiquette, Digital Life Skills, Cyber Security, Understanding and introducing the environment of security, Types of attacks and attackers, the art of protecting secrets.
Nonverbal Communication: Meaning of nonverbal communication, Advantages of using nonverbal communication, Introduction to modes of nonverbal communication, Open and Closed body language, Eye contact and Facial expression, Hand gestures, Do's and Don'ts in NVC, Learning from experts, Activities-based learning.

Suggested Readings: Follow Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0 at UGC website:
https://www.cdlu.ac.in/assets/admin/miscellaneous/Implementation%20of%20Curriculum%20and%20Guidelines%20on%20Life%20Skills%20(Jeevan%20Kaushal)%202.0.pdf

CDLU/VAC/105
Vedic Mathematics

Marks (Theory): 30 **Marks(Total) : 50**
Marks (Internal Assessment) : 20 **Time : 2 Hrs**
Credits: 02

Note for the Paper Setter: *The question paper will consist of* ***five*** *questions in all. The first question will be compulsory and will consist of* ***seven*** *short questions of* ***1*** *marks each covering the whole syllabus. In addition,* ***four*** *more questions of* ***14 marks each*** *will be set unit-wise comprising of* ***two*** *questions from each of the* ***two*** *units. The candidates are required to attempt* ***one compulsory question*** *and* ***two more questions*** *selecting one question from each unit.*

Course Outcomes (COs): At the end of the course, the students will be able

CO1: Discuss the rich heritage of mathematical temper of Ancient India Learning Outcomes: Overcome the fear of maths, Improved critical thinking

CO2: Familiarity with the mathematical underpinnings and techniques, Ability to do basic maths faster and with ease.

UNIT-I

Vedic Maths- High Speed Addition and Subtraction Sessions/Lectures, Vedic Maths: History of Vedic Maths and its Features, Vedic Maths formulae: Sutras and Upsutras, Addition in Vedic Maths: Without carrying, Dot Method, Subtraction in Vedic Maths: Nikhilam Navatashcaramam Dashatah, Fraction–Addition and Subtraction.

Unit II

Vedic Math - Miracle Multiplication and Excellent Division, Multiplication in Vedic Maths: Base Method (any two numbers upto three digits), Multiplication by Urdhva Tiryak Sutra, Miracle multiplication: Any three-digit number by series of 1's and 9's, Division by Urdhva Tiryak Sutra (Vinculum method).

Books suggested:

1. The Essential of Vedic Mathematics, Rajesh Kumar Thakur, Rupa Publications, New Delhi 2019.
2. Vedic Mathematics Made Easy, Dahaval Bathia, Jaico Publishing, New Delhi 2011
3. Vedic Mathematics: Sixteen Simple Mathematical formulae from the Vedas, Jagadguru Swami Sri Bharati Krishna Trithaji, Motilal Banarasidas, New Delhi 2015.
4. Learn Vedic Speed Mathematics Systematically, Chaitnaya A. Patil 2018. 17 Suggested Readings
5. A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi.