CHAUDHARY BANSI LAL UNIVERSITY, BHIWANI

Scheme of Examination and Syllabi of B.Sc. / B.A. Ist Semester

Mathematics

(w.e.f. 2020-21)

CHAUDHARY BANSI LAL UNIVERSITY, BHIWANI

Scheme And Syllabi of Mathematics for B.Sc./B.A under CBCS

(Semester I to VI)

(w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
SEMESTER –I					
20UMTH101	Algebra	Core	2	2	40+10=50
20UMTH102	Calculus	Core	2	2	40+10=50
20UMTH103	Mathematical Lab-I	Core	2	4	40+10=50
SEMESTER –II					
20UMTH201	Number Theory & Trigonometry	Core	2	2	40+10=50
20UMTH202	Vector Calculus & Geometry	Core	2	2	40+10=50
20UMTH203	Mathematical Lab-II	Core	2	4	40+10=50
SEMESTER –III					
20UMTH301	Differential Equations	Core	2	2	40+10=50
20UMTH302	Numerical Methods with Programming in C	Core	2	2	40+10=50
20UMTH303	Mathematical Lab-III	Core	2	4	40+10=50
SEMESTER –IV					
20UMTH401	Mechanics	Core	2	2	40+10=50
20UMTH402	Groups & Rings	Core	2	2	40+10=50
20UMTH403	Mathematical Lab-IV	Core	2	4	40+10=50

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SEMESTER –V					
Choose One: 20UMTH501 or 20UMTH502	Choose One:	Discipline Specific Elective	2	2	40+10=50
20UMTH501 Or	Statics & Dynamics				
20UMTH502	Statistical Inference				
Choose One: 20UMTH503 OR UMTH504	Choose One:	Discipline Specific Elective	2	2	40+10=50
20UMTH503 OR	Mathematical Analysis				
20UMTH504	Linear Algebra				
20UMTH505	Mathematical Lab-V	Discipline Specific Elective	2	4	40+10=50

SEMESTER –VI					
Choose One: 20UMTH601 OR 20UMTH602	Choose One:	Discipline Specific Elective	2	2	40+10=50
20UMTH601	Special Functions & Integral Transforms				
20UMTH602	Solid Geometry				
Choose One: 20UMTH603 OR 20UMTH604	Choose One:	Discipline Specific Elective	2	2	40+10=50
20UMTH603	Real Analysis				
20UMTH604	Advanced Calculus				
20UMTH605	Mathematical Lab-VI	Discipline Specific Elective	2	4	40+10=50

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Skill Enhancement Courses offered by Department of Mathematics

Scheme of Examination of SEC for B.Sc. (Non-Medical & Computer Science)

(w.e.f. 2020-21)

SEMESTER-IV					
Paper Code	**Paper Name**	**Type of Course**	**Credits (Theory/ Practical)**	**Contact Hours (Theory/ Practical)**	**Marks (External + Internal)**
Choose One:	Choose One:	Skill Enhancement	3	3	80+20=100
20USECM401	Logic and sets				
20USECM402	Analytical Geometry				
20USECM403	Probability & Statistics				
20USECM404	Vedic Arithmetic				
SEMESTER-V					
Choose One:	Choose One:	Skill Enhancement	3	3	80+20=100
20USECM501	Integral Calculus				
20USECM502	Theory of Equations				
20USECM503	Discrete Mathematics				
20USECM504	Vedic Algebra				
SEMESTER-VI					
Choose One:	Choose One:	Skill Enhancement	3	3	80+20=100
20USECM601	Boolean Algebra				
20USECM602	Transportation and Game Theory				
20USECM603	Mathematical Finance				
20USECM604	Vedic Geometry				

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Scheme of Examination and Syllabi of B.Sc. / B.A. Ist Semester Mathematics (w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
20UMTH101	Algebra	Core	2	2	40+10=50
20UMTH102	Calculus	Core	2	2	40+10=50
20UMTH103	Mathematical Lab-I	Core	2	4	40+10=50

20UMTH101

Algebra

Course objectives: To familiarize the students with the concept of rank of a matrix, eigen values and eigen vectors, applications of matrices to a system of linear equations, relations between the roots and coefficients of general equation in one variable, nature of the roots of equation, solution of cubic and biquadratic equations.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Review of matrices (Algebra of matrices, rank of a matrix, Inverse of a matrix), Linear dependence and independence of rows and columns of matrices. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Unit– II

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Diagonalization of a matrices, Bilinear and Quadratic forms.

Unit– III

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.

Unit– IV

Nature of the roots of an equation, Descartes's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.

Course outcomes: After the successful completion of the course the student would be able to find rank, eigen values and eigen vectors, understand applications of matrix to a system of linear

equations, solve equations using relation between roots and coefficients of the equations, describe the nature of the roots of an equations, solve cubic and biquadratic equations.

Suggested Readings:

1. Hall, H.S., Knight S.R.,1994. Higher Algebra. H.M. Publications.
2. Narayan S., Mittal P.K., 1953. A Text Books of Matrices. S. Chand Publishing House,New Delhi.
3. Ayers,F.,1962.Schaum's Theory and Problems of Matrices. McGraw Hill Book Company, New York.
4. Grewal,B.S.2015. Higher Engineering Mathematics, Khanna Publications,India

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20UMTH102

Calculus

Course objectives: Calculus is primarily concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. The course emphasizes a multi-representational approach to calculus, with concepts, results, and problems being expressed geometrically, numerically, analytically, and verbally.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions (Statement and Applications only). Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves. Newton's method. Radius of curvature for pedal curves. Tangential polar equations. Centre of curvature. Circle of curvature. Chord of curvature, evolutes.

Unit – II

Asymptotes in Cartesian and polar coordinates, intersection of curve and its asymptotes. Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points. Type of cusps.

Unit – III

Reduction formulae. Rectification, intrinsic equations of curve. Applications of single integration: Quadrature (area), Sectorial area. Area bounded by closed curves. Volumes and surfaces of solids of revolution(Applications Only). Theorems of Pappu's and Guilden.

Unit – IV

Multiple Integarls: Double integrals in cartesian and polar coordinates, area and volume by Double integrals, Triple integrals cartesian, cyllindrical and spherical coordinates, volume of solids by Triple integrals

Course outcomes:

Students will be able to know the basic rules of differentiation and use them to find derivatives of products and quotients and they will be able to find tangents and normals to graphs of functions given in explicit, implicit and parametric forms and apply the concepts of calculus for tracing and rectification of the curves in Cartesian, parametric and polar coordinates and understand reduction formulae and be familiar with the method of finding volumes and surfaces of solids of revolution.

Suggested Readings:

1. Narayan S., 1962. Differential Calculus. S. Chand and Company.India
2. Spiegel S., Murray R., 1963. Theory and Problems of Advanced Calculus, Mc- Graw Hill, New York.

3. Piskunov N., 1996, Differential and integral Calculus, CBS Publishers, India.
4. Narayan,S.and Mittal P.K,1962.Integral Calculus. S.Chand and Co. New Delhi,India

20UMTH103

Mathematical Lab- I

Maximum Marks-50
External Practical Examination-40
Internal Assessment-10

Mathematical problem Solving Techniques based on courses **20UMTH101 to 20UMTH102** will be taught. Problms will be based on Algebra and Calculus and Students will have to solve atleast 10 problems using MS-Excel.

Note:- Every student will maintain practical record of problems solved during practical class-work in a file. Examination will be conducted through a question paper set jointly by the external and internal examiners. The question paper will consist of questions based on problem solving techniques/algorithm. An examinee will be asked to write the solutions and run on computer. Evaluation will be made on the basis of the examinee's performance in written solutions and presentation with viva-voce and practical record.

Practical Examination will be conducted externally as per the following distribution of marks:

Writing solutions of problems:	*20 marks.*
Presentation &Viva voce:	*10 marks.*
Practical record:	*10 marks.*
Internal Assessment:	*10 marks (Attendance=5 marks, Assignment=5 marks)*

Scheme of Examination and Syllabi of B.Sc. / B.A. IInd Semester Mathematics (w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
20UMTH201	Number Theory & Trigonometry	Core	2	2	40+10=50
20UMTH202	Vector Calculus	Core	2	2	40+10=50
20UMTH203	Mathematical Lab-II	Core	2	4	40+10=50

20UMTH201

Number Theory & Trigonometry

Course objectives: The objective of this course is to familiarize the students with basic concept of elementary number theory such as results on divisibility, congruence, solution of linear congruence equations. Further some basic results on trigonometric functions are also taught.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Divisibility, Greatest common divisor, Least common multiple, Primes, Fundamental theorem of Arithmetic. Linear congruencies, Fermat's theorem, Wilson's theorem and its converse,

Unit – II

Complete residue system and reduced residue system modulo m, Euler's $\emptyset$ function and Euler's generalization of Fermat's theorem, Chinese Remainder theorem (Statement and Applications only), Quadratic residues, Legender symbol, Gauss's lemma (Statement and Applications only), Gauss reciprocity law(Applications only), Greatest integer function, Divisor function($\tau(n)$), Sum function $(\sigma(n))$,

Unit – III

De Moivre's theorem and its applications, Expansion of trigonometric functions, Direct circular and hyperbolic functions and their properties.

Unit – IV

Logarithm of a complex quantity, Gregory's series, Summation of trigonometric series.

Course outcomes: Students would be able to understand the concepts of congruences, residue classes and least residues, learn the operations of addition, subtraction, multiplication and

calculation of powers of integers with respect to modulo m, determine multiplicative inverses with respect to modulo m and use these to solve linear congruences. work with the trigonometric form of complex numbers including De-Moivre's formula and be familiar with the Euler form $r.e^{i\theta}$ of complex numbers.

Suggested Readings:

1. Loney, S.L., 2018. Plane Trigonometry, Creative Media Partners, LLC.
2. Verma ,R.S., Sukla ,K.S., 1969. Text Book on Trigonometry, Pothishala Pvt. Ltd. Allahabad.
3. Niven I., Zuckerman H.S., 1991. An Introduction to the Theory of Numbers, Willey Publication.

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20UMTH202

Vector Calculus & Geometry

Course objectives: To familiarize the students with the concept of scalar and vector product of three and four vectors, vector differentiation, gradient, divergence and curl, orthogonal curvilinear coordinates, vector integration, line integral, surface integral and volume integral.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Gradient of a scalar point function, Directional derivatives, geometrical interpretation of grad ϕ, character of gradient as a point function. Divergence and curl of vector point function and their geometrical significance, characters of Div. $\vec{f}$ and Curl $\vec{f}$ as point function, examples. Gradient, divergence and curl of sums and product and their related vector identities. Laplacian operator.

Unit – II

Orthogonal curvilinear coordinates Conditions for orthogonality fundamental triad of mutually orthogonal unit vectors. Gradient, Divergence, Curl and Laplacian operators in terms of orthogonal curvilinear coordinates, Cylindrical co-ordinates and Spherical co-ordinates.

Unit – III

Vector integration; Line integral, Surface integral, Volume integral. Problems based on Theorems of Gauss, Green & Stokes.

Unit – IV

General equation of second degree. Tracing of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic.

Course outcomes: Students would be able to find the derivative along a curve and directional derivatives, calculate and interpret gradient, divergence, curl and their related vector identities, be familiar with line, surface and volume integrals and use theorems of Gauss, Green and Stokes to compute integrals.

Suggested Readings:

1. Spiegal , Murrary R., 2009. Vector Analysis, Schaum Publishing Company, New York.
2. Saran , N. , Nigam, S.N.,1982. Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
3. Narayna S., 1955. A Text Book of Vector Calculus, S. Chand & Co., New Delhi.
4. Bill, R.J.T., 1994.Elementary Treatise on Co-Ordinary Geometry of Three Dimensions, MacMillan India Ltd.
5. Jain, P.K., Ahmad, Khalil, 1999 .A Textbook of Analytical Geometry of Three Dimensions,Wiley Eastern Ltd. .

20UMTH203

Mathematical Lab- II

Maximum Marks-50
External Practical Examination-40
Internal Assessment-10

Mathematical problem Solving Techniques based on courses **20UMTH201 to 20UMTH202** will be taught. The students will have to solve at least 20 problems and have to solve atleast 10 problems using MS-Excel.

Note:- Every student will maintain practical record of problems solved during practical class-work in a file. Examination will be conducted through a question paper set jointly by the external and internal examiners. The question paper will consist of questions based on problem solving techniques/algorithm. An examinee will be asked to write the solutions in the answer book. Evaluation will be made on the basis of the examinee's performance in written solutions and presentation with viva-voce and practical record.

Practical Examination will be conducted externally as per the following distribution of marks:

Writing solutions of problems:	*20 marks.*
Presentation &Viva voce:	*10 marks.*
Practical record:	*10 marks.*
Internal Assesment:	*10 marks (Attendance=5 marks, Assignment=5 marks)*

Scheme of Examination and Syllabi of B.Sc. / B.A. IIIrd Semester Mathematics (w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
20UMTH301	Differential Equations	Core	2	2	40+10=50
20UMTH302	Numerical Methods with Programming in C	Core	2	2	40+10=50
20UMTH303	Mathematical Lab-III	Core	2	4	40+10=50

20UMTH301

Differential Equations

Course objectives: This course has been devised to make the students learn the theory of differential Equations. Exact differential equations and their integrating Factors along with equations of first order but of higher degree are solved. To taught the students Orthogonal Trajectories and Linear Differential of Various orders, transformation of equations to normal form, change of dependent and independent variable, solutions of simultaneous and total differential Equations, Linear and non- linear partial equations along with Homogeneous and Non Homogeneous equations. To make them understand the underlying theories of classifying them.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Geometrical meaning of a differential equation. Exact differential equations, integrating factors. Reduction to Exact differential equations, First order higher degree equations solvable for x, y, dy/dx, Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form. Singular solutions.

Unit – II

Orthogonal trajectories: in Cartesian coordinates and polar coordinates. Self-orthogonal family of curves. Linear differential equations with constant coefficients. Solution by variation of

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parameters. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous linear ordinary differential equations.

Unit – III

Partial differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order: Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution.

Unit – IV

Jacobi's method, Linear partial differential equations of second and higher orders, Linear and non-linear homogenous and non-homogenous equations with constant co-efficient, Method of separation of variables.

Course outcomes: Students would be able to be familiar with formation of differential equations and to solve exact differential equations by finding integrating factors, find solution of Lagrange's equations, Clairauts equations and other standard equations of first order but not of first degree, learn the concept of auxiliary equation, particular integral for linear differential equations with constant co-efficients and their solution, understand linear differential equations of second order and their solution by different methods and get familiar with solution of ordinary simultaneous differential equations and total differential equations. Students would be able to solve Lagrange's linear equations using Charpit's general method and Jacobi's method, classify partial differential equations and transform them into cononical forms.

Suggested Readings:

1. Murray, D.A.,1967. Introductory Course in Differential Equations. Orient Longaman India.
2. Bronson,R.and Gabriel,B.C,2006. Schaum's Outline of Differential Equations.McGraw Hill,New York.
3. Ross, S.R.,2004. Differential Equations, John Wiley & Sons
4. Rai,B. & Chaudhary,D.P., Ordinary Differential Equations; Narosa, Publishing House Pvt. Ltd.
5. Sneddon, I.N., 1988.Elements of Partial Differential Equations, McGraw Hill Book Company, New York.
6. Sharma J.N and Singh K.2009. Partial Differential Equations for Engineers and Scientists, Alpha Science International.

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20UMTH302

Numerical Methods with Programming in C

Course objectives: To provide the student with numerical methods of solving the non-linear equations, interpolation, differentiation, and integration. - To improve the student's skills in numerical methods by using the numerical analysis software and computer facilities.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Programmer's model of a computer, Algorithms, Flow charts, Data types, Operators and expressions, Input / outputs 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.

Unit – III

Solution of Algebraic and Transcendental equations: Bisection method, Regula-Falsi method, Secant method, Fixed Point iterative method, Newton-Raphson's method. Newton's iterative method for finding nth root of a number, Order of convergence of above methods.

Unit – IV

Simultaneous linear algebraic equations: Gauss-elimination method, Gauss-Jordan method, Iterative method, Jacobi's method, Gauss-Seidal's method, Relaxation method. Convergence of Gauss Seidal Method.

Course outcomes: On completion of this course, the student should be able to solve interpolation, linear Equations, simultaneous linear equations, integration.

Suggested Readings:

1. Thareja,R.,Programming in C,2016. Oxford University Press.Oxford.
2. V. Rajaraman,1994. Programming in C, Prentice Hall of India.
3. M.K. Jain, S. R. K. Iyengar, R.K. Jain,1996. Numerical Method, Problems and Solutions, New Age International (P) Ltd.
4. Balagurusamy, E.,2008,Programming in ANSI C, Tata McGraw-Hill Publishing Co. Ltd.
5. Balagurusamy,E.,2010.Numerical Methods, Tata McGraw-Hill Publishing Co. Ltd,India

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20UMTH303

Mathematical Lab- III

Maximum Marks-50
External Practical Examination-40
Internal Assessment-10

Mathematical problem Solving Techniques based on courses **20UMTH301 to 20UMTH302** will be taught. Problems will be based on Differential Equations and Numerical Methods.
Students will have to solve atleast 10 problems using C-Language.
Note:- Every student will maintain practical record of problems solved during practical class-work in a file. Examination will be conducted through a question paper set jointly by the external and internal examiners. The question paper will consist of questions based on problem solving techniques/algorithm. An examinee will be asked to write the solutions in the answer book. Evaluation will be made on the basis of the examinee's performance in written solutions and presentation with viva-voce and practical record.

Practical Examination will be conducted externally as per the following distribution of marks:

Writing solutions of problems:	*20 marks.*
Presentation &Viva voce:	*10 marks.*
Practical record:	*10 marks.*
Internal Assesment:	*10 marks (Attendance=5 marks, Assignment=5 marks)*

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Scheme of Examination and Syllabi of B.Sc. / B.A. IVth Semester
Mathematics
(w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
20UMTH401	Mechanics	Core	2	2	40+10=50
20UMTH402	Groups & Rings	Core	2	2	40+10=50
20UMTH403	Mathematical Lab-IV	Core	2	4	40+10=50

20UMTH401

Mechanics

Course objectives: To familiarize the students with the concept of composition and resolution of forces, resultant of two parallel forces, moments and couples and velocity and acceleration along radial, transvers, tangential and normal directions, Newton's Laws of motion.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Composition and resolution of forces, Resultant of two Parallel forces and their applications.

Unit – II

Moments and Couples, Analytical conditions of equilibrium of coplanar forces.

Unit – III

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

Unit – IV

Elastic strings, Newton's laws of motion. Work, Power and Energy.

Course objectives: After this study, student will be able to find the resultant of two parallel forces, moments and couples and velocity and acceleration along radial, transvers, tangential and normal directions, Newton's Laws of motion.

Suggested Readings:

1. Loney,S.L., 1912.Statics, Cambride University Press
2. Verma, R.S., 1962.A Text Book on Statics, Pothishala Pvt. Ltd.,

3. Loney,S.L.,1956. An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press.
4. Chorlton,F.,2002. Text book of Dynamics, CBS Publishers, New Delhi

20UMTH402

Groups & Rings

Course objectives: The objective of this course is to familiarize the students with basic concept of modern algebra such as results on groups, cyclic groups, normal subgroups, Lagrange's theorem and its consequences, group homomorphism, permutation groups, Cayley's theorem, some basic concepts of rings such as ideal, maximal ideal, field, Euclidean rings, Principle ideal rings, Unique factorization domain are also taught.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

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, Lagrange's theorem and its consequences, Normal subgroups.

Unit – II

Quotient Groups. Homomorphism, isomorphism, automorphism and inner automorphism of a group. Automorphism of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem.

Unit – III

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphism, ideals (principle, prime and Maximal) and Quotient rings.

Unit – IV

Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion (Statement and Applications only), Polynomial rings over commutative rings, Unique factorization domain.

Course outcomes: Students would be able to demonstrate understanding of the idea of a group, subgroup, cyclic groups,normal groups and quotient groups, understand and apply the concepts of homomorphism, isomorphism, automorphisms and inner automorphisms of a group and describe rings, subrings, Euclidean rings, polynomial rings and the Eisenstien's criterion of irreducibility.

Suggested Readings:

1. Herstein I.N,1975. Topics in Algebra, Wiley Eastern Ltd., New Delhi.
2. Bhattacharya P.B., Jain S.K., Nagpal S.R., 2003, Basic Abstract Algebra (2nd edition), Cambridge University Press.
3. Sahai V., Bist V., 2013, Linear Algebra, Narosa Publishing House.
4. Luther I.S., Passi I.B.S., 1905, Algebra, Vol.-II, Narosa Publishing House.
5. Gallian J.A., 1999, Abstract Algebra, Narosa Publishing House.

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20UMTH403

Mathematical Lab- IV

Maximum Marks-50
External Practical Examination-40
Internal Assessment-10

Mathematical problem Solving Techniques based on courses **20UMTH401 to 20UMTH402** will be taught. Problems will be based on Mechanics and Groups & Rings.
Students will have to solve atleast 10 problems using Excel/ C-Language.
Note:- Every student will maintain practical record of problems solved during practical class-work in a file. Examination will be conducted through a question paper set jointly by the external and internal examiners. The question paper will consist of questions based on problem solving techniques/algorithm. An examinee will be asked to write the solutions in the answer book. Evaluation will be made on the basis of the examinee's performance in written solutions and presentation with viva-voce and practical record.

Practical Examination will be conducted externally as per the following distribution of marks:

Writing solutions of problems:	*20 marks.*
Presentation &Viva voce:	*10 marks.*
Practical record:	*10 marks.*
Internal Assesment:	*10 marks (Attendance=5 marks, Assignment=5 marks)*

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Scheme of Examination and Syllabi of B.Sc. / B.A. Vth Semester Mathematics
(w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
Choose One from 20UMTH501 or 20UMTH502 & Choose One from 20UMTH503 or 20UMTH504					
20UMTH501	Statics & Dynamics	Discipline Specific Elective	2	2	40+10=50
20UMTH502	Statistical Inference				
20UMTH503	Mathematical Analysis	Discipline Specific Elective	2	2	40+10=50
20UMTH504	Linear Algebra				
20UMTH505	Mathematical Lab-V	Discipline Specific Elective	2	4	40+10=50

20UMTH501

Statics & Dynamics

Course objectives: This course introduces the concept based on forces in equilibrium. The syllabus describes static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions and introduce the concept of velocity, acceleration motion along curve, simple harmonic motion, elastic strings, Newton's laws of motion, Kepler's laws of motion etc.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Friction, Centre of Gravity. Virtual work.

Unit – II

Forces in three dimensions, Poinsot's central axis. Wrenches, Null lines and planes.

Unit – III

.Definitions of Conservative forces and Impulsive forces. 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.

Course outcomes: Students would be able to understand the conditions of equilibrium to solve problems on friction, center of gravity and virtual work, understand and solve the problems based on stable and unstable equilibrium and be familiar with the theory of forces in three dimensions and wrenches and Students would be able to solve the problems based on simple harmonic motion and elastic strings, apply Newton's laws of motion and describe motion of a particle on smooth andrough plane curves and describe the motion of a projectile, Kepler's laws of motion and motion of aparticle in three dimensions

Suggested Readings:

1. Loney,S.L., 1912.Statics, Cambride University Press
2. Verma, R.S., 1962.A Text Book on Statics, Pothishala Pvt. Ltd.,
3. Loney,S.L.,1956. An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press.
4. Chorlton,F.,2002. Text book of Dynamics, CBS Publishers, New Delhi

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20UMTH502

Statistical Inference

Course Objective: This course deals with fundamental concepts of statistical inference including estimation and tests of simple and composite hypotheses. A brief revision will also be given of some basic topics in probability theory as well as single and multiple random variables.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Parameter and statistic, sampling distribution and standard error of estimate. Point and interval estimation, Unbiasedness, Efficiency, Consistency and Sufficiency. Method of maximum likelihood estimation.

Unit – II

Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Types of errors, Neyman- Pearson Lemma.

Unit – III

Definition of Chi-square statistic, Chi-square tests for goodness of fit and independence of attributes. Student t-distribution, properties of t-distribution, significance test of single mean and difference between two sample means.

UNIT-IV

Snedcor's F-statistics. Testing for the mean and variance of univariate normal distributions, Testing of equality of two means and two variances of two univariate normal distributions. Related confidence intervals. Analysis of variance(ANOVA) for one-way and two-way classifications.

Course outcomes: Students would be able to understand the concepts of point estimation and interval estimation, identify good estimators using criterion of good estimators and obtain them using method of maximum likelihood, explain and use Neyman-Pearson lemma, carry out tests of significance and obtain confidence intervals for single proportion and difference of two proportions, single mean, difference of two means for large samples and learn about chi-square, Students't and Snedcor F-statistics and their important applications.

Suggested Readings:

1. Mood A.M, Graybill, F.A and Boes,D.C., 1974 Introduction to the theory of Statistics, McGraw Hill.
2. Goon,A.M , Gupta,M.K. and Gupta,B.D.,2002 Fundamentals of Statistics, Vol-II.World Press
3. Hogg,R.V. and Craig,A.T.2018, Introduction to Mathematical Statistics.Pearson Education.
4. S.C. Gupta and V.K. Kapoor, 2002. Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

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20UMTH503

Mathematical Analysis

Course objectives: To familiarize the students with the basic aspects related to the topology of real numbers, convergence of sequences and series of real numbers and various convergence tests for infinite series etc and basic knowledge of complex analysis.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

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-Weirestrass theorem (Statement only), Open covers, Compact sets and Heine- Borel Theorem(Statement only).

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, Sub-sequential limits. Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series (Statement and Applications only), Cauchy's general principle of Convergence of series,

Unit – III

Infinite series: Convergence and divergence of geometric series, p-series. Applications of D-Alembert's ratio test, Raabe's test, Cauchy's nth root test, Gauss Test, Cauchy's integral test, Cauchy's condensation test. Alternating series, Leibnitz's test, absolute and conditional convergence.

Unit – IV

Extended Complex Plane, Stereographic projection of complex numbers, Functions of complex variables: exponential, logarithmic, circular, hyperbolic, inverse hyperbolic functions, real and imaginary part of complex functions; continuity and differentiability of complex functions.

Course outcomes: Students would be able to explain the concept of sequences and their types, identify the convergence of sequences and series of positive terms, apply various important convergence tests to the given series and understand the difference between conditional and absolute convergence of alternating series and basics of complex analysis.

Suggested Readings:

1. Goldberg,R.R.,1970. Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi.
2. Malik, S.C. and Arora S,1992. Mathematical Analysis, New Age International, India.
3. Narayan,S.,2013. A Course on Mathematical Analysis, S. Chand and company, New Delhi

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4. Wrede,R. and Spiegel M.R.,2002. Theory and Problems of Advanced Calculus, Schaum Publishing co., New York
5. Apostol, T.M.,1985. Mathematical Analysis, Narosa Publishing House, New Delhi.
6.. Shanti Narayan: Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.

20UMTH504

Linear Algebra

Course objectives: The objective of this course is to familiarize the students with basic concept of vector spaces such as results on subspaces, linear span, linearly independence and dependence of vectors, bases, quotient space, linear transformation, rank and nullity theorem, change of bases, Eigen values and vectors, Cauchy-Schwarz inequality, Orthogonal sets and Basis. Bessel's inequality, Gram-Schmidt orthogonalization process

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

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 vector 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, Null Space, Range space of a linear transformation, Rank and Nullity Theorem(Statement and applications).

Unit – III

Algebra of Liner Transformation, Minimal Polynomial of a linear transformation, Singular and non-singular linear transformations, Matrix of a linear Transformation, Change of basis,

Unit – IV

Eigen values and Eigen vectors of linear transformations. Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors, orthogonal complements, Orthogonal sets and Basis, Bessel's inequality for finite dimensional vector spaces (Statement only), Gram-Schmidt, Orthogonalization process.

Course outcomes: Students would be able to get familiar with vector spaces, subspaces and existence theorem for basis of a finitely generated vector space, describe the concepts of homomorphism, isomorphism and dual spaces, learn singular and non-singular linear transformations, eigen values and eigen vectors of linear transformations and having the knowledge of inner product spaces, orthogonal vectors, orthogonal sets andGram Schmidt orthogonalization process.

Suggested Readings:

1. Herstein,I.N.,1975. Topics in Algebra, Wiley Eastern Ltd., New Delhi.
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
5. Lipschutz,S.and Lipson,M.L.,2009. Schaum's outline series of Linear Algebra,McGraw Hill Co. New York.

20UMTH505

Mathematical Lab- V

Maximum Marks-50
External Practical Examination-40
Internal Assessment-10

Mathematical problem Solving Techniques based on courses **20UMTH501/ 20UMTH502 and 20UMTH503/ 20UMTH504** will be taught. Problems will be based on Statics & Dynamics / Statistical Inference and Mathematical Analysis/ Linear Algebra and Students will have to solve atleast 10 problems using Computer software- Mathematica/Excel/C-language.
Note:- Every student will maintain practical record of problems solved during practical class-work in a file. Examination will be conducted through a question paper set jointly by the external and internal examiners. The question paper will consist of questions based on problem solving techniques/algorithm. An examinee will be asked to write the solutions in the answer book. Evaluation will be made on the basis of the examinee's performance in written solutions and presentation with viva-voce and practical record.

Practical Examination will be conducted externally as per the following distribution of marks:

Writing solutions of problems:	*20 marks.*
Presentation &Viva voce:	*10 marks.*
Practical record:	*10 marks.*
Internal Assesment:	*10 marks (Attendance=5 marks, Assignment=5 marks)*

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Scheme of Examination and Syllabi of B.Sc. / B.A. VIth Semester Mathematics (w.e.f. 2020-21)

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
Choose One from 20UMTH601 or 20UMTH602 & Choose One from 20UMTH603 or 20UMTH604					
20UMTH601	Special Functions & Integral Transforms	Discipline Specific Elective	2	2	40+10=50
20UMTH602	Solid Geometry				
20UMTH603	Real Analysis	Discipline Specific Elective	2	2	40+10=50
20UMTH604	Advanced Calculus				
20UMTH605	Mathematical Lab-VI	Discipline Specific Elective	2	4	40+10=50

20UMTH601

Special Functions & Integral Transforms

Course objectives: To acquaint the students with Series solution of differential equations – Power series method, Beta and Gamma functions, Bessel, Legendre and Hermite functions, recurrence relations, generating functions, Rodrigues' Formula Orthogonality of Bessel functions, Laplace Transforms, Fourier transforms and solution of differential Equations using Laplace & Fourier Transforms.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Series solution of differential equations – Power series method, Definitions of Beta and Gamma functions. Bessel equation and its solution: Bessel functions and their properties-Convergence, recurrence.Relations and generating functions, Orthogonality of Bessel functions.

Unit – II

Legendre differentials equations and their solutions: Legendre functions and their properties-Recurrence Relations and generating functions. Orthogonality of Legendre functions . Rodrigues' Formula for Legendre , Integral Representation of Legendre polynomial.

Unit – III

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Laplace Transforms – Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Convolution theorem, Inverse Laplace transforms, convolution theorem, Inverse Laplace transforms of derivatives and integrals, solution of ordinary differential equations with constant coefficients using Laplace transforms.

Unit – IV

Fourier transforms: Linearity property, Shifting, Modulation, Convolution Theorem, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms. Solution of ordinary differential Equations using Fourier Transforms.

Course outcomes: Students would be able to be familiar with Bessel's functions, Hermite's polynomial, Legendre's polynomialand their properties, solve Bessel's, Legendre's and Hermite's equations, find the Laplace transform, inverse Laplace transform of various functions, apply Laplace transform to solve ordinary differential equations and determine the Fourier transform of various functions and solve the partialdifferential equations using them.

Suggested Readings:

1. Kreyszing, E.,1999.Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York.
2. Sneddon,I.N.,1956. Special Functions on Mathematical Physics & Chemistry. Interscience Publisher,New York.
3. Debnath L and Bhatta D.,2014. Integral Transform and their Applications,CRC,Press

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20UMTH602

Solid Geometry

Course objectives: The course is aimed to give information about tracing of conics and also aimed to give information about tangents and normals to the conics. Here we provide the knowledge of central conicoids and their generating lines.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

General equation of second degree. Tracing of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic. System of conics. Confocal conics. Polar equation of a conic, tangent and normal to the conic.

Unit – II

Sphere: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres. Co-axial system of spheres,

Unit-III

cones. Right circular cone, enveloping cone and reciprocal cone. Cylinder: Right circular cylinder and enveloping cylinder.

Unit – IV

Central conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Enveloping cone of a coincoid. Enveloping cylinder of a coincoid.

Course outcomes: Students would be able to derive system of conics, confocal conics and polar equation of a conic, determine the tangent and normal at any point, chord of contact and poles of linefor a conic, understand the concept of sphere, cone and cylinder, obtain the equations of tangent plane, director sphere, normal to the conicoidsand enveloping and describe circular section, plane sections of conicoids, generating lines, confocal lconicoid and reductions of second degree equations.

Suggested Readings:

1. Bill, R.J.T.,1994.Elementary Treatise on Co-ordinary Geometry of Three Dimensions, MacMillan India Ltd.
2. Jain, P.K. and Ahmad,K.,1999. A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd.

20UMTH603

Real Analysis

Course objectives: To acquaint with Riemann integral, improper integral and their properties. They will also able to know how distance function defined on an arbitrary non empty set and its properties.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit – I

Riemann integral, Integrabililty 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 Integrabililty 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(statement and applications), Baire's category theorem(Statements and applications), contraction Principle

Unit – IV

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

Course outcomes: Students would be able to explain the fundamental concepts of real analysis and Reimann integrability onthe universal set of functions, understand the geometric interpretation of metric space, construct and interpret various proper and improper integrals and operate with real numbers, real functions, use of characteristics of study of metricspaces in the related fields such as geometry and complex analysis etc.

Suggested Readings:

1. Jain, P.K. and Ahmad,K.,2004 Metric Spaces, 2nd Ed., Narosa Publishing House,N.Delhi
2. Apostol, T.M,1985. Mathematical Analysis, Narosa Publishing House, New Delhi.
3. Goldberg,R.R.,1970.Real analysis, Oxford & IBH publishing Co., New Delhi.
4. Narayan,S and Mittal P.K.,2013 A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. Copson,E.T.,1968. Metric Spaces, Cambridge University Press.
6. Simmons,G.F.,1963. Introduction to Topology and Modern Analysis, McGraw Hill.

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20UMTH604

Advanced Calculus

Course objectives: The objective of this course is to make the students understand the concepts of continuity, sequential continuity, properties of continuous functions, uniform continuity, limit and continuity of real valued functions of two variables, partial differentiation. Some concepts of differential geometry will be discussed.

Maximum Marks-50
External Examination-40
Internal Assessment-10
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Uniform continuity, chain rule of differentiability. Mean value theorems; Rolle's Theorem and Lagrange's mean value theorem and their geometrical interpretations. Taylor's Theorem with various forms of remainders, Darboux intermediate value theorem for derivatives(statement only), Indeterminate forms.

Unit – II

Limit and continuity of real valued functions of two variables. Partial differentiation. Total Differentials; Composite functions & implicit functions. Change of variables. Homogenous functions & Euler's theorem on homogeneous functions.

Unit – III

Taylor's theorem for functions of two variables. Differentiability of real valued functions of two variables. Schwarz and Young's theorem. Implicit function theorem. Maxima, Minima and saddle points of two variables.

Unit – IV

Lagrange's method of multipliers. Jacobian, Differentiation under integral sign, Applications of Triple integrals, Change of variable in Double and triple integrals.

Course outcomes: Students would be able to understand the concepts of continuity, uniform continuity and their related theorems, describe the concepts of limit, continuity and differentiability of real valuedfunction of two variables, explain maxima, minima and saddle pointes of two variables and Lagrange'smethod of multipliers and determine the tangent, principle normal, locus of curvature, Bertrand curves,tangent plains and apply them to different problems.

Suggested Readings:

1. Narayan S., 1962. Differential Calculus. S. Chand and Company.India
2. Spiegel S., Murray R., 1963. Theory and Problems of Advanced Calculus, Mc- Graw Hill, New York.
3. Prasad,G. 1941.Text book on Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
4. Ramana, B.V.,2008. Higher Engineering Mathematics,Tata McGraw Hill Publishing Co.Ltd. New Delhi

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20UMTH605

Mathematical Lab- VI

Maximum Marks-50
External Practical Examination-40
Internal Assessment-10

Mathematical problem Solving Techniques based on courses **20UMTH601/ 20UMTH602 and 20UMTH603/ 20UMTH604** will be taught. Programmes will be based on Special Functions & Integral Transforms / Solid Geometry and Real Analysis/ Advanced Calculus.
Students will have to solve atleast 10 problems using Computer software- Mathematica.
Note:- Every student will maintain practical record of problems solved during practical class-work in a file. Examination will be conducted through a question paper set jointly by the external and internal examiners. The question paper will consist of questions based on problem solving techniques/algorithm. An examinee will be asked to write the solutions in the answer book. Evaluation will be made on the basis of the examinee's performance in written solutions and presentation with viva-voce and practical record.

Practical Examination will be conducted externally as per the following distribution of marks:

Writing solutions of problems:	*20 marks.*
Presentation &Viva voce:	*10 marks.*
Practical record:	*10 marks.*
Internal Assesment:	*10 marks (Attendance=5 marks, Assignment=5 marks)*

Skill Enhancement Courses offered by Department of Mathematics

Scheme of Examination and Syllabi of SEC for B.Sc. (Non-Medical & Computer Science)/ B. A. Mathematics (w.e.f. 2020-21) SEMESTER-IV

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
Choose One out of following four papers:					
20USECM401	Logic and sets	Skill Enhancement	3	3	80+20=100
20USECM402	Analytical Geometry				
20USECM403	Probability & Statistics				
20USECM404	Vedic Arithmetic				

20USECM401

Logic and sets

Course objectives:

The objective of this course is to introduce the students to the basic concepts of truth table and operators, equivalences, quantifiers, predicates and basic set theory.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, bi-conditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit – II

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit – III

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set

operations. Classes of sets. Power set of a set.

Unit – IV

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

Course outcomes:

After this course students would be able to familiar with basic concepts of truth table and operators, equivalences, quantifiers, predicates and basic set theory.

Suggested Readings:

1. Grimaldi, R.P. 1998. Discrete Mathematics and Combinatorial Mathematics, Pearson Education.
2. Halmos, P.R.,1974. Naive Set Theory, Springer.
3. Kamke, E.1950.Theory of Sets, Dover Publishers.

20USECM402

Analytical Geometry

Course objectives:

The objective of this course is to introduce the students to the basic techniques for sketching and reflection properties of parabola, hyperbola and ellipse.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Techniques for sketching parabola, ellipse and hyperbola.

Unit – II

Reflection properties of parabola, ellipse and hyperbola.

Unit – III

Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.

Unit – IV

Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Course outcomes:

After study this paper students would be able to familiar with the basic techniques for sketching and reflection properties of parabola, hyperbola and ellipse.

Suggested Readings:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd., 2002.
3. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.1920.
4. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

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20USECM403

Probability and Statistics

Course objectives:

The objective of this course is to introduce the students to the basic knowledge of distribution function, mathematical expectation, moments, expectations of function of two random variables etc.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation.

Unit – II

Moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, continuous distributions: uniform, normal, exponential.

Unit – III

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions.

Unit – IV

Expectation of function of two random variables, conditional expectations, independent random variables.

Course outcomes:

After study of this paper students would be able to familiar with the basic knowledge of distribution function, mathematical expectation, moments, expectations of function of two random variables etc.

Suggested Readings:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Application,* 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Model,* 9th Ed., Academic Press, Indian Reprint, 2007.

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20USECM404

Vedic Arithmetic

Course objectives:

The objective of this course is to introduce the students to the knowledge of multiplication, division, LCM, HCF and power of numbers by using different vedic methods.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Multiplication: Ekadhikena Purvena method (multiplication of two numbers of two digits), Ekadhikena Purvena (multiplication of two numbers of three digits), Urdhvatiryakbhyam (multiplication of two numbers of three digits), Nikhilam Navtashcarman Dashtaha (multiplication of two numbers of three digits), Combined Operations.

Unit – II

Division: Nikhilam Navtashcarman Dashtaha (two digits divisor), Paravartya Yojayati-Sutra (three digits divisor). Divisibility: Ekadhikena Purvena method (two digits divisor), Ekadhikena Purvena (two digits divisor).

Unit – III

LCM and HCF in arithmetic and Algebra.

Unit – IV

Power: Square (four digits numbers), Cube(two digits numbers). Root: Square root (four digits numbers), Cube root(six digits numbers).

Course outcomes:

After the study, students would gain the knowledge of multiplication, division, LCM, HCF and power of numbers by using different vedic methods.

Suggested Readings:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leekavati, Chokhambba Vidya Bhawan, Varansi.
6. Bharatiya Mathematicians, Sharda Sanskriti Sansthan, Varanasi.

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Scheme of Examination and Syllabi of SEC for B.Sc. (Non-Medical & Computer Science)/ B. A. Mathematics
(w.e.f. 2020-21)
SEMESTER-V

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
Choose One out of following four papers:					
20USECM501	Integral Calculus	Skill Enhancement	3	3	80+20=100
20USECM502	Theory of Equations				
20USECM503	Discrete Mathematics				
20USECM504	Vedic Algebra				

20USECM501

Integral Calculus

Course objectives:

The objective of this course is to introduce the students to the knowledge of integration of rational and irrationals, reduction formulae for rational, trigonometric, exponential, logarithm functions, areas and volume by using double and triple integral.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals.

Unit – II

Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations.

Unit – III

Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution.

Unit – IV

Double and Triple integrals.

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Course outcomes:

After this course students would acquire the knowledge of integration of rational and irrationals, reduction formulae for rational, trigonometric, exponential, logarithm functions, areas and volume by using double and triple integral.

Suggested Readings:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd.,2002.

20USECM502

Theory of Equations

Course objectives:

The objective of this course is to introduce the students to the knowledge of general properties of polynomials and equations, symmetric functions, transformations of equations and algebraic solutions of cubic and biquadratic.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials.

Unit – II

General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Unit – III

Symmetric functions, Applications symmetric function of the roots, Transformation of equations.

Unit – IV

Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Course outcomes:

After this course, students would gain the knowledge of general properties of polynomials and equations, symmetric functions, transformations of equations and algebraic solutions of cubic and biquadratic.

Suggested Readings:

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

20USECM503

Discrete Mathematics

Course objectives:

The objective of this course is to introduce the students to the basic concepts of truth table and operators, equivalences, quantifiers, predicates and basic set and graph theory .

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit – I

Sets, principle of inclusion and exclusion, relations, equivalence relations and partition, denumerable sets, partial order relations, Mathematical Induction, Pigeon Hole Principle and its applications.

Unit – II

Propositions, logical operations, logical equivalence, conditional propositions, Tautologies and contradictions. Quantifier, Predicates and Validity.

Unit – III

Permutations and combinations, probability, basic theory of Graphs and rings.

Unit – IV

Discrete numeric functions, Generating functions, recurrence relations with constant coefficients. Homogeneous solution, particular relations, total rotation, Solution of recurrence relation by the method Generating function.

Course objectives:

After this study students would be able to know the basic concepts of truth table and operators, equivalences, quantifiers, predicates and basic set and graph theory .

Suggested Readings:

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.2014.
3. Seymour Lipschutz, Finite Mathematics (International edition 1983), McGraw-Hill Book Company, New York.1983.
4. C.L. Liu, Elements of Discrete Mathematics, McGraw- Hill Book Co.1998.

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20USECM504

Vedic Algebra

Course objectives:

The objective of this course is to introduce the students to the vedic methods for multiplication (by Urdhvatiragbhyam Method), division, LCM and HCF and solve linear equations.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Multiplication: Urdhvatiragbhyam Method, Combined Operations.

Unit – II

Division (Divisor: Linear Expression of Single Variable), Factorization (Quadratic Expression of single variable).

Unit – III

LCM and HCF

Unit – IV

Solutions of linear simultaneous equations.

Course outcomes:

After this course students would gain the knowledge of vedic methods for multiplication, division, LCM and HCF and solve linear equations.

Suggested Readings:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Beejganitam, Chokhambba Vidya Bhawan, Varansi.
6. Bharatiya Mathematicians, Sharda Sanskriti Sansthan, Varanasi.

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Scheme of Examination and Syllabi of SEC for B.Sc. (Non-Medical & Computer Science)/ B. A. Mathematics
(w.e.f. 2020-21)
SEMESTER-VI

Paper Code	Paper Name	Type of Course	Credits (Theory/ Practical)	Contact Hours (Theory/ Practical)	Marks (External + Internal)
Choose One out of following four papers:					
20USECM601	Boolean Algebra	Skill Enhancement	3	3	80+20=100
20USECM602	Transportation and Game Theory				
20USECM603	Mathematical Finance				
20USECM604	Vedic Geometry				

20USECM601

Boolean Algebra

The objective of this course is to introduce the students to the knowledge of ordered sets and their properties, Lattices and Boolean polynomials etc.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements.

Unit – II

Lattices as ordered sets, complete lattices, lattices as algebraic structures, sub-lattices, products and homomorphism.

Unit – III

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials.

Unit – IV

Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Course outcomes:

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After study of this paper students would be acquire the knowledge of ordered sets and their properties, Lattices and Boolean polynomials etc.

Suggested Readings:

1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order,* Cambridge University Press, Cambridge, 1990.

2. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra,* 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

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20USECM602

Transportation & Game Theory

Course objectives:

The objective of this course is to introduce the students to the knowledge of transportation problem, vogel approximation, Hungarian method for solving assignment problem and game theory.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Transportation problem and its mathematical formulation, northwest-corner method, least cost Method.

Unit – II

Vogel approximation method for determination of starting basic solution.

Unit – III

Algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit – IV

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure.

Course outcomes:

After the study, student would gain the knowledge of transportation problem, vogel approximation, Hungarian method for solving assignment problem and game theory.

Suggested Readings :

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows,* 2nd Ed., John Wiley and Sons, India, 2004.
2. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research,* 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, *Operations Research, An Introduction,* 8th Ed., Prentice-Hall India, 2006.

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20USECM603

Mathematical Finance

Course objectives:

The objective of this course is to introduce the students to the knowledge of comparison, arbitrage and risk aversion, floating rate bonds, asset return, Diversification, portfolio diagram etc.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation.

Unit – II

Net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields. Floating-rate bonds, immunization.

Unit – III

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance.

Unit – IV

Diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).

Course outcomes:

After this course students would acquire the knowledge of comparison, arbitrage and risk aversion, floating rate bonds, asset return, Diversification, portfolio diagram etc.

Suggested Readings:

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.
2. John C. Hull, Options, *Futures and Other Derivatives,* 6th Ed., Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed.; Cambridge University Press, USA, 2003.

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20USECM604

Vedic Geometry

Course objectives:

The objective of this course is to introduce the students to the knowledge of Bhaudhayana Number, trigonometry, Co-ordinate Geometry and complex numbers.

Maximum Marks-100
External Examination-80
Internal Assessment-20
Max. Time- 3 hrs.

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit – I

Concept of Bhaudhayana Number (BN): BN of an angle, Multiplication of a constant in a BN, BN of complimentary angles, BN of sum and difference of an angle, BN of half angle.

Unit – II

Trigonometry: Definition of trigonometric ratios, Trigonometric identities.

Unit – III

Co-ordinate Geometry: Different forms of straight lines.

Unit – IV

Complex Numbers: Multiplication, division and square root.

Course outcomes:

After this course students would be able to gain the knowledge of Bhaudhayana Number, trigonometry, Co-ordinate Geometry and complex numbers.

Suggested Readings:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Beejganitam, Chokhambba Vidya Bhawan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskriti Sansthan, Varanasi.

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