K.K. UNIV ERSITY

NALANDA, BIHAR - 803115

SCHOOL OF APPLIED SCIENCES

BACHELOR OF SCIENCE (B.Sc.)

MATHEMATICS

(Three Years Full Programme)

2022-2023

PROGRAMME STRUCTURE & SYLLABUS

K.K. UNIVERSITY 803115 NALANDA

Pro Vice Chancellor
KK University
Berauti, Nepura, Bihar Sharif
Nalanda - 803115 (Bihar)

B.Sc. Mathematics (Hons.) - Program Structure- Total Credit - 144						
SESSION : 2022-2025						
semester : I						
S.No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Total Credit**
1	BSMT- 1101	Calculus	3	1	0	4
2	BSMT- 1102	Algebra	3	1	0	4
3	BSMT - 1103	number theory	3	1	0	4
4	BSPH-S- 1101	Physics-I	3	0	0	3
5	BSCH-S- 1101	Chemistry -I	3	0	0	3
6	HNL - 1101	Hindi - I	2	0	0	2
7	BSPH-S- 1101-P	Practical Physics - I	0	0	4	2
8	BSCH-S- 1101-P	Practical Chemistry - I	0	0	4	2
						24
semester : II						
S.No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Total Credit**
1	BSMT- 1201	Real Analysis	3	1	0	4
2	BSMT- 1202	Differential Equations	3	1	0	4
3	BSMT - 1203	probability and Statics	3	1	0	4
4	BSPH-S- 1201	Physics-II	3	0	0	3
5	BSCH-S- 1201	Chemistry -II	3	0	0	3
6	ENL - 1201	English -I	2	0	0	2
7	BSPH-S- 1201-P	Practical Physics -II	0	0	4	2
8	BSCH-S- 1201-P	Practical Chemistry -II	0	0	4	2
						24
semester : III						
S.No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Total Credit**
1	BSMT - 2101	Theory of Real Functions	3	1	0	4
2	BSMT - 2102	Partial differential Equations and System of ODE	3	1	0	4
3	BSMT - 2103	Linear programming	3	1	0	4
4	BSPH-S- 2101	Physics-III	3	0	0	3
5	BSCH-S- 2101	Chemistry -III	3	0	0	3
6	HNL-2101	Hindi - II	2	0	0	2
7	BSPH-S- 2101-P	Practical Physics - III	0	0	4	2
8	BSCH-S-2101-P	Practical Chemistry -III	0	0	4	2
						24

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BSMT – 1101

C1.1 Calculus –

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type e^{ax+b} Sinx, e^{ax+b}, Cosx, $(ax + b)^n$ cosx, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L' Hospital's rule, applications in business, economics and life sciences.

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx\, dx, \int \cos nx\, dx, \int \tan nx\, dx, \int \sec nx\, dx, \int (logx)^n\, dx, \int sin^n\, x\, sin^m x\, dx,$, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, are length, are length of parametric curves, area of surface of revolution, Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations classification into conics using the discriminate, polar equations of conics.

Triple product, introduction to vector functions, operations with vector- valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

List of practical's (using any software)

(i) Plotting of graphs of function $e^{ax+b}, \log(ax+b), \frac{1}{ax+b}, \sin(ax+b), \cos(ax+b), |ax+b|\ and$ to illustrate the effect of a and b on the graph.

(ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(iii) Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).

(iv) Obtaining surface of revolution of curves.

(v) Tracing of conics in Cartesian coordinates/ polar coordinates.

(vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic parabolic using Cartesian coordinates.

(vii) Matrix operation (addition, multiplication, inverse, transpose.)

Book Recommended

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K.J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
3. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
4. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

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BSMT – 1102

C1.2 Algebra

Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications.
Equivalence relations, Functions Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, principles of Mathematical Inducation, statement of Fundamental Theorem of Arithmetic.

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$, solution sets of linear systems, applications of linear systems, linear independence.

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n and rank of a matrix, Egen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended

1. Titu Andreessen and Dorian Andrica, Complex Numbers A to Z, Birkhauser, 2006.
2. Edgar G. Goodaire Michael M. Parameter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, Linear Algebra and its applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

BSMT- 1103

DSE 1.2 Number Theory

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruence's, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

Books Recommended

1. David M. Burton, Elementary Number Theory, 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.
2. Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd. Delhi, 2007.

BSMT – 1201

C 2.1 Real Analysis

Review of algebraic and order properties of R, δ-neighborhood of a point in R, idea of countable sets, uncountable sets and unaccountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Supreme and infirm, The Completeness property of R, The Archimedean Property, Density of Rational (and irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (Statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cuachy's Convergence Criterion.

Infinite series, Convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Books Recommended

1. R.G. Bartel and D. R. Sherbert, Introduction Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Anaysis, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, prentice Hall, 2001
4. S.K. Berberian, A First Course in Analysis, Springer Verlag, New York, 1994.

BSMT- 1202

C 2.2 Differential Equations

Differential equations and mathematical models. General, Particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undertermined coefficients, methods of variation of parameters.

Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

List of Practical (using any software)

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator.)
9. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
10. Battle model (basic battle model, jungle warfare, long range weapons).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy's root test by plotting n^{th} roots.
16. Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ term.

Books Recommended

1. Belinda Barnes and Glenn R. Fulford, Mathematical modeling with case studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Fracis group, London and New York , 2009.
2. C.H. Edwards and D.E. Penny, Differential Equations and Boundary value problems Computing and Modeling, Pearson Education India, 2005.
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
4. Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.

BSMT- 1203

DSE 2.3 Probability and Statics

Sample space, probability axioms, real random variables (discrete and continuous), Cumulative distribution function, probability mass/ density functions mathematical expectation, moments, moment generating function, characteristic function, discrete distributions;: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, vicariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statics, person Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E.Freund, Mathematical Statistics with Applications, 7th Ed., Person Education, Asia, 2006.
3. Sheldon Ross, introduction to probability Models. 9th Ed., Academic press, Indian Reprint, 2007.
4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw-Hill, Reprint 2007.

BSMT- 2101

C 3.1 Theory of Real Functions

Limits of functions ($\in -\delta\ approach$), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.

Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, In (1+x), 1/ax + x and $(1+x)^n$.

Books Recommended

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
3. A. Mattuck, Introduction to Analysis, prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

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BSMT- 2102

C 3.3 PDE and Systems of ODE

Partial Differential Equations – basic concepts and Definitions, Mathematical Problems. First- Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Conical Forms of First-order Linear Equations. Method of Sepration of Variables for solving first order partial differential equations.

Derivation of heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string. Initial Boundary Value problems, Semi-Infinite String with a fixed end, Semi-infinite String with a Free end, Equations with non-homogeneous boundary conditions, Non-Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem, Solving the Heat Conduction problem.

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method.

List of practical's (using any software)

(i) Solution of Cauchy problem for first order PDE.

(ii) Finding the characteristics for the first order PDE.

(iii) Plot the integral surfaces of a given first order PDE with initial data.

(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) $u(x,0) = \emptyset(x), u_t(x,0) = \psi(x), \quad x \in R, t > 0$

(b) $u(x,0) = \emptyset(x), u_t(x,0) = \psi(x), \quad u(0,t) = 0, x \in (0,\infty), t > 0$

(c) $u(x,0) = \emptyset(x), u_t(x,0) = \psi(x), \quad u_x(0,t) = 0, x \in (0,\infty), t > 0$

(d) $u(x,0) = \emptyset(x), u_t(x,0) = \psi(x), \quad u(0,t) = 0, u(1,t) = 0, 0 < x < l, t > 0$

(v) Solution of wave equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) $u(x,0) = \emptyset(x), u(0,t) = a, u(l,t) = b, \quad 0 < x < l, t > 0$

(b) $u(x,0) = \emptyset(x), \quad x \in R, \ 0 < t < T$

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(c) $u(x,0) = \emptyset(x),\ u(0,t) = a,\ x \in (0,\infty), t \geq 0$

Books Recommended

1. Tyn Myint-U and Lokenath Debnath, Linear partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
3. Martha L Abell, James P Braselton, Differential equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.

BSMT – 2103

DSE 3.3 Linear Programming

Introduction to linear Programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of staring basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Books Recommended

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.
4. G. Hadley, Linear programming, Narosa Publishing House, Delhi, 2002.

BSMT- 2201

C 401 Numerical Methods

Use of Scientific Calculator is allowed.

Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation.

Transcendetal and Polynomial equations: Bisection method, Newton's method, Secant method.
Rate of convergence of these methods.

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

Interpolation: Lagrange and Newton's methods, Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons $3/8^{th}$ rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.

Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

List of Practical's (using any software)

(i) Calculate the sum 1/1 + ½ + 1/3 + ¼ + …….. +1/N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Bisection Method.
(v) Newton Raphson Method.
(vi) Secant Method.
(vii) Regulai Falsi Method.
(viii) LU decomposition method.
(ix) Gauss-Jacobi Method.
(x) SOR method or Gauss-Siedel Method.
(xi) Lagrange Interpolatio or Newton Interpolation.
(xii) Simpson's rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Array should be introduced to the students.

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Books Recommended

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Person Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Geral and P.O. Wheatley, Applied Numerical Analysis, person Education, India, 2008.
4. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning private Limited, 2013.
5. John H. Mathews and Kurtis D.Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning private Limited, 2012.

BSMT – 2202

C 4.2 Riemann Integration and Series of Functions

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability.

Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann inerrability of monotone and continuous functions, Properties of the Riemann integral; definition and inerrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

Improper integrals; convergence of Beta and Gamma functions.

Point wise and uniform convergence of sequence of functions. Theorems on continuity, derivability and inerrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Books Recommended

1. K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Text in Mathematics, Springer (SIE), Indian reprint, 2004.
2. R.G. Bartle D.R. Sherbert, introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011

BSMT – 2203

DSE 4.3 Differential Geometry

Theory of Space Curves: Space curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres, Existence of space curves. Evolutes and involutes of curves.
Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Line of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Developables : Developable associated with space curves and curveson surfaces, Minimal surfaces.

Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobin, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3- index Christopher symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

Books Recommended

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
2. B. O'neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
3. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003.
4. D.J. Struik, Lectures on Classical Differential Geometry, Dover Publications, 1988.
5. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.

6. B.Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003.

BSMT – 3101

C 3.2 Group Theory I

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Subgroups and examples of subgroups, centralizer, center of a group, product of two subgroups.

Properties of cyclic groups, classification of subgroups of cyclic groups, Cycle Notation for permutations, properties of permutations, even and odd permutations, alternating, group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Group homeomorphisms, properties of homeomorphisms, Cayley's theorem, properties of isomorphism's, First, Second and Third isomorphism theorems.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, Contemporary Abtract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
4. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 195.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

BSMT – 3102

C 4.3 Ring Theory and Linear Algebra I

Definition and examples of rings, properties of rings, sub rings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Ring homeomorphisms, properties of ring homeomorphisms, Isomorphism theorems I, II and III, field of quotients.

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphism's, Isomorphism theorems, inevitability and isomorphism's, change of coordinate matrix.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., prentice-Hall of India Pvt. Ltd., new Delhi, 2004.
4. Joseph A. Gallian, Contemporary Abstract algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
5. S. Lnag, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
6. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
7. S. Kumaresan, Linear Algebra-A Geometric Approach, Prentice hall of India, 1999.
8. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
9. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

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BSMT – 3103

C 5.1 Multivariate Calculus

Use of Scientific calculator is allowed.

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and sphereical co-ordinates.

Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Green's theorem, surface integrals integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Books Recommended

1. G.B Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K.J. Smith, Calculus, 3rd Ed., Dorling Kidersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and a. Weinstein, basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks/Cole, Thomson Learning, USA, 2001.

BSMT – 3104

DSE 4.2 Mechanics

Moment of a force about a point an axis, couple and couple, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other canters, Theorem of pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Conservative force field, conservation force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Books Recommended

1. I.H. Shames and G.Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
2. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics. 11th Ed., Doring Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

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BSMT – 3201

C 5.2 Group Theory II

Automorphism, inner automorphism, automorphism, groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commentator subgroup and its properties.

Properties of external direct products, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.
Groups acting on themselves by conjugation, class equation and consequences, conjugacy in s_n, P-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
4. David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
5. J.R. Durbin, Modern Algebra, John Wiley & Sons, New York Inc., 2000.
6. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

BSMT – 3202

C 6.2 Ring Theory and Linear Algebra II

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in z(x). Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minmal polynomial for a linear operator.

Inner product spaces and noms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, orthogonal projections and Spectral theorem.

Books Recommended

1. John B. Fraleigh, A First course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
6. Gilbert Strang, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
7. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
8. S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.

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BSMT – 3203

C 6.1 Metric Spaces and Complex Analysis

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantraction mappings, banach Fixed point Theorem. Connectedness, connected subsets of R.

Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fized point Theorem. Connectedness, connected subsets of R. Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatieves, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Liouville's theorem and the fundamental theorem ofalgebra. Convergence of sequences and series, Taylor series and its examples.

Laurent series and its examples, absolute and uniform convergence of power series.

Books Recommended

1. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
2. S.Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
3. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.
4. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw- Hill International Edition, 2009.
5. Joseph Bak and Donald J. Newman, Complex Analysis, 2nd Ed., Undergraduate Text in Mathematics, Springer- Verlag new York, Inc., New York, 1997.

BSMT – 3204

SEC 1.1 Logic and Sets

Introduction, Propositions, truth table, negation, conjunction and disjunction. Implications, biconditional Propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and negations.

Sets, subsets, Set operations and 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 set.
Difference and Symmetric difference of two sets. Set identities, Generalized union and intersection. Relation: product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, nary relations.

Books Recommended

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

Syllabus for subsidiary Papers of physics

BSPH-S- 1101 PHYSICS - I

L	T	P	Total Credit
3	0	0	3

UNIT	CONTENTS
I	Relativity – Galilean transformation Inertial frame of reference. Michelson-Morley experiment, Lorentz., Fitzgerald Contraction Einstein's Postulates, Lorentz, Transformation and its Consequences, Addition of velocities. Relativistic Doppler effect on propagation of light waves, variation of mass with velocity. Mass energy relation.
II	Mechanics and properties of Matter- Inertial and non-inertial frames of reference; Coriolis and centrifugal forces and their simple application. Motion in Central field. Kepler's law. Generalized coordinates. Constraints (Homonymic and non homonymic) Lagrangian equation of motion and its simple applications. Elasticity & Elastic constants, Relation between elastic constant bending of beams and Cantilevers, Torsion of cylinder and rigidity modulus by flat spiral spring.
III	Effect of temperature and pressure on elasticity. Surface tension and surface energy. Ripples and gravity waves; surface tension by the method of ripples; Effect of temperature and pressure on surface tension. Perfect fluids, equation of Continuity Euler's equation for a perfect fluid Benoulli's equation. Viscosity of fluids, critical velocity. Poiseuille's formula with correction. Flow of a compressible fluid through a narrow tube; viscosity of gases: Rankine's method. Effect of temperature and pressure on viscosity.

Reference Books:	
1.	Concepts of Modern Physics: Arthur Beiser
2.	Introduction to Special Relativity: Robert Resnick.
3.	Classical Mechanics: J.C. Upadhyay
4.	Mechanics by D.S. Mathur

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BSPH-S- 1201 PHYSICS – II

L	T	P	Total Credit
3	0	0	3

UNIT	CONTENTS
I	Waves and Acoustics- Differential equation of a wave. Equation of progressive waves. Stationary waves. Compression waves in fluids and in extended solids. Free, damped and force oscillation's Fourier analysis Vibration of strings. Intensity and Loudness of sound and their measurements Acoustics of buildings Ultrasonic's.
II	Kinetic Theory of gases:- basics assumptions of kinetic theory, Ideal gas approximations, deduction of perfect gas laws, Maxwell's distribution law (both in terms of velocity and energy), root mean square and most probable speeds Finite size of molecules, Collision probability, distribution of free path from Maxwell's distribution, Degree of freedom, equipartition of energy.
III	Transport phenomena:- Viscosity, thermal conduction and diffusion of gases, Brownian motion: Einstein theory, perrin's work, determination of Avogadro number. Real gas:- Nature of intermolecular interaction: isotherms of real gases, Vander Waals equation of state, critical constant of gas, law of corresponding states, Virial coefficients, Boyle's temperature.

Reference Books:	
1.	The Physics of Waves and Oscillations: N.K. Bajaj.
2.	Heat and Thermodynamics: K.W. Zeemansky
3.	A Treatise on Heat : M.N. Saha and B.N. Srivastava.
4.	Kinetic Theory of Gases: Walter Kauzmann

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BSPH-S- 2101 PHYSICS –III

L	T	P	Total Credit
3	0	0	3

UNIT	CONTENTS
I	Boundary conditions at the surface of separation of two dielectrics. Electric doubles, Dipole moment, Dielectric polarization. Electrical image- problems involving Infinite conducting plane and thin conducting spherical shell only. Magnetic shell, Langevin and Weiss' theory to dia, para and ferromagnetic. Curie's law, production and measurement of strong magnetic field, Magnetic circuit and Electromagnetic.
II	Current Electricity and Modern Physics: Thermodynamic treatment of see back, peltier and Thomson effects and their applications. Moving coil aperiodic and ballistic galvanometer, Growth and decay of currents in electric. Circuits, Oscillatory discharge of a condenser. A.C. and A.C. circuits: use of vectors and complex quantities in. A.C. circuits theory (L.R.C.R. and I.C.R. circuits), De Sauty's bridge, Anderson's bridge and Carey Foster's bridge.
III	Measurement of electronic charge by Millikan's method and specific charge of an electron by Thomson's method. Natural radioactivity. Rutherford & Soddy's theory of activity Elementary ideas about nucleus and its structure. Nuclear fission. Reactors, Aaron's mass spectrograph.

Reference Books:

1.	Concepts of Modern Physics: Arthur Beiser
2.	Electronic devices: T.L. Floyd
3.	Electronic Fundamental and Applications: D. Chatopadhyay and P.C. Rakshit.
4.	Elementary Modern Physics: A.P. Arya
5.	Solids State Physics: C. Kittel.

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BSPH-S- 2201 PHYSICS –IV

L	T	P	Total Credit
3	0	0	3

UNIT	CONTENTS
I	Photoelectric emission, Einstein's photoelectric equation, Photo-electric, Photo-conductive and photo voltaic cells. Compton effect Bragg's law and determination of x-ray wavelength. Cathode ray oscilloscope and its uses in amplitude, frequency and phase measurements. Solid state rectifier one stage R.C. Amplifierprinciples of amplitude modulation and demodulation Radio receiver through Block diagram.
II	Optics- Fermat's Principle, Newton's rind. Michelson's interferometer Fresnel's diffraction at straight edge. Fraunhofer's diffraction single slit, double slit, plane transmission gratings, Resolving power of microscope and telescope. Polarisation, production of plane. Circularly and elliptically polarized lights. Nicol's prism. Quarter wave plate. Half-shade polarimeter babinet's compensator. Bohr's theory of hydrogen spectra. Principle action Ruby laser. Maxwell's equations. Equation of plane electromagnetic waves and its solution.
III	Thermal Physics – Maxwell's law of distribution of Velocities and its experimental verification; Degree of freedom & equipartition of energy. Mean free path and its experimental determination, Perfect gas equation and Van der Waals equation of state. Cycle Entropy and its Calculation in simple cases. Thermodynamic relations and their applications to Simple physical problem. Clausius-Clapeyron equation. Joule- Thomson effect, Liquefaction of gases with special reference to Helium, super fluidity in liquid helium. Kirchhoff law and black body radiation. Stefan Boltzmann law its deduction and experimental verification.

Reference Books:

1.	Heat and Thermodynamics: Brij Lal and N. Subramanyam.
2.	Heat and Thermodynamics: K.W. Zeemansky.
3.	A textbook of Optics : N. Subrahmanyam, Brijalal and M.N. Avadhanulu
4.	Optics: Ajoy Ghatak

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BSCH-S- 1101 : CHEMISTRY – I

UNITS	CONTENTS	Contact Hrs.
I	**Physical Chemistry** **Gaseous State** (a) Kinetic Theory of gases, Derivation of kinetic gas equation, deduction of gas laws, calculation of gas constants and kinetic theory. (b) Types of solids, crystal forces, law of constancy of angels, seven crystal systems, law of rational indices, Bragg's Law, Lattice energy, Born-Haber cycle	**4**
	Thermochemistry (a) Heat in chemical reactions, Reaction enthalpy, standard enthalpy changes, (b) Hess Law, Kirchoff law (c) Bond energy and determination	**4**
	Ionic Equilibrium (a) Ionic product of water, pH, pK_a, pK_b, pK_w (b) Buffer solution, Idea of buffer solution in everday life. (c) Solubility product and its application in salt analysis. (d) Specific conductance, Molar conductance, Equivalent conductance.	**4**
II	**Inorganic Chemistry** **Atomic Structure and Bonding** (a) Features of H-spectra and Bohr's theory. (b) Shapes of orbitals and their labellings, idea of quantum number (c) Pauli's Exclusion Principles, Hund's rule, Aufbau principle (d) Electronic configuration of elements (e) Idea of iconic and covalent bonds, Ionisation potential, Electronegativity, **Chemistry of the following elements** Li, Sn, Fluorine, Chlorine, Iodine	**4**
III	**Organic Chemistry** **Structure and mechanism** (a) Hybridisation, bond angle, bond length, idea of bonds, (b) Inductive effect, electromeric effect, mesomeric effect (c) Bond fission and products	**4**

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BSCH-S- 1101P: PRACTICAL : CHEMISTRY – I

PRACTICAL	
1.	Inorganic chemistry Volumetric Analysis (a) Acidimetry and alkalimetry (b) Use of potassium permanganate and potassium dichromate (c) Iodometry
2.	Note book and Viva voce

BSCH-S- 1201 : CHEMISTRY –II

UNITS	CONTENTS	Contact Hrs.
I	**Physical Chemistry** **Gaseous State** (a) Rate of reaction, order and molecularity (b) Expression for specific rate constant of first order reaction. (c) Half-life period and Units	**4**
	Colligative Properties (a) Osmosis and its determination (b) Vapour Pressure (c) Raoult's law of lowering vapour pressure (d) Relation between osmotic pressure and lowering of vapour pressure.	**4**
II	**Inorganic Chemistry** Principles involved in the volumetric and gravimetric estimation of Cu and Fe Isotopes: Brief idea of detection and separation, Radiocarbon dating	**4**
III	**Organic Chemistry** **Nomenclature** (a) IUPAC Nomenclature of aliphatic and aromatic compounds Chemistry of monohydric alcohol and Grignard reagent Idea of purification of compounds, Chromatography	**4**

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BSCH-S- 1201P : PRACTICAL : CHEMISTRY – II

PRACTICAL	
1.	Organic chemistry Detection of nitrogen, sulphur and halogen in organic compounds Detection of following functional group of organic compounds (a) OH (Phenolic) (b) CHO (c) C= O (d) COOH (e) NH_3 and NO_2
2.	Note book and Viva voce

BSCH-S- 2101 : CHEMISTRY –III

UNITS	CONTENTS	Contact Hrs.
I	**Physical Chemistry** **State of Matter** (a) Van der Waals equation, critical constants, collision frequency, mean free path (b) Idea of lattice planes, stoichiometric and non-stoichiometric defects in simple ionic solid	**4**
	Thermodynamics (a) Extensive and Intensive system (b) First and second law of thermodynamics (c) Carnot cycle	**4**
	Inorganic Chemistry **Atomic structure and bonding** (a) De Broglie waves (b) Schrodinger wave equation (c) Idea of overlap and hybridization (d) Metallic bonding (e) Double salts and complex salts (f) Werner's theory	**4**
II	**Introduction to the transition metal complex** Variable oxidation states, magnetism	**4**
III	**Organic Chemistry** **Structure and Mechanism** (a) Different types of isomerism (b) Electrophilic and nucleophilic substitution at saturated carbon	**4**
	Natural Products (a) Carbohydrates (b) Elementary idea of Alkaloids and Terpenoids	**4**

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BSCH-S- 2201 : CHEMISTRY –IV

UNITS	CONTENTS	Contact Hrs.
I	**Physical Chemistry** **Ionic Equilibrium** (a) Oswald's dilution law (b) Salt Hydrolysis (c) Theory of acid- base indicator	**4**
	Chemical Kinetics (a) Second order reaction, expression of rate constant (b) Effect of temperature on reaction rate (c) Arrhenius equation	**4**
II	**Inorganic Chemistry** (a) Chemistry of Group 4 elements (b) Idea of Major pollutants in environments	**4**
	Chemistry of Fe, Cr, Ni compounds	**4**
III	**Organic Chemistry** Structure of Benzene and benzene Diazonium chloride	**4**
	Brief idea of Polymers, resins, drugs	**4**

BSCH –S- 2201P : PRACTICAL : CHEMISTRY – IV

PRACTICAL	
1.	Organic Chemistry Preparation of Organic compounds by using following reactions: (a) Acetylation of Aniline (b) Oxidation of benzaldehyde (c) Hydrolysis of esters
2.	Note book and Viva voce

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