Minutes of the B.O.S Meeting
Department of Mathematics held on May 26, 2015

A meeting of the B.O.S. of the Department of Mathematics was held on 26.05.2015 at 2.30 p.m. in the Seminar Room. The following members were present in the Meeting:

1. Prof. Naseem Ahmad	(Chairperson)
2. Prof. M. Rais Khan	Member
3. Prof. Mohd. Hasan Shahid	Member
4. Prof. A. Wafi	Member
5. Prof. S. M. K. Haider	Member
6. Prof. Ayub Khan	Member
7. Dr. Shehzad Hasan	Member
8. Dr. Arshad Khan	Member
9. Dr. M.Yahya Abbasi	Member
10. Ms. Sakshi Dhall	Member
11. Prof. H. C. Taneja, DTU, Delhi	External Member

The following decisions were taken:

1. Minutes of the meeting held on 06.04.2015 were confirmed together with point of observation raised by Prof. M. Hasan Shahid as two meetings of approved board for UGC-SAP-I programme chaired by V.C. will be held twice in a year in the month of March and November respectively while two meetings of Dept. will be conducted in the month of May and November respectively to review the lab. contingency. The minutes of the emergent B.O.S. meeting held on 15.04.2015 were also confirmed.
2. The work load and time-table were discussed and approved to implement the load and time-table as it were in the academic year 2014-15 is approved for the next academic year 2015-16. It was also resolved that the time-table distributed will not be changed unless the teacher concern is not consulted. In case of any problem, the problem will be discussed with the person concern first then change may be taken place.
3. Choice based credit system was discussed and adopted with a revision of syllabus of U.G. and P.G. The revision will be taken care by the following committee.
    - Head of the Dept. (Chairman)
    - Prof. Abdul Wafi (Member)
    - Prof. Ayub Khan (Member)

4. The minor change in the thesis title of Ms. Sucheta Naik, the Ph. D. student of Dr. Arshad Khan (Supervisor) and Prof. R. K. Mohanty (Co-supervisor) was discussed and approved the title as follows:

   Old title: Spline Function Approximation for the Solution of Non Linear Singular Boundary Value Problem

   New Title: Numerical Solution of the System of Nonlinear Singular Two Point Boundary Value Problems on a Variable Mesh.

5. The panel of experts was discussed and the members were requested to furnish two names of the experts with their specialization and affiliation to the Chairman of the B.O.S. All the names will be discussed in the committee comprising the following

   - Head of the Dept. (Chairman)
   - Prof. M. R. Khan (Member)
   - Prof. M. Hasan Shahid (Member)
   - Prof. Abdul Wafi (Member)
   - Prof. S. M. K. Haider (Member)
   - Prof. Ayub Khan (Member)

   Finally the panel will be sent and reported in the next B.O.S. meeting.

6. Under the any other item the following issues were raised and discussed

   (i) Prof. M. Hasan Shahid raised the issue of the journal published by the Dept. It was decided that the journal will be published annually i.e. only one volume a year. The managing editors will be changed to

   - Prof. M. Hasan Shahid
   - Dr. Arshad Khan

   It was also decided to review the editorial board for necessary changes, if any.

   (ii) The issue regarding the payment of self-finance courses M.Sc. Tech. (IMCA) and M.A./M. Sc. (Evening) were discussed. It was reported by the Chaiman that the payment has not been made sofar inspite of the assurance given by the Finace Officer number of times. It was resolved that the HOD and co-ordinators should take the matter with Vice-Chancellor and request the payment as early as possible.

The meeting came to its end at 4.00 p.m.

29.5.15

Department of Mathematics
Faculty of Natural Science, Jamia Millia Islamia, New Delhi-25
Structure of B. A./ B. Sc. (Hons.) Mathematics (Core Courses)

Semester – I

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-1.1	Calculus	4	4	25	75	100
2	BHM-1.2	Algebra	4	4	25	75	100

Semester – II

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-2.1	Differential Equations – I	4	4	25	75	100
2	BHM-2.2	Operations Research and Linear Programming	4	4	25	75	100

Semester – III

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-3.1	Analysis – I	4	4	25	75	100
2	BHM-3.2	Group Theory	4	4	25	75	100
3	BHM-3.3	Numerical Methods	4	4	25	75	100

Semester – IV

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-4.1	Analysis – II	4	4	25	75	100
2	BHM-4.2	Differential Equations – II	4	4	25	75	100
3	BHM-4.3	Ring Theory	4	4	25	75	100

Semester – V

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-5.1	Functions of Several Variables	4	4	25	75	100
2	BHM-5.2	Metric Spaces	4	4	25	75	100
3	BHM-5.3	Linear Algebra	4	4	25	75	100

Semester – VI

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-6.1	Mechanics	4	4	25	75	100
2	BHM-6.2	Geometry of Curves and Surfaces	4	4	25	75	100
3	BHM-6.3	Complex Analysis	4	4	25	75	100

Department of Mathematics
Faculty of Natural Science, Jamia Millia Islamia, New Delhi-25

Course Structure of U.G. under CBCS
(For Honours Only)

Semester – I

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-1.3C	Bio-Mathematics	4	4	25	75	100

Semester – II

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-2.3C	Geometry of Two and Three Dimensions	4	4	25	75	100

Semester – IV

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-4.4C$_1$	Mathematical Modelling	4	4	25	75	100
2	BHM-4.4C$_2$	Logic and Sets	4				

Semester – V

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-5.4C$_1$	Probability and Statistics	4	4	25	75	100
2	BHM-5.4C$_2$	Industrial Mathematics	4				

Semester – III (Ability Enhancement)

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-3.4AE	Programming in C *	4	4	25	75	100

** practical to be performed in Lab.*

Semester – VI (Skills Enhancement)

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	BHM-6.4SE$_1$	Object Oriented Programming Using C++ *	4	4	25	75	100
2	BHM-6.4SE$_2$	Applications of Algebra	4				

** practical to be performed in Lab.*

B. A./ B. Sc. (Hons.) Mathematics, Semester – I

BHM-1.1	Calculus	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Limit and Continuity by $\varepsilon - \delta$ approach, Differentiability, Successive differentiation, Leibnitz Theorem, Rolle's Theorem, Mean Value Theorems, Taylor and Maclaurin series.

Unit-II Indeterminate forms, Curvature, Cartesian, Polar and parametric formulae for radius of curvature, Partial derivatives, Euler's theorem on homogeneous functions.

Unit-III Asymptotes, Test of concavity and convexity, Points of Inflexion, Multiple points, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves.

Unit-IV Derivations and illustrations of reduction formulae of the various types. Volumes by slicing; disks and washers methods, volumes by cylindrical shells, parametric equations, arc length, arc length of parametric curves, surfaces of solids of revolution

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 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. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd.
5. Khalil Ahmad, Text Book of Calculus, World Education Publishers, 2012.

B. A./ B. Sc. (Hons.) Mathematics, Semester – III

BHM-3.1	Analysis –I	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Bounded and unbounded sets, Infimum and supermum of a set and their properties, Order completeness property of R, Archimedian property of R, Density of rational and irrational numbers in R, Dedekind form of completeness property, Equivalence between order completeness property of R and Dedekind property. Neighbourhood, open set, Interior of a set, Limit point of a set, Closed set and related Theorems/results. Derived set, Closure of a set, Bolzano-Weierstrass theorem for sets. Countable and uncountable sets.

Unit-II Sequence of real numbers, Bounded sequence, limit points of a sequence, Bolzano Weierstrass theorem for sequence, Limit inferior and limit superior, Convergent and non-convergent sequences, Cauchy's sequence, Cauchy's general principal of convergence, Algebra of sequences, Theorems on limits of sequences, Subsequences, Monotone sequences, Monotone convergence Theorem.

Unit-III Infinite series and its convergence and divergence, Cauchy's criterion for convergence of series, Test for convergence of positive term series, Comparison tests, Ratio test, Cauchy's n^{th} root test, Raabe's test, Logrithmic test, Integral test, Alternating series, Leibnitz test, Absolute and conditional convergence.

Unit-IV Continuous functions ($\varepsilon - \delta$ approach), Discontinuous functions, Types of discontinuities, Sequential criterion for continuity and discontinuity, Theorems on continuity, Uniform continuity, Relation between continuity and uniform continuity, Derivative of a function, Relation between continuity and differentiability, Increasing and decreasing functions, Darboux theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's theorem with Cauchy's and Lagrange's form of remainder.

Books Recommended:

1. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis (3^{rd} Edition)*, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2003.
2. S. C. Malik and Savita Arora, *Mathematical Analysis*, New Age International (P) Ltd. Publishers, 2009.
3. K. A. Ross, *Elementary Analysis: The Theory of Calculus. under graduate Texts in Mathematics*. Springer (SIE). Indian reprint, 2004.
4. Sudhir R. Ghorpade and Balmohan V. Limaye, *A course in Calculus and Real Analysis, Undergraduate Text in Maths.*, Springer (SIE), Indian reprint 2006.
5. T. M. Apostol, *Mathematical Analysis*, Addison-Wesley Series in Mathematics, 1974.
6. Gerald G. Bilodeau, Paul R. Thie, G. E. Keough, *An Introduction to Analysis*, 2^{nd} Ed., Jones & Bartlett, 2010.

B. A./ B. Sc. (Hons.) Mathematics, Semester – III

BHM-3.2	Group Theory	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Sets, Relations, Functions, Binary operations, Definition of groups with examples and its properties, Subgroups, Order of an element of a group, Cyclic groups, Cosets, Lagrange's theorem and its consequences, Normal subgroup and Commutator subgroups, Factor groups.

Unit-II Group Homomorphism, Isomorphisms, Kernel of a homomorphism, The homomorphism theorems, The Isomorphism theorems, Permutation groups, Even and Odd permutations, Alternating groups, Cayley's theorem and Regular permutation group

Unit-III Automorphism, Inner automorphism, Automorphism group of finite and infinite cyclic groups, Conjugacy relation, Normalizer and Centre, External direct products, definition and examples of Internal direct products.

Unit-IV Class equation of a finite group and its applications, Structure of finite Abelian groups, Cauchy's theorem, Sylow's theorem and consequences, Definition and example of Simple groups, Non-simplicity tests.

Books Recommended:

1. I. N. Herstein, *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.
2. Joseph A. Gallian, *Contemporary Abstract Algebra (4th Ed)*, Narosa Publishing House, New Delhi.
3. N. Jacobson, *Basic Algebra Vol. I & II*, W. H. Freeman.
4. Surjeet Singh and Qazi Zameeruddin, *Modern Algebra*, Vikas Publishing House Pvt., Ltd., New Delhi
5. N S Gopalakrishan, *University Algebra*, New Age International (P) Limited, New Delhi.

B. A./ B. Sc. (Hons.) Mathematics, Semester – III

BHM-3.3	Numerical Methods	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Absolute, relative and percentage errors, General error formula. Solution of algebraic and transcendental equations: Bisection method, False position method, Fixed-point iteration method, Newton's method and its convergence, Chebyshev method. Solution of system of non-linear equations by Iteration and Newton-Raphson method.

Unit-II Direct methods to solve the system of linear equations: Gauss elimination method, Gauss Jordan method, LU decomposition method. Indirect methods: Gauss-Jacobi and Gauss-Seidal methods. The algebraic Eigen value problems by Householder and Power method.

Unit-III Finite difference operators and finite differences, Interpolation and interpolating polynomials: Newton's forward and backward difference formulae, Central differences: Sterling's and Bessel's formula. Lagrange's interpolation formula, Divided Differences. their properties and Newton's general interpolation formula. Inverse interpolation.

Unit-IV Numerical differentiation of tabular and non-tabular functions. Numerical integration using Gauss quadrature formulae: Trapezoidal rule, Simpson's rules, Romberg formula and their error estimation. Numerical solution of ordinary differential equations by Picard's method, Taylor series, Euler's method and Runge-Kutta methods. Multi-step method: Adams-Moulton method.

Books Recommended:

1. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007
2. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New age International Publisher, India, 5th edition, 2007
3. C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education, India,7th edition, 2008.
4. S. S. Sastry, Introductory Methods of Numerical Analysis (Fifth Ed.), Prentice Hall of India (Ltd.) New Delhi-110001, 2012.
5. M. Pal, Numerical Analysis for Scientists and Engineers, Narosa Publisher, 2007.
6. N. Ahmad, Fundamental Numerical Analysis with error estimation, Anamaya Publisher.

B. A./ B. Sc. (Hons.) Mathematics, Semester – IV

BHM-4.1	Analysis-II	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Definition, existence and properties of Riemann integral of a bounded function, Darboux theorem, Condition of integrability, Riemann integrability for continuous functions, monotonic function and theorems on function with finite or infinite number discontinuity (without proof). The Riemann integral through Riemann sums, Equivalence of two definitions, Properties of Riemann integral, Fundamental theorem of calculus, First Mean Value Theorems, Second Mean Value Theorems, Generalized Mean Value Theorems.

Unit-II Definition of improper integrals, Convergence of improper integrals, Test for convergence of improper integrals, Comparison test, Cauchy's test for convergence, Absolute convergence, Abel's Test, Dirichlet's Test, Beta and Gamma functions and their properties and relations.

Unit-III Pointwise and uniform convergence of sequences and series of functions, Cauchy's criterion for uniform convergence of sequence and series, Weierstrass M-test, Uniform convergence and continuity, Uniform convergence and differentiation, Uniform convergence and integration. Weierstrass Approximation Theorem.

Unit-IV Fourier Series, Fourier Series for even and odd functions, Half Range Series, Fourier Series on intervals other than $[-\pi, \pi]$.

Power Series, Radius of Convergence, Cauchy's Hadamard Theorem, Uniform and Absolute convergence, Abel's Theorem (without proof), exponential and logarithmic functions.

Books Recommended:

1. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis (3^{rd} Edition),* John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2003.
2. S. C. Malik and Savita Arora, *Mathematicla Analysis,* New Age International (P) Ltd. Publishers, 2009.
3. K. A. Ross, *Elementary Analysis: The Theory of Calculus, Under graduate Texts in Mathematics,* Springer (SIE), Indian reprint, 2004.
4. Sudhir R. Ghorpade and Balmohan V. Limaye, *A course in Calculus and Real Analysis, Undergraduate Text in Maths.,* Springer (SIE), Indian reprint 2006.
5. T. M. Apostol, *Mathematical Analysis,* Addison-Wesley Series in Mathematics, 1974.
6. Gerald G. Bilodeau, Paul R. Thie, G. E. Keough, *An Introduction to Analysis,* 2^{nd} Ed., Jones & Bartlett, 2010.
7. A. Mattuck, *Introduction to Analysis,* Prentice Hall, 1990.
8. Charles G. Denlinger, *Elements of Real Analysis*, Jones & Bartlett (Student Edition), 2011.

B. A./ B. Sc. (Hons.) Mathematics, Semester – IV

BHM-4.2	Differential Equations – II	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Total differential equations, Simultaneous total differential equations, Equations of the form $dx/P = dy/Q = dz/R$, Methods of grouping and multipliers, Solution of a system of linear differential equation with constant coefficients, An equivalent triangular system, Degenerate case.

Unit-II Formation and solution of a partial differential equations, Equations easily integrable. Linear partial differential equations of first order- Lagrange's equation, Non-linear partial differential equation of first order- Solution of some standard type of equations, Charpit's method.

Unit-III Homogeneous linear partial differential equations of second and higher orders with constant coefficients, Different cases for complimentary functions and particular integrals, Non-homogeneous partial differential equations with constant coefficients, Classification of second order linear partial differential equations, Partial differential equations reducible to equations with constant coefficients, Monge's method.

Unit-IV Variation of a functional, Variational problems, Euler's equations and its various cases, Externals, Functional depending on n unknown functions, Functionals depending on higher order derivatives, Variational problems in parametric form, Isoperimetric problem, Canonical form of Euler's equation, Functionals depending on functions of several independent variables, Ostrogradsky's equation.

Books Recommended:

1. Dennis G. Zill, A first course in differential equations,
2. Tyn Mint-U and Lokenath Debnath, Linear Partial Differential Equations
3. D.A. Murray: Introductory Course on Differential Equations, Orient Longman (India), 1967.
4. A.S. Gupta: Calculus of variations with applications, Prentice Hall of India, 1997.
5. I.N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Book Company, 1988.
6. Zafar Ahsan: Differential Equations and their Applications, Prentice Hall of India, New Delhi (2nd Edition, 13th reprint May 2012).

B. A./ B. Sc. (Hons.) Mathematics, Semester – IV

BHM-4.3 Ring Theory	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs	4	4	4

Unit-I Rings and their properties, Boolean Ring, Integral domain, Division ring and Field, Subrings, Ideals and their properties, Operations on ideals, Ideal generated by a subset of a ring, Quotient rings.

Unit-II Homomorphism of rings and its properties, Kernel of a homomorphism, Natural homomorphism, Isomorphism and related theorems, Field of quotients.

Unit-III Polynomial rings over commutative rings, Properties of $R[X]$, Division algorithm and its consequences, Factorization of polynomials, Irreducibility test, Eisenstein's criterion for irreducibility.

Unit-IV Factorization in integral domains, prime and irreducible element, Principal Ideal Domain, Euclidean Domain, Unique Factorization Domain and its properties.

Books Recommended:

1. I. N. Herstein, *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.
2. N. Jacobson: *Basic Algebra*, Volume I and II. W. H. Freeman and Co.
3. Surjeet Singh and Qazi Zameeruddin: *Modern Algebra*, Vikas Publication.
4. J.A. Gallian, *Contemporary Abstract Algebra*, Narosa Publication.

B. A./ B. Sc. (Hons.) Mathematics, Semester – V

BHM-5.1 Functions of Several Variables	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs	4	4	4

Unit-I Functions of several variables. Domains and Range. Functional notation, Level curves and level surfaces. Limits and continuity. Partial derivatives. Total differential. Fundamental lemmas. Differential of functions of n variables and of vector functions. The Jacobian matrix. Derivatives and differentials of composite functions, The general chain rule.

Unit-II Implicit functions. Inverse functions. Curvilinear co-ordinates. Geometrical Applications. The directional derivatives. Partial derivatives of higher order. Higher derivatives of composite functions. The Laplacian in polar, cylindrical and spherical co-ordinates. Higher derivatives of implicit functions. Maxima and minima of functions of several variables.

Unit-III Vector fields and scalar fields. The gradient field. The divergence of a vector field. The curl of a vector field. Combined operations. Irrotational fields and Solenoidal fields. Double integrals, triple integrals and multiple integrals in general. Change of variables in integrals. Arc length and surface area.

Unit-IV Line integrals in the plane. Integrals with respect to arc length. Basic properties of line integrals. Line integrals as integrals of vectors. Green's Theorem. Independence of path, Simply connected domains, Extension of results to multiply connected domains. Line Integrals in space. Surfaces in space, orientability. Surface integrals. The divergence theorem. Stokes's theorem. Integrals independent of path.

Books Recommended:

1. Wilfred Kaplan: Advanced Calculus., Adisson-Wasley Publishing Company, 1973.
2. E. Swokowski: Calculus with Analytical Geometry, Prindle, Weber & Schmidt, 1994
3. E. Kreyzig: Advanced Engineering Mathematics, John Wiley and Sons, 1999.
4. David Widder: Advanced Calculus, Prentice Hall of India, 1999.
5. S. C Malik and Savita Arora: Mathematical Analysis, New Age International(P)1996

B. A./ B. Sc. (Hons.) Mathematics, Semester – V

BHM-5.2 Metric Spaces	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs	4	4	4

Unit-I Definition and examples of metric spaces, open spheres and closed spheres, Neighbourhood of a point, Open sets, Interior points, Limit points, Closed sets and closure of a set, Boundary points, diameter of a set, Subspace of a metric space.

Unit-II Convergent and Cauchy sequences, Complete metric space, Dense subsets and separable spaces, Nowhere dense sets, Continuous functions and their characterizations, Isometry and homeomorphism. Fixed points and contraction mapping, Banach's contraction Theorem.

Unit-III Compact spaces, Sequential compactness and Bolzano-Weierstrass property, Finite Intersection property, Continuous functions and compact sets.

Unit-IV Disconnected and connected sets, connected subsets of R, Continuous functions and connected sets.

Books Recommended:

1. G.F. Simmons: *Introduction to Topology and Modern Analysis*, McGraw Hill, 1963.
2. E.T. Copson, *Metric spaces*, Cambridge University Press, 1968.
3. P.K. Jain and Khalil Ahmad: *Metric spaces*, Second Edition, Narosa Publishing House, New Delhi, 2003.
4. B. K. Tyagi, *first course in metric spaces,* Cambridge University Press, 2010.

B. A./ B. Sc. (Hons.) Mathematics, Semester – V

BHM-5.3 Linear Algebra	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs	4	4	4

Unit-I Definition examples and basic properties of a vector space, Subspaces, Linear Dependence Independence, Linear combinations and span, Basis and dimension, Sum and intersection of subspaces, Direct sum of subspaces.

Unit-II Definition and examples of linear transformations, Properties of linear transformations, Range and kernel, The rank and nullity of a linear transformation, Rank-Nullity Theorem and its consequence, The matrix representation of a linear transformation, Change of basis, Isomorphism.

Unit-III Scalar product in an Inner product spaces. Orthogonality in inner product Spaces, Normed linear spaces, Inner product on complex vector spaces, Orthogonal Complements, orthogonal sets and projections, Gram-Schmidt Orthogonalization process, Bessel's inequality.

Unit-IV Eigenvalues and Eigen vectors, Characteristic equation and polynomial, Eigenvectors and eigenvalues of linear transformations and matrices, The Cayley-Hamilton Theorem. Similar matrices and Diagonalization, Eigenvalues and eigenvectors of symmetric and Hermitian matrices, Orthogonal Diagonalization, Quadratic forms and conic sections.

Books Recommended:

1. David C. Lay: *Linear algebra and its applications (3rd Edition),* Pearson Education, Asia, Indian Reprint, 2007.
2. Geory Nakos and David Joyner: *Linear algebra with Applications*, Brooks/ Cole, Publishing Company, International Thomson Publishing, Asia, Singapore, 1998.
3. Stephen H. Friedberg, Arnold J. Insel and L.E.Space- *Linear Algebra*, 4th dition, PHI Pvt Ltd., New Delhi, 2004.
4. I. V. Krishnamurty, V.P. Mainra, J.L. Arora- *An introduction to Linear Algebra*, East West Press , New Delhi, 2002.

B. A./ B. Sc. (Hons.) Mathematics, Semester – VI

BHM-6.1 Mechanics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs	4	4	4

Unit I: Moment of force about a point and an axis, couple and couple moment, 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.

Unit II: Laws of 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 centers, theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorem, relation between second moments and products of area, polar moment of area, principal axes.

Unit III: Conservative 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.

Unit IV: Translation and rotation of rigid bodies, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references, motion of a particle relative to a rotating frame of reference, frame of reference in general motion.

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. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
3. John L. Synge Byron A. Griffith, Principle of Mechanics, Mc GrawHill International Student Edition.

B. A./ B. Sc. (Hons.) Mathematics, Semester – VI

BHM-6.2	Geometry of Curves and Surfaces	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Tensors: Summation convention, co-ordinate transformation, Scalar, contravariant and covariant vectors, Tensors of higher rank, Algebra of tensors and contraction, Metric tensor and 3-index christofell symbols, covariant derivative of contravariant, covariant vectors and higher rank tensors.

Unit-II Curves in R^3: Representation of curves, unit speed curves, tangent to a curve, principal vector and binormal vector , osculating plane, normal plane and rectifying plane, curvature and torsion, Serret - Frenet formula, Helix.

Unit-III Behavior of curve near a point, osculating circle and osculating sphere, Necessary and sufficient condition for a curve to lie on a sphere, involutes and evolutes, Fundamental existence theorem for space curves.

Unit-IV Surface in R^3: Definition and examples of a smooth surface, tangent plane and unit surface normal, Surface of revolution, first fundamental form and its properties, Direction co-efficient on a surface, angle between tangential direction on a surface, second fundamental form, normal curvature, Principal curvature, Shape operator and its properties.

Books Recommended

1. Elementary Differential Geometry, B.O. Neill, Academic Publishers.
2. Elementary Differential Geometry, Andrew Pressley, Springer.
3. Differential Geometry of Curves and Surfaces, M. P. do Carmo, Prentice Hall.
4. Introduction to Differential geometry, t. G. Willmore, Oxford University Press.
5. Differential Geometry, D. Somasundaram, Narosa Publishing House.

B. A./ B. Sc. (Hons.) Mathematics, Semester – VI

BHM-6.3	Complex Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs		4	4	4

Unit-I Complex number system, Algebraic properties, Geometric interpretation, exponential forms, powers and roots, Properties of moduli, Regions in complex plane, Limit, continuity and derivatives.

Unit-II Analytic functions, CR equations, sufficient conditions, polar conditions, Harmonic functions, Construction of analytic function, Line integral.

Unit-III Cauchy Goursat theorem, Cauchy integral formula, Derivatives of analytic function, Fundamental theorem of calculus in the complex plane, Taylor's and Laurent series.

Unit-IV Definitions and examples of conformal mappings, Zeros of analytic function, Residues, Residue at poles, Residue theorem, Evaluation of Integrals involving sine and cosine series.

Books Recommended

1. R.V. Churchill and J W Brown: Complex Variable & Applications. McGraw Hill, International Book Company, London.
2. Punnuswamy: An Introduction to Complex Analysis, Narosa Publication

BHM-1.3C	Bio-Mathematics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Mathematical Biology and the modelling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population.

Unit-II Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.

Unit-III Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population. Discrete Models: Overview of difference equations, steady state solution and linear stability analysis.

Unit-IV Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

Books Recommended:

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.
2. J.D., Murray, *Mathematical Biology*, Springer, 1993.
3. Y.C. Fung, *Biomechanics*, Springer-Verlag, 1990.
4. F. Brauer, P.V.D. Driessche, and J. Wu, *Mathematical Epidemiology*, Springer, 2008.
5. M. Kot, *Elements of Mathematical Ecology*, Cambridge University Press, 2001.

New

U.G. - CBCS (Hons.) , Semester – IV

BIIM-4.4C$_1$	Mathematical Modelling	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Introduction- Definition & Simple situations for Mathematical Modelling, Technique of Mathematical Modelling, Classification of Mathematical Models, Some characteristic of Mathematical Models. Mathematical models based on Geometry, Algebra and Calculus. Limitations of Mathematical Modelling.

Unit-II Mathematical Models through ODE: Linear Growth and Decay Models, Non-linear Growth and Decay Models, Compartmental Models, M.M. in Population Growth. Epidemics through Systems, Compartment Models through system of ODE, Modelling in Economics through systems of ODE. MM for planetary motions, MM for Circular motion and motion of satellites.

Unit-III Difference Equations with Applications: Formation of diff. equations. First order difference equations: Homogeneous, Non-homogeneous, The equations of the form $xx_{n+1} - bx_n = a$, method of Undetermined Coefficients. Second order linear difference equations: Homogeneous equations, Auxiliary equation, non-homogeneous equations. Applications of difference equations (Models)

Unit-IV Integral Equations: Definition of Integral equation. Fredholm and Volterra integral equations. Conversion of linear diff. equation to an integral equation and vice versa with examples. Conversion of boundary value problems to integral equations using Green's Function. Integral equations of the convolution type. Integro-diff. equations. Solution of Fredholm equations with separable kernels.

References:

1. Mathematical Modelling by J.N.Kapur New Age Publications
2. UMAP-Module 322: Published in cooperation with the Society for Industrial and Applied Mathematics
3. Higher Engineer Mathematics by B.S.Grewal, Khanna Publication.

New

U.G. - CBCS (Hons.) , Semester – IV

HM-4.4C$_2$	Logic and Sets	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

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, Sets, Subsets, Set operations and the laws of set theory and Venn diagrams, Examples of finite and infinite sets.

Unit-III Finite sets and counting principle, Empty set, Properties of empty set, Standard set operations, Classes of sets, Power set of a set, Difference and Symmetric difference of two sets, Set identities, Generalized union and intersections.

Unit-IV Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-ary relations.

References:

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

U.G. - CBCS (Hons.) , Semester – IV

RHM-5.4C$_1$	Probability and Statistics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Sample space and events, algebra of events, axiomatic approaches, conditional probability, basic laws of total probability and compound probability, Bayes' theorem, Prior probabilities (priori) and posterior probabilities.

Unit-II Discrete and continuous random variables, mathematical expectation, variance, moment about a point, central moment, moment generating function, Binomial, Poisson, Normal and Rectangular distributions.

Unit III Two dimensional random variables, joint distribution functions, marginal distributions, covariance, linear regression and correlation, rank correlation, least square method of fitting regression lines.

Unit-IV Sampling, random sampling, large sample tests of means and proportion, t-student, χ^2 (chi square) and F distributions (without derivation) and testing of hypothesis based on them.

References

1. Irwin Miller and Marylees Miller, *John E. Freund's Mathematical Statistics with Applications*, Pearson Education.
2. Robert V. Hogg, Allen Craig Deceased and Joseph W. McKean, *Introduction to Mathematical Statistics*, Pearson Education
3. Sheldon M. Ross, *Introduction to probability and statistics for engineers and scientists*, Elsevier Academic Press.
4. J.N. Kapur and H.C. Saxena, *Mathematical Statistics*, S. Chand.
5. P.N.Arora, *Comprehensive Statistical Methods*, S.Chand.

New

U.G. - CBCS (Hons.) , Semester – IV

BHM-5.4C$_2$	Industrial Mathematics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Medical Imaging and Inverse Problems: The content is based on Mathematics and X-ray and CT scan based on knowledge of calculus differential equations, complex numbers and matrices.

Unit-II Introduction to Inverse Problems: Why should we teach inverse problems? Illustration of inverse problems through pre-calculus, calculus, Matrices and differential equations. Geological anomalies in Earth's interior from measurements and its surface(Inverse problems for Natural disaster) and Tomography.

Unit-III X ray introduction, X ray behaviour and Beers Law (The fundamental question and image construction) Lines in the place. Random Transform: Definition and examples, Linearity, Phantom(Shepp-Logan Phatom-Mathematical phantoms) Back Projection: Definition, Properties and examples

Unit-IV CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

References

1. Timothy G. Feeman, The Mathematics for medical imaging. A beginner's guide, Springer Under graduate Text in Mathematics and Technology, Springer 2010.
2. C.W. Groetsch. Inverse problems. Activities for undergraduates, the Mathematical Association of America, 1999.
3. Andreas Kirsch. An Introduction to the Mathematical Theory of Inverse Problems, 2nd Edn. Springer, 2011

Semester – III (Ability Enhancement)

BHM-3.4AE	Programming in C	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Number system – binary, octal, decimal, hexadecimal, conversions among different number systems. Programming languages, low and high level programming languages, compiler, interpreter, algorithms and flowcharts

Unit-II Character set, Identifiers and Keywords, Constants, Variables, Declaration & Definition, Data Types, Operators, basic structure of C programming, If, Nested if, if-else-if, Switch, for loop, while loop, do-while loop, break, continue, goto statement.

Unit-III Pre-processor directives, Library functions, need for user define functions, Function prototyping, Definition of Function, Passing arguments to a function using Call by reference & Call by value, Returning multiple values, Recursion, Recursive Functions, Concept of Scope & lifetime, Storage classes - auto, register, static, extern.

Unit-IV Declaring Defining and Initializing array, Accessing elements of array, passing arrays to functions, Introduction to multidimensional arrays, strings, Pointers Declarations, Initializing Pointer, De-referencing Pointer, Structures, Overview of File handling.

References

1. E. Balagurusamy , Programming in ANSI C, McGraw-Hill.
2. Yashavant Kanitkar, Let Us C, BPB Publications.
3. Gottfricd, Dyron S., Programming with C, McGraw Hill.

New

Semester – VI (Skills Enhancement)

BHM-6.4SE$_1$	Object Oriented Programming Using C++	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	3(T) + 1(P)	4

Prerequisite: Knowledge of C Language.

Unit-I Object Oriented Paradigm: Comparison of Programming Paradigms, Characteristics of Object-Oriented Programming Languages, Object-Based programming Languages, Brief History of C++, Structure of a C++ Program, Difference between C and C++ , cin, cout, new, delete operators, ANSI/ISO Standard C++.

Unit-II Implementing OOPS concepts in C++, Objects and Classes, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Passing, using Reference Variables with Functions, Abstract Data Types, Constructors - Default and Copy Constructor, Assignment Operator Deep and Shallow Copying, Concepts of Name Spaces, This Pointer.

Unit-III Access Modifiers – Private, Public and Protected. Implementing Class Functions within Class declaration or outside the Class declaration, Instantiation of objects, Scope Resolution Operator, Working with Friend Functions, using Static Class Members. Understanding Compile Time Polymorphism, Function Overloading.

Unit-IV Operator Overloading as Member Function and Friend Function. Inheritance Basics, Types of Inheritance – Simple, Multilevel, Multiple, Hierarchical and Hybrid, Virtual Class, Upcasting & Downcasting, Virtual Function, Pure Virtual Function.

References

1. A. R. Venugopal, Rajkumar, and T. Ravishanker, ***Mastering C++***, TMH, 1997.
2. S. B. Lippman and J. Lajoie, ***C++ Primer***, 3rd Ed., Addison Wesley, 2000.
3. Bruce Eckel, ***Thinking in C++***, 2nd Ed., President, Mindview Inc., Prentice Hall.
4. D. Parasons, ***Object Oriented Programming with C++***, BPB Publication.
5. Bjarne Stroustrup , ***The C++ Programming Language***, 3rd Ed., Addison Welsley.
6. Steven C. Lawlor, ***The Art of Programming Computer Science with C++***, Vikas
1. Publication.
7. Schildt Herbert, ***C++: The Complete Reference***, 4th Ed., Tata McGraw Hill, 1999.

Department of Mathematics
Faculty of Natural Science, Jamia Millia Islamia, New Delhi-25
Course Structure of M.Sc. Mathematics with Computer Science

Semester – I

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MTM-1.1	Real Analysis	4	4	25	75	100
2	MTM-1.2	Abstract Algebra	4	4	25	75	100
3	MTM-1.3C$_1$*	Discrete Mathematical Structures	4	4	25	75	100
	MTM-1.3C$_2$*	Computer Organization and Architecture					
4	MTM-1.4	Computer Fundamentals & C Programming	4	4	25	75	100
5	MTM-1.5	Numerical Analysis	4	4	25	75	100
	Lab-I	*Programming in C*	-	2	25	25	50

Semester – II

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MTM-2.1	Topology	4	4	25	75	100
2	MTM-2.2	Linear Algebra	4	4	25	75	100
3	MTM-2.3	Differential Equations and Applications	4	4	25	75	100
4	MTM-2.4C$_1$*	Data Structures in C	4	4	25	75	100
	MTM-2.4C$_2$*	Data Structures in Java					
5	MTM-2.5SE#	Object Oriented Programming using Java	4	3+1	25	75	100
6	*Lab-II*	*Data Structures using C/Java*	-	2	25	25	50

Semester – III

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MTM-3.1	Functional Analysis	4	4	25	75	100
2	MTM-3.2	Mechanics	4	4	25	75	100
3	MTM-3.3	Differential Geometry	4	4	25	75	100
4	MTM-3.4	Operating Systems	4	4	25	75	100
5	MTM-3.5C$_1$*	Software Engineering	4	4	25	75	100
	MTM-3.5C$_2$*	Object Oriented Analysis & Design					
6	MTM-3.6AE#	Web Designing	4	3+1	25	75	100
7	*Lab-III*	*Operating Systems*	-	2	25	25	50

Semester – IV

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MTM-4.1	Complex Analysis	4	4	25	75	100
2	MTM-4.2	Differentiable Manifolds	4	4	25	75	100
3	MTM-4.3	Wavelet Analysis	4	4	25	75	100
4	MTM-4.4	Database Management System	4	4	25	75	100
5	MTM-4.5C$_1$*	Fluid Dynamics	4	4	25	75	100
	MTM-4.5C$_2$*	Operations Research					
	MTM-4.5C$_3$*	Lattice Theory					
6	*Lab-IV*	*DBMS*	-	2	25	25	50
7	MTM-4.6MP	*Minor Project (Lab based)*	-	4	-	-	100

***CBCS papers subject to the availability of the teacher**
***C: Choice Based**
#AE: Ability Enhancement
#SE: Skill Enhancement

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.2 Abstract Algebra	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Groups, Order of an element of a group, Subgroups, Cyclic groups, Cosets, Normal subgroups, Quotient groups, Homomorphisms, Isomorphisms, Permutation groups.

Unit-II Cayley's Theorem, Automorphisms, Normalizer and centre, Conjugate classes, Class equation and its applications, Direct products, Sylow's theorems, Finite abelian groups, Normal series and Solvable groups.

Unit-III Rings, Subrings, Ideals, Integral Domain and their properties, Quotient Rings, Ring Homomorphisms, Isomorphisms, Ring of polynomials and their properties.

Unit-IV Principal ideal domain, Euclidean domain, Unique factorization domain, Primitive polynomials, Gauss lemma, Eisenstein's criterion for irreducibility.

Books Recommended

1. I. N. Herstein, *Topics in Algebra*, John Wiley & Sons., 2006.
2. Surjeet Singh and Qazi Zameeruddin, *Modern Algebra*, Vikas Publications, 2003.
3. N. Jacobson, *Basic Algebra*, Vol. I & II (2nd Edition), Dover Books on Mathematics, 1984.
4. D. A. R. Wallace, *Groups, Rings and Fields, Series*, Springer Undergraduate Mathematics Series, 2001.
5. N. H. McCoy, *Theory of Rings*, Chelsea Pub. Co., 1973.

New

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.3C$_2$	Computer Organization and Architecture	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Number Systems, Binary Arithmetic, Fixed-point and Floating-point representation of numbers, Codes, Complements, Character Representation – ASCII, EBCDIC. Boolean Algebra: Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and Properties of Boolean Algebra, Boolean functions, Canonical and Standard Forms.

Unit-II Basic Gates – AND, OR, NOT, Universal Gates – NAND, NOR, Other Gates – XOR, XNOR etc. NAND, NOR implementations of digital circuits, Simplification of Boolean Expressions: Formulation of simplification problem, Karnaugh Maps, Minimal, Combinational Logic Design Procedure, Adders, Subtractors, Code Conversion, Decimal Adder, Magnitude Comparator, Decoders, Encoder, Multiplexers, De-multiplexer.

Unit-III Flip-Flops, Clocked RS, D type, JK, T type, State table, State diagram and State equations. Flip-flop excitation tables. Design Procedure, Design of sequential circuit and Counters, Shift registers, Synchronous Counters.

Unit-IV Primary Memory, Secondary memory, Cache memory, Memory Hierarchy, Basic architecture of computer, Bus structures, Von Neumann concept. Overview of Microprogramming, Addressing modes, Pipelining, Synchronous and Asynchronous Data transfer, DMA data transfer.

Books Recommended

1. M. Morris Mano, *Computer System Architecture*, Prentice Hall of India, 1982.
2. William Stalling, *Computer Organization and Architecture*, Pearson Education, 2015.
3. Andrew S. Tanenbaum, *Structured Computer Organization*, PHI, 2006.
4. J. P. Hayes, *Computer Architecture and Organization*, McGraw Hill Education India, 2012.
5. M. Morris Mano, *Computer Engineering Hardware Design*, PHI, 1988.
6. V. Rajaraman & T. Radhakrishnan, *An Introduction to Digital Computer Design*, PHI, 2004.
7. Nicholas Carter, *Schaum's Outlines Computer Architecture*, McGraw-Hill Education, 2002.
8. Carl Hamacher, Zvonko Vranesic, Safwat Zaky. *Computer Organization*, 5th Edition, McGraw-Hill Education India, 2001.
9. M. Morris Mano, *Digital Logic and Computer Design*, PHI, 2004.
10. Donald Givone, *Digital Principles and Design*, TMH (Unit II and V), 2002.

M.Sc. Mathematics with Computer Science, Semester II

MTM-2.2	Linear Algebra	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Vector space, Subspaces and properties, Basis and Dimensions, Sum and direct sum of subspaces, Independent subspaces, Quotient space, Linear transformations, Rank and Nullity of a linear transformation, Sylvester's law of nullity.

Unit-II Algebra of linear transformations, Hom(U,V), Singular and Non-singular linear transformations, Invertible linear transformations, Dual spaces, Principle of duality, Bidual, Annihilators.

Unit-III Matrix of a linear transformation, Change of Basis, Equivalent and Similar matrices, Relationship between Hom(U,V) and M , F , Minimal polynomials of a linear transformation and its properties, Cyclic space.

Unit-IV Eigen values and Eigen vectors, Inner product spaces, Orthogonality and Orthonormality, Schwarz inequality, Gram-Schmidt orthogonalization process, Adjoint, Hermitian, Unitary and Normal linear operators.

Books Recommended

1. I. N. Herstein, *Topics in Algebra*, John Wiley & Sons. 2006.
2. P. R. Halmos, *Linear Algebra Problem Book (Dolciani Mathematical Expositions)*, Number 16, The Mathematical Association of America, 1995.
3. Hoffman & Kunze, *Linear Algebra*, PHI, 1971.
4. Surjeet Singh & Qazi Zameeruddin, *Modern Algebra*, Vikas Publications., 2003.

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.4C$_1$ Data Structures in C	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Definition of Data Structure, Types of Data Structures, Abstract Data Type (ADT), Algorithms: Algorithm Concepts, Definition of Algorithm, Objectives of Algorithms, Quality of an Algorithm, Space Complexity and Time Complexity of an Algorithm, Introduction to Arrays, Row and Column Major Implementations of 1 - D, 2-D, 3-D Arrays, Searching in Arrays - Linear Search, Binary Search, Hash Tables.

Unit-II Sorting in arrays - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Concept of a Linked List, Linear Single and Double Linked Lists, Circular linked List, Operations on Linked Lists and implementation in C, Applications of Linked List. Introduction to Stacks, Operations on Stack, Stack Implementation in C, Applications of Stack.

Unit-III Introduction to Queues, Types of Queues: Linear Queue, Circular Queue, Priority Queue, Double Ended Queue, Operations on Queues, Queue Implementation in C, Concept of a Tree, Definitions and Examples of n-ary Tree, Binary Tree, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree. Level of a Node, Height and Depth of a Tree, Binary Search Tree, Operation on Trees, Tree Traversal and Search Algorithm with Implementation in C, AVL Tree, B Tree, B+ Tree, Heap Tree.

Unit-IV Huffman Algorithm. Definitions of Vertex, Edge and Graph, Types of Graphs – Directed and Undirected, Connected and Disconnected, Cyclic and Acyclic, Isomorphic Graphs. Representation of Graphs: Adjacency Matrix, Linked List. Incidence Matrix, Path Matrix. Graph Algorithms – Breadth First Search (BFS), Depth First Search (DFS), Spanning Tree, Minimum Spanning Tree (MST), Kruskal's Algorithm, Prim's Algorithm and Shortest Path Algorithms.

Books Recommended:

1. S. Lipshutz, Data Structures, *Schaum outline series*, McGraw-Hill, 2011.
2. D. Samanta, *Classic Data Structures*, PHI, 2006.
3. Yashavant P. Kanetkar, *Data Structures through C*, Second Edition, BPB, 2003.
4. A.M. Tanenbaum, *Data Structures Using C and C++*, Prentice-Hall, Inc., New Jersey, 1998.
5. Cormen, Leiserson, Rivest and Stein, *Introduction to Algorithms*, 2nd Edition, McGraw-Hill, 2009.

New

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.4C$_2$ Data Structures in Java	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Definition and Types of Data Structure, Abstract Data Type (ADT), Algorithms: Algorithm Concepts, Definition of Algorithm, Objectives of Algorithms, Quality of an Algorithm, Space Complexity and Time Complexity of an Algorithm, Introduction to Arrays, Row and Column Major Implementation of Multi-Dimensional Arrays, Searching in Arrays - Linear Search, Binary Search.

Unit-II Sorting in Arrays - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort. Introduction to Java Collections Framework: Interfaces (Set, List, Queue, Deque etc.) and Classes (ArrayList, Vector, LinkedList, HashSet, LinkedHashSet etc.). Ordered and Unordered Implementations of Lists and their Applications. Introduction to Stacks, Operations on Stack, Stack Implementations In Java, Applications of Stack.

Unit-III Introduction to Queues, Types of Queues - Linear Queue, Circular Queue, Priority Queue, Double Ended Queue, Operations on Queues, Queue Implementations in Java. Concept of a Tree, Definitions and Examples of n-ary Tree, Binary Trees, Strictly Binary Tree, Complete Binary Tree, Full Binary Tree, Level of a Node, Height and Depth of a Tree, Binary Search Trees, Operation on Trees, Tree Traversals and Search Algorithm with Implementation in Java, AVL Tree, B-Tree, B+ Tree, Heap Tree.

Unit-IV Huffman Algorithm. Definitions of Vertex, Edge and Graph, Types of Graphs – Directed and Undirected, Connected and Disconnected, Cyclic and Acyclic, Isomorphic Graph, Representation of Graphs: Adjacency Matrix, Linked List. Incidence Matrix, Path Matrix. Graph Algorithms – Breadth First Search (BFS), Depth First Search (DFS), Spanning Tree, Minimum Spanning Tree (MST), Kruskal's Algorithm, Prim's Algorithm, and Shortest Path Algorithms.

Books Recommended:

1. S. Lipshutz, *Data Structures*, Schaum outline series, McGraw-Hill, 2011.
2. D. Samanta, *Classic Data Structures*, PHI, 2006.
3. Robert Lafore, *Data Structures & Algorithms in Java*, 2nd Edition, Pearson, 2009.
4. John R. Hubbard and Huray Anita, *Data Structures with Java*, Pearson Prentice Hall, 2004.
5. Mark Allen Weiss, *Data Structures and Algorithms Analysis in Java*, 3rd Edition, Pearson Education, 2011.
6. Cormen, Leiserson, Rivest and Stein, *Introduction to Algorithms*, 2nd Edition, McGraw-Hill, 2009.

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.5SE	Object Oriented Programming using Java (Skill Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	3+1	3L + 2P

Unit-I Paradigms of Programming Languages, Basic Concepts of Object Oriented Approach, Comparison of Object Oriented and Procedure Oriented Approach, Benefits and Applications of Object Oriented Programming. Introduction to Java, Basic Features of Java, Java Virtual Machine, Java Runtime Environment, Primitive Data Type and Variables, Expressions, Statements and Arrays, Operators, Control Statements.

Unit-II Encapsulation, Classes and Objects, Class Members. Data Members and Member Functions. Class Member Visibility, Understanding Static, Constructors, Argument Passing, Object Initialisation, Garbage Collection. Polymorphism: Ad hoc and Universal Polymorphism. Inheritance Basics: Access Control, Use of Super, Types of Inheritance, Method Overriding, Dynamic Method Dispatching, Preventing Inheritance and Overriding.

Unit-III Defining and Implementing an Interface, Applying Interface, Accession of Interface Variable, Abstract Class. Java API Packages, Using System Packages, Naming Conventions, Creating Packages, Accessing a Package, Adding a Class to a Package. Exception Types, Exception Handling, Catching Multiple Exceptions, Java Built-in Exception, Creating Exception Subclasses.

Unit-IV Multithreading, Main Thread, Creating Threads, Thread Priorities, Life Cycle of Thread, Synchronization in Java, Thread Exceptions, String: Fundamental of Characters and Strings, String and StringBuffer Classes, Introduction to Applet Programming.

Books Recommended:

1. Cay Horstmann, *Computing Concepts with Java Essentials*, 2nd Edition, Wiley India, 2006.
2. Bruce Eckel, *Thinking in Java*, Pearson Education, 2006.
3. H. Schildt, *Java 2: The Complete Reference* (5th ed.), Tata McGraw Hill, 2002.
4. Richard Johnson, *An Introduction to Java Programming and Object-Oriented Application Development*, Thomson Learning, 2006.
5. Deitel & Deitel, *Java-How to Program* (7th ed.), Prentice Hall, 2007.
6. Daniel Liang, *Introduction to Java Programming* (5th ed.), Prentice Hall, 2011.

M.Sc. Mathematics with Computer Science, Semester – III

MTM-3.2 Mechanics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Kinematics of a rigid body motion, Moments and Products of inertia, Perpendicular and Parallel axis theorem, Momental ellipsoid, Kinetic energy, Theorem of König, Angular momentum, Euler's dynamical equations.

Unit-II Generalized coordinates, Constraints, Basic problem of mechanics, Degree of freedom, Ideal constraints, D' Alembert's principle, Necessary and sufficient condition for a holonomic system to be in equilibrium, Generalized forces for a holonomic system.

Unit-III Lagrange's equations of motion. Lagrange function, Techniques of calculus of variations, Hamilton's equation of motion.

Unit-IV Hamilton's principles, Canonical transformation, Lagrange's and Poison brackets, Integral in variances, Hamilton-Jacobi Poisson equations.

Books Recommended:

1. Synge and Griffith, *Principle of Mechanics*, McGraw Hill Company, 1959.
2. Chorlton, F., *Textbook of Dynamics*, John Wiley & Sons, 2004.
3. K. SankaraRao, *Classical Mechanics*, PHI India, 2005.
4. Madhumagal Pal, *A Course on Classical Mechanics*, Narosa Publication, 2008.
5. C. Fox, *An introduction to the Calculus of Variation*, Dover Publication, 1988.
6. S.L. Loney, *Ele. Treatise on the dynamics of particle and of rigid bodies*, Forgotten Books, 2012

M.Sc. Mathematics with Computer Science, Semester – III

MTM-3.3	Differential Geometry	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Tensors: co-ordinate transformation, Contravariant, Covariant vectors and tensors of higher rank, Contraction, Quotient law of tensor, Metric tensor and 3-index christofell symbols and their properties, Transformation law for christofell symbols, Covariant derivative of a vector and tensor, Riemannian curvature tensor and its properties, Ricci tensors and scalar curvature.

Unit-II Curves in R^3: Representation of curves, Unit and arbitrary speed curves, Frenet frame, curvature and torsion, Serret - Frenet formula, Helix, Minkowski 3-space , Slant helix, Minkowski space time , k-type slant helix, Directional derivative and covariant derivative, Frame field, Altitude matrix and connection Forms, Curve frame rotation matrix, Offset curves.

Unit-III Surface in R^3: Definition and examples of a smooth surface, Differentiable functions on surfaces, Tangent plane and unit surface normal, Surface of revolution, First fundamental form and its properties, Second fundamental form, Tangential intersection of two surfaces, Normal curvature, Principal curvature.

Unit-IV Meusnier's theorem, Euler's theorem, Umbilical surface, Helicoidal surface, Shape operator and its properties, Gaussian and mean curvature, Minimal surface, Ruled surface, Line of curvature, Rodriguez formula, Geodesic of a surface and geodesic equation, Gauss and Weingarten equations, Mainardi-Codazzi equations, Geodesic curvature, Liouville's formula, Gauss-Bonnet theorem.

Books Recommended:

1. B.O. Neill, *Elementary Differential Geometry*, Academic Publishers, 2006.
2. Andrew Pressley, *Elementary Differential Geometry*, Springer, 2010.
3. M. P. doCarmo, *Differential Geometry of Curves and Surfaces*, Prentice Hall, 1976.
4. Zafar Ahsan, *Tensors: Mathematics of Differential Geometry and Relativity*, PHI, 2015.
5. D. Somasundaram, *Differential Geometry*, Narosa Publishing House, 2005.
6. Anthony W. Nutbourne, Ralph R. Martin, *Differential geometry Applied to Curve and Surface Design*, Volume I, John Wiley & Sons, 1988.

M.Sc. Mathematics with Computer Science, Semester – III

MTM-3.4 Operating Systems	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Introduction, Evolution of Operating System, Role and Functions of Operating Systems, Operating System Classification, Operating System Structure, Definition of Multiprogramming, Multitasking, Multiprocessing, Multi-user, Timesharing, Multithreading.

Unit-II Process Overview, Process States and State Transitions, Levels of Schedulers and Scheduling Algorithms, Process Communication, Process Synchronization, Semaphores, Critical Section and Mutual Exclusion Problem, Classical Synchronization Problems, Multithreading, Introduction to Deadlock, Coffman's Conditions for deadlock, Deadlock Detection and Recovery, Deadlock Prevention, Deadlock Avoidance.

Unit-III Classical Memory Management Techniques- Monoprogramming, Multiprogramming with fixed and variable partitions, Relocation & Protection, Swapping, Internal and External Fragmentation, Memory Compaction, Virtual Memory - Paging, Page Table, Page Replacement Policies, Segmentation, Thrashing.

Unit-IV File Concept, File Operations, Access Methods, Directory Structure, File-System Mounting, File Sharing, File-system Structure, File-System Implementation, Directory Implementation, Disk block Allocation Methods, Free Space Management, Disk structure, Disk Scheduling Algorithms- FCFS, SSTF, SCAN, C-SCAN, LOOK, C- LOOK.

Books Recommended:

1. A. S. Tanenbaum, *Modern Operating Systems*, Pearson Education, 3rd edition, 2015.
2. Silberschatz, P. B. Galvin and G. Gagne, *Operating System Concepts*, Wiley, 2009.
3. William Stallings, *Operating Systems: Internals and Design Principles*, PHI, 2009.
4. D.M. Dhamdhere, *Operating Systems: A Concept Based Approach*, Tata McGraw-Hill, 2007.
5. Deitel Deitel Choffnes, *Operating Systems*, Pearson, 2004.

M.Sc. Mathematics with Computer Science, Semester – III

MTM-3.5C$_1$ Software Engineering	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Definition, Program Vs Software, Overview of S/W Engineering Process, Software life cycle Models: Build and Fix, Waterfall, Prototype, Iterative Enhancement Model, Evolutionary, Spiral Model, RAD Model.

Unit-II Requirements Engineering Process, Requirements Elicitation & Analysis Techniques, Problem Analysis, Data Flow Diagrams, Data Dictionaries, Software Requirement and Specifications (SRS), Characteristics of good quality SRS, Components of SRS - Functional & Non-Functional Requirements, Requirements Validation, Use Cases, Decision Table, Decision Tree.

Unit-III Software Project Planning Objectives, Project Size Estimation, Cost Estimation - COCOMO Estimation Model. Software Risks, Risk Identification, Risk Refinement, Risk Monitoring & Management. Introduction to Software Design, Principles, Abstraction, Modularity, Information Hiding, Functional Independence, Module Level Concepts: Cohesion, Coupling, Types of Cohesion and Coupling.

Unit-IV Design components - Data Design, Architectural Design, User Interface Design, Component Design, Activity Diagrams. Introduction to Software Testing, Error, Faults, Failure, Software Reliability, Functional and Structural Testing, Basis Path Testing, Cyclomatic complexity, Testing Levels: Unit, Integration, Validation and System Testing, Alpha and Beta Testing, Quality Assurance.

Books Recommended:

1. R.S. Pressman, *Software Engineering: A Practitioner's Approach*, McGraw-Hill, 2014.
2. Pankaj Jalote, *An Integrated Approach to Software Engineering*, Narosa Publishing, 2015.
3. K. K. Aggarwal and Yogesh Singh, *Software Engineering*, New Age International Publishers, 2008.
4. W. S. Jawadekar, *Software Engineering: Principles and Practice*, McGraw-Hill, 2004.
5. Douglas Bell, *Software Engineering for Students*, Addison-Wesley, 2007.

New

M.Sc. Mathematics with Computer Science, Semester – III

MTM-3.6AE	Web Designing (Ability Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	3+1	3L + 2P

Unit-I Brief History of Internet, World Wide Web, Communication on the Internet, Internet Domains, Internet Server Identities, Establishing Connectivity on the Internet, Protocol used in Internet – TCP/IP, SMTP, PPP, HTTP, Services on the Internet - E-mail, Usenet, FTP, Search Engines, Web Browsers, Web Servers, Design Templates.

Unit-II Introduction to HTML, Basic Structure of a HTML Document, Document Head and Body, Titles and Footers, Working with Texts – Texts Formatting, Text Styles, Text Effects, Ordered & Unordered Lists, Table – TR & TD Tags, Cell Spacing, Cell Padding, Colspan, Rowspan, Frames – FRAME and FRAMESET Tags, Hyperlinks, Forms – FORM and INPUT Tags, Text Box, Radio Button, Checkbox, SELECT Tag and Pull Down Lists, Hidden, Submit and Reset.

Unit-III Introduction to DHTML, Benefit of CSS, CSS Properties, CSS Styling – Background, Text Format, Controlling Fonts, Working with Lists and Tables, CSS ID and Class, Web Page Layout and Editing with CSS, Writing JavaScript into HTML, Basic Programming using JavaScript, JavaScript Client Validations, Dialog Boxes, Overview of Document Object Model, Event Handling.

Unit-IV Introduction to Server-Side Programming, Overview of Server-Side Programming Languages, Introduction to Servlets, Servlet Life Cycle, Servlet Implementation and Configuration, Servlet Exception, Requests & Responses, Deployment Descriptor, Session Tracking, Introduction to JSP, JSP Tags, Implicit Objects, Working with Session Objects, Database Connection using JSP/Servlet, Overview of Tomcat Sever – Configuration and Web Application Deployment.

Books Recommended:

1. Robert W. Sebesta, *Programming the World Wide Web*, (4th ed.), Addison Wesley, 2007.
2. Dick Oliver, Michael Morrison, *Sams Teach Yourself HTML and CSS in 24 Hours*, Pearson Education, 2005.
3. Danny Goodman, *JavaScript & DHTML Cookbook: Solutions and Example for Web Programmers*, O'Reilly Media, 2003.
4. Ivan Bayross, *HTML 5 and CSS 3 Made Simple*, BPB, 2012.
5. Jim Keogh, *J2EE: The Complete Reference*, TMH, 2015.
6. Wrox Press, *Professional JSP J2EE 1.3 Edition*, Shroff Publishers, 2005.

M.Sc. Mathematics with Computer Science, Semester – IV

MTM-4.1 Complex Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Complex integration, Cauchy-Goursat Theorem, Cauchy's integral formula. Higher order derivatives, Morera's theorem, Cauchy inequality and Liouville's theorem, The fundamental theorem of algebra.

Unit-II Taylor's theorem, Maximum modulus principle, Schwarz lemma, Laurent's series, Isolated singularities, Residues, Cauchy's residue theorem, Evaluation of integrals, Branches of many valued functions with arg z, log z, and z^a .

Unit-III Meromorphic functions, The argument principle, Rouche's theorem, Inverse function theorem.

Unit-IV Bilinear transformations and their properties and classification, Definition and examples of conformal mappings.

Books Recommended:

1. B. Choudhary, *Elements of Complex Analysis*, Wiley Eastern Ltd., New Delhi, 1993.
2. J.B. Conway, *Functions of one Complex variable*, Springer-Verlag, International Student-Edition, Narosa Publishing House, 1980.

M.Sc. Mathematics with Computer Science, Semester – IV

MTM-4.2 Differentiable Manifolds	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Differentiable manifolds, Definition and examples, Smooth maps between two smooth manifolds, Tangent vector and tangent space at a point on a manifold, Tangent bundle of manifold.

Unit-II Vector fields, Lie bracket, Jacobian of a smooth map, One parameter group of transformation, Integral curves on manifolds, Involutive distribution, Lie derivatives.

Unit-III Cotangent space, Differential forms, Pullback of 1-form, Tensor fields, Exterior derivatives, Immersions, Submersions and submanifolds examples.

Unit-IV Connections, Geodesics, Covariant differentiations, Torsion, curvature, Structure equations of Cartan, Bianchi identities, Riemannian metric, Riemannian manifold, Riemannian connection, Riemannian curvature, Sectional curvature, Ricci curvature and Scalar curvature.

Books Recommended:

1. B.O. Neill, *Elementary Differential Geometry*, Academic Publishers, 2006.
2. U.C. De and A. Shahikh, *Differentiable Manifolds*, Narosa Publications, 2007.
3. S. Kumaresan, *A Course in Differential Geometry and Lie Groups*, Hindustan Book Agency, 2002.
4. Boothby, *An Introduction to Differentiable Manifolds and Riemannian Geometry*, Academic Press, 2002.
5. Gerardo F. Torres del Castillo, *Differentiable Manifolds*, Birkhauser, 2012.
6. M. P. DoCarmo, *Riemannian Geometry*, Brikhauser, 2013.

M.Sc. Mathematics with Computer Science, Semester – IV

MTM-4.4	Database Management System	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Introduction to Databases and Database Management System (DBMS), Characteristics of DBMS Approach, Advantages, Disadvantages & Applications of DBMS, Role of DBA, Data Integrity, Entity Integrity, Domain Integrity, Referential Integrity, Keys: Super key, candidate key, alternate key, Introduction to Transactions and Serializability, ACID properties.

Unit-II Three Schema Architecture of DBMS, Data Independence, Classifications of DBMS. Data Model, Types, Data Modelling Using E-R Diagram, Entity Types, Relationship Types, Role names & Recursive relationship, relationship degree, Attributes, Key attributes, Weak Entity, Owner Entity, Identifying relationship, Partial Key, Cardinality and Participation constraint, Characteristics of Hierarchical & Network Model.

Unit-III Relational Model Concepts, Conversion of ER Diagram to Relational Model, Relational Algebra- Select, Project, Cartesian Product, Joins, Division & Set operations, Aggregate Functions, Introduction to Tuple and Domain Relational Calculus, Functional dependency.

Unit-IV Design Guidelines for Relational Schemas, Normalisation, Types of Normal Forms, De-normalization. SQL: DDL, DML, DCL, Queries for Table Creation, Deletion and Modification in SQL, Defining Constraints, Select query for Data Extraction, group by, having, order by clauses, Insert, Delete & Update Statements in SQL, Views in SQL, types of Joins, Aggregate Functions, Nested Queries, Introduction of PL/SQL, Programming Constructs, Procedures, Functions, Exception handling, Cursors.

Books Recommended:

1. Elmasri, Navathe, *Fundamentals of Database Systems*, Pearson Education, 2008.
2. Henry F. Korth, Abraham Silberschatz, S. Sudurshan, *Database System Concepts*, McGraw-Hill, 2005.
3. C. J. Date, *An Introduction to Database Systems*. Pearson. 2006.
4. Ramakrishna, Gehrke, *Database Management Systems*, Mcgraw-Hill, 2014.
5. S.K. Singh, *Database Systems Concepts, Design and Applications*, Pearson, 2011.
6. Jeffrey D. Ullman, Jennifer Widom, *A first course in Database Systems*, Pearson, 2014.

M.Sc. Mathematics with Computer Science, Semester – IV

MTM-4.5C$_1$ Fluid Dynamics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I **Kinematics:** Definition, Lagrangian and Eulerian Specifications, Stramline, Path line and Streak line, Linear strain rate, Shear strain rate, Vorticity and Circulation, Material derivative, Acceleration of fluid particle, Numerical problems on Lagrangian/Eulerian specifications, Stramline/pathe line/Streak line and Material derivative.

Unit-II **Conservation laws:** Conservation of mass in integral and differential forms, Origin of forces in fluid, Stress at a point, Conservation of Momentum, Constitutive equation for Newtonian fluid, Navier-Stokes equation, Euler equation, Bernoulli's equation and its applications, Boussinesq approximation.

Unit-III **Laminar Flows:** Steady flow between parallel plates, Volume flow rate, Average velocity, Plane Couette flow, Magnitude of shear stress, Plane Poiseuille flow, Magnitude of shear stress, Steady flow in a pipe, Shear stress at any point, Volume flow rate, Impulsively started plate: Similarity solutions.

Unit-IV **Dynamic Similarity:** Dimensional analysis, Rayleigh's technique, Backinghamπ – theorem, Significance of Reynolds number, Definition of Reynold's number. Froude number. Euler number. Mach number. Prandtl number. Boundary Boundarylaer and boundary equation, Boundary layer thickness, Displacement thickness, Drag and lift, Blassius equation and its solution.

Books Recommended:

1. P. K. Kundu and I. M. Cohem, *Fluid Mechanics*, Elsevier Publication, 2010.
2. Fay, *Introduction to Fluid Mechanics*, Prentice Hall of India, 1996.
3. H. Schlichting, K. Gersten, *Boundary-Layer Theory*, 8th Edition, Springer; 2000.
4. M. D. Raishghania, *Fluid Dynamics*, S. Chand Publication, 2003.

New

M.Sc. Mathematics with Computer Science, Semester – IV

MTM-4.5C$_2$ Operations Research	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Convex sets and their properties, Graphical method, Integer Programming, Branch and Bound Technique, Theory of Simplex method, Two-Phase Simplex Method, Big-M method.

Unit-II Duality in LP, Conversion of primal to dual, Dual Simplex method, Sensitivity analysis, Discrete change in price vector, requirement vector and coefficient matrix, adding a new variable and new constraints.

Unit-III Queuing Theory, Distribution of arrival and departure pattern, (M/M/1):(∞/FCFS), (M/M/1):(N/FCFS) and (M/M/S):(∞/FCFS) queuing models, Network analysis, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT), Project management with CPM/PERT.

Unit-IV Dynamic programming, Bellman's Principle of Optimality, Nonlinear Programming (NLP), Graphical method for NLP, Kuhn-Tucker Conditions for Constrained Optimization, Quadratic Programming, Wolfe's modified Simplex method, Separable Programming.

Books Recommended:

1. H. A. Taha, *Operations Research*, 9th edition, Pearson Education, 2014.
2. Hillier and Lieberman, *Introduction to Operations Research*, McGraw Hill, 1995.
3. S. D. Sharma, *Operations Research*, Kedar Nath Ram Nath Publishers.
4. J. K. Sharma, *Operations Research – Theory and Application*, Macmillian Publication, 2009.
5. S. M. Sinha, *Mathematical Programming*, Elsevier India Pvt. Ltd., 2005.

Minutes of B.O.S Meeting
Department of Mathematics held on September 09 &10, 2015

A meeting of the B.O.S. of the Department of Mathematics was held on September 09-10, 2015 at 11:00 a.m. in the Seminar Room. The following members were present in the Meeting:

1. Prof. Naseem Ahmad (Chairperson)
2. Prof. M.Hasan Shahid Member
3. Prof. A. Wafi Member
4. Prof. S. M. K. Haider Member
5. Prof. Ayub Khan Member
6. Dr. Shehzad Hasan Member
7. Dr. Arshad Khan Member
8. Dr. M.Yahya Abbasi Member
9. Ms. Sakshi Dhall Member
10. Prof. Lukman Ahmad Khan External Member
    Deptt. of Bio Sciences, JMI

The following decisions were taken:

5. The board agreed to interview the candidates who submitted the proposal for the admission to Ph. D. in Mathematics, 2015-16 at the starting of the meeting. The criteria for admission was set as follows:
   (a) A candidate passed **B.A./B.Sc and M.A./M.Sc with I div.**
   (b) One should proceed the Ph.D. in the same field of research in which he/she has completed M.Phil.

The following candidates were interview:

S. No.	**Reg. No.**	**Name of Candidates**	**Proposal submitted on**	Willing area of Research
1	JMIP001032	Ambreen Naz	Nonlinear Dynamics	Nonlinear Dynamics
2	JMIP003207	Alka Yadav	General type of prposal	Modern Algebra
3	JMIP004066	Vasant Kumar Mishra	Chaos Control & Syn.	Chaos Control & Syn.
4	JMIP000249	Puja Bansal	Geom. Of Sub-manifolds	Geom. of Sub-manifolds
5	JMIP000740	Showkat Ahmad Dar	Complex Analysis	Complex Analysis
6	JMIP000342	Saima Jabee	Diff. Geometry	Diff. Geometry
7	JMIP003912	Shalja Awasthi	Algebra	Algebra
8	JMIP000613	Sudhanshu Shekhar	Fracture Mechanics	Fracture Mechanics
9	JMIP001317	Savita Rani	Diff. Manifolds	Diff. Manifolds
10	JMIP001841	Sukhvinder Kaur	General Type of Proposal	Nonlinear Dynamics
11	JMIP001521	Sanyam Gupta	Self Inject. Dim of N. Ring	Modern Algebra
12	JMIP000275	Miridula Mundalia	Abstract Algebra	Abstract Algebra

13	JMIP004477	Uday Singh	Chaos Time Series	Chaos Time Series
14	JMIP004434	Umama Anwar	Diff. Geometry	Diff. Geometry
15	JMIP002353	Sabahat Ali	A study of Ideals . . .	A study of Ideals Algebra
16	JMIP003178	Vishvajit Singh	Chaos Control & Syn.	Chaos Control & Syn.
17	JMIP001781	Akif Fairooze Talee	Fuzzy Ideals in Algebra . .	Fuzzy Ideals in Algebra

On the basis of set criteria and the performance of the candidate, B.O.S. recommended the names of the following candidates for provisional admission to Ph.D. programme in Mathematics, 2015.

S.No.	**Reg. No.**.	Name of Candidates	Broad Area	Supervisor
4	JMIP000249	Puja Bansal	Geom. Of Sub-manifolds	Prof. M.H.Shahid
15	JMIP002353	Sabahat Ali	A study of Ideals . . .	Dr. M.Yahya Abbasi
17	JMIP001781	Akif Fairooze Talee	Fuzzy Ideals in Algebra . . .	Dr. M. Yahya Abbasi

The following candidates have not been recommended

S.No.	**Reg. No.**	Name of Candidate	Reason(s) for not to be recommended
1	JMIP001032	Ambreen Naz	Presentation is not up to mark. Basic maths. is weak
2	JMIP003207	Alka Yadav	Performance is not satisfactory
3	JMIP004066	Vasant Kumar Mishra	Performance is not satisfactory
5	JMIP000740	Showkat Ahmad Dar	Not fulfilling the set criteria
6	JMIP000342	Saima Jabee	Not fulfilling the set criteria
7	JMIP003912	Shalja Awasthi	Not fulfilling the set criteria
8	JMIP000613	Sudhanshu Shekhar	Not fulfilling the set criteria
9	JMIP001317	Savita Rani	Her background of Maths. is not up to the mark
10	JMIP001841	Sukhvinder Kaur	No proposal to explain. Research direction is not set by her.
11	JMIP001521	Sanyam Gupta	His performance is not up to the mark. Basic maths. is not strong enough.
12	JMIP000275	Miridula Mundalia	Her performance is not up to the mark. Basic maths. is not strong enough.
13	JMIP004477	Uday Singh	Not fulfilling the set criteria
14	JMIP004434	Umama Anwar	No proposal to explain. Research direction is not set yet by her.
16	JMIP003178	Vishvajit Singh	No proposal to explain. Research direction is not yet set by him.

The meeting was adjourned for 10.09.2015 at 11:00 am

On 10.09.2015, the following members were present:

1.	Prof. Naseem Ahmad	(Chairperson)
2.	Prof. M.Hasan Shahid	Member
3.	Prof. A. Wafi	Member
4.	Prof. S. M. K. Haider	Member
5.	Prof. Ayub Khan	Member
6.	Dr. Shehzad Hasan	Member
7.	Dr. Arshad Khan	Member
8.	Dr. M.Yahya Abbasi	Member

The following decisions were taken:

1. The minutes of B.O.S. meeting held on 26.05. 2015 were confirmed by circulation while the minutes of emergent B.O.S. meeting held on July 27-28, 2015 were discussed and confirmed with minor corrections.
2. HoD reported that the panel of experts was sent to the administration.
3. The syllabi of UG and PG courses, Sem. I were discussed in meeting of sub committee of BOS on 8.9.2015. The syllabi of U.G. & P.G. courses, Sem. I were approved.
4. The examiners for UG and PG have been discussed and Chair was authorised to appoint the Examiners/ Moderators for the Odd semester examination 2015.
5. This agenda has already discussed in the starting.
6. The matter regarding the additional space was discussed and it was unanimously decided to request the administration to allocate additional space to the department to accommodate the faculty members to be appointed in near future.
7. Under any other item, the faculty members thanks to Prof. Naseem Ahmad for his contribution and upliftment of the department during his tenure as Head of the Department.

The meeting came to its end at **1:30 pm** with vote of thanks to the Chair.

JMI Mail

Ahmad Kamal (Asstt. Prof. D/o Mathematics) <akamal1@jmi.ac.in>

Conformation by circulation of the minutes of BOS held on 14-Dec-2015.

2 messages

HoD, Mathematics, JMI <mathematics@jmi.ac.in> Tue, Jan 19, 2016 at 1:08 PM
To: "Abdul Wafi (HoD, Mathematics)" <awafi@jmi.ac.in>, Mohammad Khan <mrkhan2@jmi.ac.in>, "Ayub khan (professor)" <akhan12@jmi.ac.in>, Arshad Khan <akhan2@jmi.ac.in>, Mohammad Abbasi <mabbasi@jmi.ac.in>, "Naseem Ahmad (Professor, D/o Mathematics)" <nahmad4@jmi.ac.in>, "Sakshi Dhall, Asstt. Professor, Maths" <sdhall@jmi.ac.in>, "Prof. S.M. Haider (D/o Mathematics)" <shaider@jmi.ac.in>, Shehzad Hasan <shasan@jmi.ac.in>, "Prof. M. Hasan Shahid" <mshahid@jmi.ac.in>, "Ahmad Kamal (Asstt. Prof. D/o Mathematics)" <akamal1@jmi.ac.in>, izhar uddin Uddin <izharuddin.rm@gmail.com>

Minutes of the B.O.S Meeting

Department of Mathematics held on December 14, 2015

A meeting of the B.O.S. of the Department of Mathematics was held on 14.12.2015 at 3.30 p.m. in the Seminar Room. The following members were present in the Meeting:

1. Prof. Abdul Wafi	(Chairperson)
2. Prof. M. Rais Khan	Member
3. Prof. Mohd. Hasan Shahid	Member
4. Prof. Naseem Ahmad	Member
5. Prof. S. M. K. Haider	Member
6. Dr. Shehzad Hasan	Member
7. Dr. Arshad Khan	Member
8. Dr. M.Yahya Abbasi	Member
9. Dr. Ahmad Kamal	Member
10.Dr. Izhar Uddin	Member
11. Prof. Luqman A. Khan	External Member

At the outset, Prof. Naseem Ahmad welcomed Prof. Abdul Wafi as a new HOD. The HOD welcomed Dr. Ahmad Kamal and Dr. Izhar Uddin who have recently joined the department as faculty members.

1. The Minutes of the BOS meeting held on 09.09.2015 and adjourn meeting held on 10.09.2015were discussed and confirmed with some minor correction.
2. There were typographical errors in the item no. 5 of minutes of BOS meeting held on September 09-10, 2015 regarding Ph.D admission programme 2015. The minutes of agenda item no.5 should be read as follows:

Name		
Pooja Bansal	A Study of Geometry	A Study of Geometry of Submanifolds
Sabahat Ali Khan	A Study of Ideals....	A Study of Ideals in Algebraic System
Aakif Fairooze Talee	Fuzzy Ideals in Algebra....	Some Contributions to Fuzzy Ideals in Algebraic System

3. Distribution of teaching load for even semester of UG and PG courses were discussed and approved. HOD was authorised to do minor changes, if required.
4. Confirmation of UG and PG course structures and syllabi for second semester in the light of CBCS were discussed and approved.
5. The appointment of examiners for UG and PG even semester examinations, 2016 were discussed and approved. HOD was authorised to do minor changes, if required.
6. Various committees were formed and approved for smooth functioning of the departmental affairs.
7. Under any other item, Prof. Mohd. Hasan Shahid suggested to re-introducing the course on Mathematical Modelling and Computer Simulation in M.Sc. Tech. (IMCA). The board agreed on his suggestion.

The meeting came to an end at 4.30 p.m. with the vote of thanks to the chair.

(Prof. Abdul Wafi)

Head

HoD, Mathematics, JMI <mathematics@jmi.ac.in> Thu, Oct 17, 2019 at 1:03 PM
To: "Ahmad Kamal (Asstt. Prof. D/o Mathematics)" <akamal1@jmi.ac.in>

JMI Mail

Ahmad Kamal (Asstt. Prof. D/o Mathematics) <akamal1@jmi.ac.in>

Minutes of BOS held on May 05,2016

1 message

HoD, Mathematics, JMI <mathematics@jmi.ac.in> Sat, Jun 4, 2016 at 3:48 PM
To: "Prof. M. Hasan Shahid" <mshahid@jmi.ac.in>, "Naseem Ahmad (Professor, D/o Mathematics)" <nahmad4@jmi.ac.in>, "Prof. S.M. Haider (D/o Mathematics)" <shaider@jmi.ac.in>, "Ayub khan (professor)" <akhan12@jmi.ac.in>, Arshad Khan <akhan2@jmi.ac.in>, Mohammad Abbasi <mabbasi@jmi.ac.in>, Shehzad Hasan <shasan@jmi.ac.in>, "Sakshi Dhall, Asstt. Professor, Maths" <sdhall@jmi.ac.in>, "Ahmad Kamal (Asstt. Prof. D/o Mathematics)" <akamal1@jmi.ac.in>, "Izhar Uddin (Asstt. Prof., D/o Mathematics)" <izharuddin1@jmi.ac.in>, Mohammad Khan <mrkhan2@jmi.ac.in>

Dear Colleagues,

Please find the minutes of BOS held on May 05,2016.
Please give your comments/opinion, if any by June 10, 2016.

With regards,

Prof. Abdul Wafi
Head

Department of Mathematics

Minutes of B.O.S Meeting held on May 05, 2016

A meeting of B.O.S. of the Department of Mathematics was held on 05.05.2016 at 3.30 p.m. in the Seminar Room. The following members were present in the meeting:

1. Prof. Mursaleen AMU, Aligarh (External member)
2. Prof. Luqman A Khan (External member)
3. Prof. Abdul Wafi (Chairperson)
4. Prof. Mohd. Hasan Shahid Member
5. Prof. Naseem Ahmad Member
6. Prof. S. M. K. Haider Member
7. Prof. Ayub Khan Member
8. Dr. Shehzad Hasan Member
9. Dr. Arshad Khan Member
10. Dr. Mohd.Yahya Abbasi Member
11. Ms. Shakshi Dhall Member
12. Dr. Ahmad Kamal Member
13. Dr. Izhar Uddin Member

The following decisions were taken:

1. The Minutes of the BOS meeting held on 14.12.2015 and emergent BOS meetings held on 02.02.2016 and 26.02.2016 were confirmed.

2. The board discussed and approved the course structure and syllabi of UG and PG courses offered by Department of Mathematics under CBCS.

3. The board discussed and agreed to organize a conference entitled **International Conference on Differential Geometry, Algebra and Analysis** which is scheduled to be held during November 15-17, 2016 and formed the following committee:

Convener: Prof. Mohd. Hasan Shahid

Organizing Secretaries: Dr. Arshad Khan, Dr. Mohd.Yahya Abbasi and Dr. Izhar Uddin

4. The board approved the distribution of teaching load for odd semester of UG and PG courses and HOD was authorized to do minor changes, if required.

5. The board approved the name of the examiner for B.Sc. (Hons) VI semester viva-voce examination.

7. The board approved the names of examiners for Ph.D. course work.

8. The board approved the following names of external experts for moderation committee of UG and PG courses.

UG- Prof. Noor Muhammad Khan

PG- (i) Prof. L.M. Saha, (ii) Prof. M.N. Hoda and (iii) Dr. S.K. Naqvi

9. The progress report of JMI International Journal of Mathematical Sciences was placed for discussion and after deliberation a new editorial committee was formed for smooth and timely publication of the journal. The following names were proposed and approved:

Managing editor: Prof. Mohd. Hasan Shahid

Associate editors: Dr. Shehzad Hasan, Dr. Arshad Khan and Dr. Mohd Yahya Abbasi

The meeting came to an end at 4.45 p.m. with the vote of thanks to the chair.

(Prof. Abdul Wafi)

Head

B.Sc.(Hons.) Mathematics
(2016-17)

Course Structure		
Semester- I	Semester- II	Semester- III
Semester- IV	Semester- V	Semester- VI

COURSE STRUCTURE

Code	Title of Paper	Unit	Credit	Maximum Marks
Semester – I				
BHM-111	Calculus	4	4	100
BHM-112	Analytical Geometry	4	4	100
BHM-113 (GE-1) *#	C1. Set Theory and Number Theory C2. Computer Fundamentals	4	4	100
BHM-114 (AE-1)	English/MIL Communication	4	4	100
Semester – II				
BHM-211	Differential Equations	4	4	100
BHM-212	Statistical Techniques	4	4	100
BHM-213 (GE-2) *#	C1. Programming in C (P) C2. Econometrics	4	4	100
BHM-214 (AE-2)	English/MIL Communication	4	4	100
Semester – III				
BHM-311	PDE and System of ODE	4	4	100
BHM-312	Numerical Methods	4	4	100
BHM-313	Group Theory	4	4	100
BHM-314 (GE-3) *#	C1. Information Security C2. OOPs in C++ (P)	4	4	100
BHM-315 (SE-1) *#	C1. Latex & Web Designing C2. Computer Graphics	4	4	100
Semester – IV				
BHM-411	Real Analysis	4	4	100
BHM-412	Ring Theory	4	4	100
BHM-413	Linear Programming	4	4	100
BHM-414 (GE-4) *#	C1. Mathematical Modelling C2. Data Structures (P)	4	4	100
BHM-415 (SE-2) *#	C1. Graph Theory C2. Fuzzy Sets and Logics	4	4	100
Semester – V				
BHM-511	Riemann Integration and Series of Functions	4	4	100
BHM-512	Multivariate Calculus	4	4	100
BHM-513	Metric Spaces	4	4	100
BHM-514	Linear Algebra	4	4	100
BHM-515 (DS-1) *#	C1. Modelling and Simulation C2. Discrete Mathematics	4	4	100
BHM-516 (DS-2) *#	C1. Mathematical Finance C2. Dynamical Systems	4	4	100
Semester – VI				
BHM-611	Integral Equations and Calculus of Variations	4	4	100
BHM-612	Complex Analysis	4	4	100
BHM-613	Differential Geometry	4	4	100
BHM-614	Mechanics	4	4	100
BHM-615 (DS-3) *#	C1. Boolean Algebra and Automata Theory C2. Bio-Mathematics	4	4	100
BHM-616 (DS-4) *#	C1. Industrial Mathematics C2. Applications of Abel	4	4	100

New

B.Sc. (Hons.) Mathematics
Semester – I
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-112	**Analytical Geometry**	**4L**	**25**	**75**

Unit-I General equation of second degree, Pair of lines, Parabola, Tangent, Normal, Pole and Polar and their properties, Ellipse, Hyperbola, Tangent, Normal, Pole and Polar, Conjugate diameters.

Unit-II Asymptotes, Conjugate hyperbola and Rectangular hyperbola, Polar equation of a conics, Polar equation of tangent, normal, polar and asymptotes, Tracing of parabola, Ellipse and hyperbola.

Unit-III Review of straight lines and planes, Equation of sphere, Tangent plane, Plane of contact and polar plane, Intersection of two spheres, radical plane, Coaxial spheres, Equation of a cone, Intersection of cone with a plane and a line, Enveloping cone, Right circular cone.

Unit-IV Equation of cylinder, Enveloping and right circular cylinders, Equations of central conicoids, Tangent plane, Normal, Plane of contact and polar plane, Enveloping cone and enveloping cylinder, Equations of paraboloids and its simple properties.

Books Recommended:

1. Ram Ballabh: *Textbook of Coordinate Geometry*, Prakashan Kendra.
2. S. L. Loney: *The elements of Coordinate Geometry*, Michigan Historical Reprint Series.
3. P.K. Jain and Khalil Ahmad: *Textbook of Analytical Geometry*, New Age International (P) Ltd. Publishers, 1986.
4. R. J. T. Bell. *Elementary Treatise on Coordinate Geometry of Three Dimensions*, Macmillan India Ltd., 1994.
5. E. H. Askwith: *A Course of Pure Geometry*, Merchant Books, 2007.

New

B.Sc. (Hons.) Mathematics
Semester – I
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-113 (GE-1) C1	**Set Theory and Number Theory**	**4L**	**25**	**75**

Unit-I Cartesian products of sets, equivalence relations and partition, fundamental theorem of equivalence relation, equivalent set, countable sets and uncountable sets, cantor's theorem

Unit-II Cardinal numbers, power of continuum, cardinal arithmetic, inequalities in cardinals, Schoeder-Bernstein theorem, partially and totally ordered sets

Unit-III Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruencies, complete set of residues, Algebraic congruencies Chinese Remainder theorem, Fermat's Little theorem, Lagrange theorem, Wilson's theorem.

Unit-IV 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 congruencies with composite moduli.

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.
3. Seymour Lipschutz : *Set Theory and related topics*. McGraw-Hill Education; 2nd edition, 1998.
4. J. Hunter: *Number Theory*, Oliver & Boyd, Edinburgh and London, 1964.

New

B.Sc. (Hons.) Mathematics
Semester – I
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-113 (GE-1) C2	**Computer Fundamentals**	**4L**	**25**	**75**

Unit-I Introduction to Computers, Characteristics of Computers, Generations of Computer, Block Diagram of a Computer, Functions of the Different Units - Input unit, Output unit, Memory unit, CPU (Control Unit , ALU). Data vs Information, Hardware vs Software, flowcharts, algorithms.

Unit-II Number Systems: Introduction, Types of Number System: Binary, Octal, Decimal, Hexadecimal, Conversions from One Base to Another, r's complement, (r-1)'s complement, Addition and Subtraction operations in different number system, Binary-coded Decimals (BCD), Gray Code.

Unit-III Input Devices: Keyboard, Point and draw devices-mouse, joystick, track ball, light pen; Data Scanning devices-image scanner, OCR, OMR, MICR, Bar code reader, card reader. Output Devices: Monitor, Printers: laser printer, dot-matrix printer, ink jet printer. Levels of Memories: Registers, Cache Memory, Primary Storage, Secondary Storage. Primary Memory: RAM, ROM and types. Secondary Memories: Floppy drive, CD/DVD, Flash drive, Hard disk, Structure of a hard disk, concept of tracks, sectors, cylinders.

Unit-IV Classifications of Software: System Software, Application Software, Embedded Softwares etc… Programming languages- Machine language, Assembly language, High level language, types of high level languages, Translators – Compiler, Interpreter. Operating System, Functions of Operating System, Types of Operating Systems. Introduction to Computer Networks, Internet and World Wide Web, FTP, Electronic Mail.

Books Recommended.

1. P. K. Sinha and Priti Sinha: *Computer Fundamentals*, BPB, 2007.
2. V. Rajaraman and N.Adabala: *Fundamentals of Computers, 6th Revised Edition*, PHI, 2014.
3. E. Balagurusamy: *Fundamentals of Computers*, McGraw Hill Education, 2009.
4. Anita Goel: *Computer Fundamentals*, Pearson Education, 2010.

New

B.Sc. (Hons.) Mathematics
Semester – II
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-212	**Statistical Techniques**	**4L**	**25**	**75**

Unit-I Probability: Basic concepts and definitions (Classical and Axiomatic definition), conditional probability, basic laws of total probability and compound probability, Bayes' theorem, Prior probabilities (priori) and posterior probabilities.

Unit-II Discrete and continuous random variables, mathematical expectation, variance, moment about a point, central moment, moment generating function. Various discrete and continuous probability distributions: Uniform (continuous and discrete), Binomial, Negative Binomial, Poisson, Exponential, Normal and Rectangular distributions.

Unit-III Two-dimensional random variables, joint distribution functions, marginal distributions, covariance, linear regression and correlation, rank correlation, least square method of fitting regression lines.

Unit-IV Statistical Testing and Estimation Techniques: Properties of good estimator-unbiasedness, Minimum variance unbiased estimators, Method of Maximum likelihood, Confidence Intervals for mean, variance and proportions. Large sample tests for mean and proportion, chi square test for goodness of fit, Tests based on t and F-distributions.

Reference Books

1. Irwin Miller and Marylees Miller, *John E. Freund's: Mathematical Statistics with Applications*, Pearson Education, 2012
2. Robert V. Hogg, Allen Craig Deceased and Joseph W. McKean: *Introduction to Mathematical Statistics*, Pearson Education, 2012.
3. Sheldon M. Ross: *Introduction to Probability and Statistics for Engineers and Scientists*, Elsevier Academic Press, 2009.
4. V.K Rohtagi and A.K. Saleh. *An Introduction to Probability and Statistics*, 2nd Ed., John Wiley & Sons, 2005.
5. A.M. Goon, M.K. Gupta and T.S. Dasgupta: *Fundamentals of Statistics* (Vol. I), 7th Ed., The World Press Pvt. Ltd., 2000.
6. Neil A. Weiss: *Introductory Statistics*, 7th Ed., Pearson Education, 2007.

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B.Sc. (Hons.) Mathematics
Semester – II
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-213 (GE-2) C2	**Econometrics**	**4L**	**25**	**75**

Unit-I Statistical Concepts Normal distribution; chi-square, t- and F-distributions; estimation of parameters; properties of estimators; testing of hypotheses: defining statistical hypotheses; distributions of test statistics; testing hypotheses related to population parameters; Type I and Type II errors; power of a test; tests for comparing parameters from two samples.

Unit-II Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem, forecasting.

Unit-III Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - R2 and adjusted R2; partial regression coefficients; testing hypotheses – individual and joint; functional forms of regression models, qualitative (dummy) independent variables.

Unit-IV Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation. Specification Analysis Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

Books Recommended:

1. Jay L. Devore: *Probability and Statistics for Engineers*, Cengage Learning, 2010.
2. John E. Freund: *Mathematical Statistics*, Prentice Hall, 1992.
3. Richard J. Larsen and Morris L. Marx: *An Introduction to Mathematical Statistics and its Applications*, Prentice Hall, 2011.
4. D.N. Gujarati and D.C. Porter: *Essentials of Econometrics*, 4th Ed., McGraw Hill, International Edition, 2009.
5. Christopher Dougherty: *Introduction to Econometrics*, 3rd Ed., Oxford University Press, Indian edition, 2007.

B.Sc. (Hons.) Mathematics
Semester – III
Syllabus

New

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-314 (GE-3) C1	**Information Security**	**4L**	**25**	**75**

Unit-I Overview of Security: Protection versus security; aspects of security–data integrity, data availability, privacy; security problems, user authentication, Orange Book.

Unit-II Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy.

Unit-III Cryptography: Substitution, transposition ciphers, symmetric-key algorithms-Data Encryption Standard, advanced encryption standards, public key encryption - RSA; Diffie-Hellman key exchange, ECC cryptography, Message Authentication- MAC, hash functions.

Unit-IV Digital signatures: Symmetric key signatures, public key signatures, message digests, public key infrastructures.
Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended:

1. W. Stallings: *Cryptography and Network Security Principles and Practices,* 4th Ed., Prentice-Hall of India, 2006.
2. C. Pfleeger and S.L. Pfleeger: *Security in Computing* , 3rd Ed., Prentice-Hall of India, 2007.
3. D. Gollmann: *Computer Security*, John Wiley and Sons, NY, 2002.
4. J. Piwprzyk, T. Hardjono and J. Seberry: *Fundamentals of Computer Security*, Springer-Verlag Berlin, 2003.
5. J.M. Kizza: *Computer Network Security*, Springer, 2007.
6. M. Merkow and J. Breithaupt: *Information Security: Principles and Practices*, Pearson Education, 2006.

B.Sc. (Hons.) Mathematics
Semester – III
Syllabus

New

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-315 (SE-1) C1	**Latex & Web Designing**	**4L**	**25**	**75**

Unit-I LaTeX: elements of LaTeX, typesetting mathematics, graphics in LaTeX, PSTricks, Beamer presentation.

Unit-II Introduction to World Wide Web, communication on the Internet, Internet domains, Internet server identities, establishing connectivity on the Internet, Internet protocols, Internet services - E-mail, FTP, search engines, web browsers.

Unit-III Introduction to HTML, basic structure of a HTML document, working with texts and tables, frames, images and links, forms, creating simple web pages.

Unit-IV Introduction to DHTML, benefit of CSS, CSS properties, CSS styling, working with lists and tables, web page layout and editing with CSS, writing JavaScript into HTML, basic programming using JavaScript.

Books Recommended:

1. L. Lamport. LATEX: *A Document Preparation System, User's Guide and Reference Manual*, Addison-Wesley, New York, second edition, 1994.
2. Martin J. Erickson and Donald Bindner: *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*, CRC Press, Boca Raton, FL, 2011.
3. Robert W. Sebesta: *Programming the World Wide Web*, (4th ed.), Addison Wesley, 2007.
4. Dick Oliver, Michael Morrison: *Sams Teach Yourself HTML and CSS in 24 Hours*, Pearson Education, 2005.
5. Danny Goodman: *JavaScript & DHTML Cookbook: Solutions and Example for Web Programmers*, O'Reilly Media, 2003.
6. Ivan Bayross: *HTML 5 and CSS 3 Made Simple*, BPB, 2012.

B.Sc. (Hons.) Mathematics
Semester – III
Syllabus

New

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-315 (SE-1) C2	**Computer Graphics**	**4L**	**25**	**75**

Unit-I Introduction of computer graphics and its applications, development of computer graphics, raster scan and random scan graphics storages, displays processors and character generators, colour display techniques, interactive input and output devices.

Unit-II Points, lines and curves: scan conversion, line drawing algorithms, circle and ellipse generation algorithms, conic-section generation, and polygon filling algorithms.

Unit-III Two-dimensional viewing, coordinate systems, linear transformations, clipping: point and line clipping, line and polygon clipping algorithms.

Unit-IV Three-dimensional concepts: basic transformation - translation, rotation, scaling, reflections, projections, three dimensional object representation: polygons, curved lines, splines, quadric surfaces, three dimensional line clipping algorithms.

Books Recommended:

1. D. Hearn and M.P. Baker: *Computer Graphics, 2nd Ed.*, Prentice–Hall of India, 2004.
2. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes: *Computer Graphics: Principals and Practices*, 2nd Ed., Addison-Wesley, MA, 1990.
3. D.F. Rogers: *Procedural Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 2001.
4. D.F. Rogers and A. J. Admas: *Mathematical Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 1990.

B.Sc. (Hons.) Mathematics
Semester – IV
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-413	**Linear Programming**	**4L**	**25**	**75**

Unit-I Linear Programming Problem: Definition, mathematical formulation, standard form, Solution space, solution – feasible, basic feasible, optimal, infeasible, multiple, redundancy, degeneracy, Solution of LP Problems - Graphical Method, Integer programming, Branch and Bound method.

Unit-II Simplex Method, Degeneracy in Simplex method. Duality in LP, Dual Simplex Method, Economic interpretation of Dual, Transportation Problem, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method), Stepping stone method, modified distribution method, Unbalanced transportation problem, Degeneracy in transportation problems.

Unit-III Assignment Problem, Hungarian Method for Assignment Problem, Elementary inventory models, EOQ model with or without shortages, Replacement models, Individual replacement policy, Group replacement problem.

Unit-IV Sequencing problem, *m* machines *n* jobs problem, Graphical method for sequence problem. Game Theory, pure and mixed strategies, Saddle point, Two-Persons-Zero-Sum Game, Game with mixed strategies, Dominance rule, Graphical Method, Inter - relation between the theory of games and linear programming, Solution of game using Simplex method.

Books Recommended:

1. A. H. Taha: *Operations Research – An Introduction*. Prentice Hall, 2010
2. J. K. Sharma: *Operations Research – Theory and Application*, Macmillian Pub., 2007.
3. J. K. Sharma: *Operations Research – Problems and Solutions*, Macmillian Pub., 2007.
4. G. Hadley: *Linear Programming*, Narosa Publishing House, 2002
5. S. D. Sharma: *Operations Research*, KNRN Publications, 2013

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B.Sc. (Hons.) Mathematics
Semester – IV
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-414 (GE-4) C2	**Data Structures (P)**	**4L+2P**	**25**	**75**

Unit-I Definition of Data Structure, Types of Data Structures, Introduction to Arrays, Single and Multi-Dimensional Arrays, Row and Column Major Implementations of Multi-Dimensional Arrays, Recursion, Hashing.

Unit-II Concept of a Linked List, Linear Single and Double Linked Lists, Circular linked List, Operations on Linked Lists and implementation in C, Applications of Linked List. Introduction to Stack, Implementation of Stack in C using Array and Linked List, Applications of Stack.

Unit-III Introduction to Queue, Implementation of Queue in C using Array and Linked List, Applications of Queue. Concept of a Tree, Definitions and Examples of n-ary Tree, Binary Tree, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree. Level of a Node, Height and Depth of a Tree, Binary Search Tree, Operation on Trees, Tree Traversal and Search Algorithm

Unit-IV Huffman Algorithm. Definitions of Vertex, Edge and Graph, Types of Graphs – Directed and Undirected, Connected and Disconnected, Cyclic and Acyclic. Representation of Graphs: Adjacency Matrix, Linked List. Incidence Matrix, Path Matrix. Graph Algorithms – Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree, Kruskal's and Prim's Algorithm.

Searching Techniques - Linear Search and Binary Search. Sorting Techniques - Selection Sort, Insertion Sort, Bubble Sort, Quick Sort, and Heap Sort.

Books Recommended:

1. S. Lipshutz, *Data Structures:* Schaum Outline Series, Tata Mc-graw Hill, 2012.
2. D. Samanta, *Classic Data Structures*: PHI Publication, 2010.
3. Yashavant P. Kanetkar: *Data Structures through C,* Second Edition, BPB, 2003.
4. Yashavant P. Kanetkar: *Understanding Pointers in C,* BPB, 2003.

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B.Sc. (Hons.) Mathematics
Semester – IV
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-415 (SE-2) C1	**Graph Theory**	**4L**	**25**	**75**

Unit-I Definition, examples and basic properties of graphs, pseudographs, complete graphs, bipartite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Unit-II Applications of paths and circuits: the Chinese postman problem, digraphs, the Bellman-Ford algorithm, tournaments, directed network, scheduling problems, definition, examples and basic properties of trees, spanning trees, minimum spanning tree algorithms, Kruskal's algorithm, Prim's algorithm, acyclic digraphs, Bellman's algorithm.

Unit-III Planar graphs, colouring of graphs, statement of the four-colour theorem, the five colour theorem, circuit testing, facilities design, flows and cuts, construction of flows, constructing maximal flows, rational weights, applications of directed networks, matchings

Unit-IV

Books Recommended

1. Edgar G. Goodaire and Michael M. Parmenter: *Discrete Mathematics with Graph Theory*, 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.
2. Rudolf Lidl and Günter Pilz: *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
3. C.L. Liu: *Elements of Discrete Mathematics*, 2nd Ed., Tata McGraw Hill Publishing Company Ltd., 2001

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B.Sc. (Hons.) Mathematics
Semester – IV
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-415 (SE-2) C2	**Fuzzy Sets and Logics**	**4L**	**45**	**75**

Unit-I Fuzzy Sets and Uncertainty: Uncertainty and information, fuzzy sets and membership functions, chance versus fuzziness, properties of fuzzy sets, fuzzy set operations. Fuzzy Relations: Cardinality, operations, properties, fuzzy Cartesian product and composition, fuzzy tolerance and equivalence relations, forms of composition operation.

Unit-II Fuzzification and Defuzzification: Various forms of membership functions, fuzzification, defuzzification to crisp sets and scalars. Fuzzy Logic and Fuzzy Systems: Classic and fuzzy logic, approximate reasoning, Natural language, linguistic hedges, fuzzy rule based systems, graphical technique of inference.

Unit-III Development of membership functions: Membership value assignments: intuition, inference, rank ordering, neural networks, genetic algorithms, inductive reasoning. Fuzzy Arithmetic and Extension Principle: Functions of fuzzy sets, extension principle, fuzzy mapping, interval analysis, vertex method and DSW algorithm.

Unit-IV Fuzzy Optimization: One dimensional fuzzy optimization, fuzzy concept variables and casual relations, fuzzy cognitive maps, agent based models. Fuzzy Control Systems: Fuzzy control system design problem, fuzzy engineering process control, fuzzy statistical process control, industrial applications.

Books Recommended:

1. T.J. Ross: *Fuzzy Logic with Engineering Applications*, 3rd Ed., Wiley India Pvt. Ltd., 2011.
2. H.J. Zimmerman: *Fuzzy Set Theory and its Application*, 3rd Ed., Springer India Pvt. Ltd., 2006.
3. G. Klir and B. Yuan: *Fuzzy Set and Fuzzy Logic: Theory and Applications*, Prentice Hall of India Pvt. Ltd., 2002.
4. G. Klir and T. Folger: *Fuzzy Sets, Uncertainty and Information*, Prentice Hall of India Pvt. Ltd., 2002.

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B.Sc. (Hons.) Mathematics
Semester – V
Course Structure

Code	Title of Paper	Unit	Credit	Maximum Marks
BHM-511	Riemann Integration and Series of Functions	4	4	100
BHM-512	Multivariate Calculus	4	4	100
BHM-513	Metric Spaces	4	4	100
BHM-514	Linear Algebra	4	4	100
BHM-515 (DS-1)	C1. Modelling and Simulation C2. Discrete Mathematics	4	4	100
BHM-516 (DS-2)	C1.Mathematical Finance C2. Dynamical Systems	4	4	100

B.Sc. (Hons.) Mathematics
Semester – V
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-511	**Riemann Integration and Series of Functions**	**4L**	**25**	**75**

Unit-I Definition, existence and properties of Riemann integral of a bounded function, Darboux theorem, Condition of integrability, Riemann integrability for continuous functions, monotonic function and theorems on function with finite or infinite number discontinuity (without proof). The Riemann integral through Riemann sums, Equivalence of two definitions, Properties of Riemann integral, Fundamental theorem of calculus, First Mean Value Theorems, Second Mean Value Theorems, Generalized Mean Value Theorems.

Unit-II Definition of improper integrals, Convergence of improper integrals, Test for convergence of improper integrals, Comparison test, Cauchy's test for convergence, Absolute convergence, Abel's Test, Dirichlet's Test, Beta and Gamma functions and their properties and relations.

Unit-III Pointwise and uniform convergence of sequences and series of functions, Cauchy's criterion for uniform convergence of sequence and series, Weierstrass M-test, Uniform convergence and continuity, Uniform convergence and differentiation, Uniform convergence and integration, Weierstrass Approximation Theorem.

Unit-IV Fourier Series, Fourier Series for even and odd functions, Half Range Series, Fourier Series on intervals other than $[-\pi, \pi]$.
Power Series, Radius of Convergence, Cauchy's Hadamard Theorem, Uniform and Absolute convergence, Abel's Theorem (without proof), exponential and logarithmic functions.

Books Recommended:

1. R. G. Bartle and D. R. Sherbert: *Introduction to Real Analysis (3^{rd} Edition)*, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2003.
2. S. C. Malik and Savita Arora: *Mathematical Analysis*, New Age International (P) Ltd. Publishers, 2009.
3. K. A. Ross, *Elementary Analysis: The Theory of Calculus, Under graduate Texts in Mathematics*, Springer (SIE), Indian reprint, 2004.
4. Sudhir R. Ghorpade and Balmohan V. Limaye: *A course in Calculus and Real Analysis, Undergraduate Text in Maths.*, Springer (SIE), Indian reprint 2006.
5. T. M. Apostol: *Mathematical Analysis*, Addison-Wesley Series in Mathematics, 1974.
6. Gerald G. Bilodeau, Paul R. Thie, G. E. Keough: *An Introduction to Analysis*, 2^{nd} Ed., Jones & Bartlett, 2010.
7. A. Mattuck: *Introduction to Analysis*, Prentice Hall, 1990.
8. Charles G. Denlinger: *Elements of Real Analysis*, Jones & Bartlett (Student Edition), 2011.

New

B.Sc. (Hons.) Mathematics
Semester – V
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-515 (DS-1) C1	**Modelling and Simulation**	**4L**	**25**	**75**

Unit-I What is Mathematical Modeling? History of Mathematical Modeling, latest development in Mathematical Modeling, Merits and Demerits of Mathematical Modeling. Introduction to difference equations, Non-linear Difference equations, Steady state solution and linear stability analysis.

Unit-II Introduction to Discrete Models, Linear Models, Growth models, Decay models, Newton's Law of Cooling, Bank Account Problem and mortgage problem, Drug Delivery Problem, Harrod Model of Economic growth, War Model, Lake pollution model, Alcohol in the bloodstream model, Arm Race models, Linear Prey-Predator models, Density dependent growth models with harvesting, Numerical solution of the models and its graphical representation using EXCEL.

Unit-III Introduction to Continuous Models, Carbon Dating, Drug Distribution in the Body, Growth and decay of current in a L-R Circuit, Horizontal Oscillations, Vertical Oscillations, Damped Force Oscillation, Dynamics of Rowing, Combat Models, Mathematical Model of Influenza Infection (within host), Epidemic Models (SI, SIR, SIRS, SIC), Spreading of rumour model, Steady State solutions, Linearization and Local Stability Analysis, logistic and gomperzian growth, preypredator model, Competition models, Numerical solution of the models and its graphical representation using EXCEL.

Unit-IV Fluid flow through a porous medium, heat flow through a small thin rod (one dimensional), Wave equation, Vibrating string, Traffic flow, Theory of Car-following, Crime Model, Linear stability Analysis: one and two species models with diffusion, Conditions for diffusive instability with examples.

Books Recommended:

1. B. Albright: *Mathematical Modeling with Excel*, Jones and Bartlett Publishers, 2010.
2. F.R. Marotto: *Introduction to Mathematical Modeling using Discrete Dynamical Systems*, Thomson Brooks/Cole, 2006.
3. J.N. Kapur: *Mathematical Modeling*, New Age International, 2005.
4. B. Barnes and G. R. Fulford: *Mathematical Modelling with Case Studies*, CRC Press, Taylor and Francis Group, 2009.
5. L. Edsberg: *Introduction to Computation and Modeling for Differential Equations*, John Wiley and Sons, 2015.

New

B.Sc. (Hons.) Mathematics
Semester – V
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-515 (DS-1) C2	**Discrete Mathematics**	**4L**	**25**	**75**

Unit-I Sets - finite and Infinite sets, uncountably Infinite Sets, functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.

Unit-II Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem

Unit-III Basic Terminology, Models and Types, multigraphs and weighted graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees.

Unit-IV Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

Books Recommended:

1. C.L. Liu , D.P. Mahopatra: *Elements of Discrete mathematics*, 2nd Edition , Tata McGraw Hill, 1985,
2. Kenneth Rosen: *Discrete Mathematics and Its Applications*, Sixth Edition ,McGraw Hill 2006
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest: *Introduction to Algorithms*, 3rd edition Prentice Hall on India, 2009
4. M. O. Albertson and J. P. Hutchinson: *Discrete Mathematics with Algorithms* , John wiley Publication, 1988
5. J. L. Hein: *Discrete Structures, Logic, and Computability*, 3rd Edition, Jones and Bartlett Publishers, 2009
6. D.J. Hunter: *Essentials of Discrete Mathematics*, Jones and Bartlett Publishers, 2008

New

B.Sc. (Hons.) Mathematics
Semester – V
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-516 (DS-2) C1	**Mathematical Finance**	**4L**	**25**	**75**

Unit-I Introduction, The accumulation and amount functions, The effective rate of interest, Simple interest, Compound interest, Present value, The effective rate of discount, Nominal rates of interest and discount, Forces of interest and discount, Varying interest. Equation of value, Unknown time, Unknown rate of interest, Determining time periods, Practical examples.

Unit-II Introduction, Annuity-immediate, Annuity-due, Annuity values on any date, Perpetuities, Unknown time, Unknown rate of interest, Varying interest, Annuities not involving compound interest. Differing payment and interest conversion periods, Annuities payable less frequently than interest convertible, Annuities payable more frequently than interest convertible, Continuous annuities, Payments varying in arithmetic progression, Payments varying in geometric progression.

Unit III Introduction, Finding the outstanding loan balance, Amortization schedules, Sinking funds, Differing payment periods and interest conversion periods, Varying series of payments, Amortization with continuous payments, Step-rate amounts of principal.

Unit-IV Introduction, Types of securities, Price of a bond, Premium and discount, Valuation between coupon payment dates, Determination of yields rates, Callable and putable bonds, Serial bonds, some generalizations, other securities, Valuation of securities. Discounted cash flow analysis, Uniqueness of the yield rate, Reinvestment rates, Interest measurement of a fund

Books Recommended:

1. Stephen G. Kellison: *The Theory of Interest*, 3rd Edition. McGraw Hill International Edition (2009).
2. R. J. Elliott and P. E. Kopp: *Mathematics of Financial Markets*, Springer (1999).
3. S. Chandra, S. Dharmaraja, Aparna Mehra, R. Khemchandani: *Financial Mathematics: An Introduction,* Narosa Publishing House, 2014.

New

New

B.Sc. (Hons.) Mathematics
Semester – V
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-516 (DS-2) C2	**Dynamical Systems**	**4L**	**25**	**75**

Unit-I Linear Dynamical Continuous Systems: First order equations, existence uniqueness theorem, growth equation, logistic growth, constant harvesting, Planar linear systems, equilibrium points, stability, phase space, n-dimensional linear systems, stable, unstable and center spaces.

Unit-II Nonlinear autonomous Systems: Motion of pendulum, local and global stability, Liapunov method, periodic solution, Bendixson's criterion, Poincare Bendixson theorem, limit cycle, attractors, index theory, Hartman Grobman theorem, nonhyperbolic critical points, center manifolds, normal forms, Gradient and Hamiltonian systems.

Unit-III Local Bifurcation: Fixed points, saddle node, pitchfork trans-critical bifurcation, Hopf bifurcation, co-dimension. Discrete systems: Logistic maps, equilibrium points and their local stability, cycles, period doubling, chaos, tent map, horse shoe map.

Unit-IV Deterministic chaos: Duffing's oscillator, Lorenz System, Liapunov exponents, routes to chaos, necessary conditions for chaos.

Books Recommended:

1. M.W. Hirsch, S. Smale, R.L. Devaney: *Differential Equations, Dynamical Systems and an Introduction to Chaos*, Academic Press, 2008.
2. S.H. Strogatz: *Nonlinear Dynamics and Chaos*, Westview Press, 2008.
3. M. Lakshmanan, S. Rajseeker: *Nonlinear Dynamics*, Springer, 2003.
4. L. Perko: *Differential Equations and Dynamical Systems*, Springer,1996.
5. J.H. Hubbard, B.H. West: *Differential equations: A Dynamical Systems Approach*, Springer Verlag, 1995.
6. D. Kaplan, L. Gloss: *Understanding Nonlinear Dynamics*, Springer, 1995.
7. S. Wiggins: *Introduction to Applied Nonlinear Dynamical Systems and Chaos*, Springer-Verlag, 1990.

New

B.Sc. (Hons.) Mathematics
Semester – VI
Course Structure

Code	Title of Paper	Unit	Credit	Maximum Marks
BHM-611	Integral Equations and Calculus of Variations	4	4	100
BHM-612	Complex Analysis	4	4	100
BHM-613	Differential Geometry	4	4	100
BHM-614	Mechanics	4	4	100
BHM-615 (DS-3)	C1. Boolean Algebra and Automata Theory C2. Bio-Mathematics	4	4	100
BHM-616 (DS-4)	C1. Industrial Mathematics C2. Applications of Algebra	4	4	100

B.Sc. (Hons.) Mathematics
Semester – VI
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-611	**Integral Equations and Calculus of Variations**	**5L+1T**	**25**	**75**

Unit-I Preliminary Concepts: Definition and classification of linear integral equations. Conversion of initial and boundary value problems into integral equations. Conversion of integral equations into differential equations. Integro-differential equations.
Fredholm Integral Equations: Solution of integral equations with separable kernels, Eigen values and Eigen functions. Solution by the successive approximations, Neumann series and resolvent kernel. Solution of integral equations with symmetric kernels, Hilbert-Schmidt theorem, Green's function approach.

Unit-II Volterra Integral Equations: Successive approximations, Neumann series and resolvent kernel. Equations with convolution type kernels.
Solution of integral equations by transform methods: Singular integral equations, Hilbert transform.

Unit-III Calculus of Variations: Basic concepts of the calculus of variations such as functionals, extremum, variations, function spaces, the brachistochrone problem.
Necessary condition for an extremum, Euler`s equation with the cases of one variable and several variables, Variational derivative. Invariance of Euler`sequations. Variational problem in parametric form.

Unit-IV General Variation: Functionals dependent on one or two functions. Derivation of basic formula, Variational problems with moving boundaries, Broken extremals: Weierstrass–Erdmann conditions.

Books Recommended:

1. Abdul J. Jerry: *Introduction to Integral Equations with Applications*, 2nd Ed., Clarkson University Wiley Publishers, 1999.
2. G. L. Chambers: *Integral Equations: A short Course*, International Text Book Company Ltd., 1976.
3. R. P. Kanwal: *Linear Integral Equations*, 2nd Ed., Birkhauser Bosten, 1997.
4. Hochstadt Harry: *Integral Equations*, John Wiley & Sons, 1989.
5. I. M. Gelfand, S.V. Fomin: *Calculus of Variations*, Dover Books, 2000.
6. Weinstock Robert: *Calculus of Variations with Applications to Physics and Engineering*, Dover Publications, INC., 1974.

New

B.Sc. (Hons.) Mathematics
Semester – VI
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-615 (DS-3) C1	**Boolean Algebra and Automata Theory**	**4L**	**25**	**75**

Unit-I Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.
Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Unit-II Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: Deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Unit-III Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Unit-IV Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence. Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems About CFGs.

Books Recommended:

1. B A. Davey and H. A. Priestley: *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter: *Discrete Mathematics with Graph Theory*, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Günter Pilz: *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. J. E. Hopcroft, R. Motwani and J. D. Ullman: *Introduction to Automata Theory, Languages, and Computation*, 2nd Ed., Addison-Wesley, 2001.
5. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou: *Elements of the Theory of Computation*, 2nd Ed., Prentice-Hall, NJ, 1997.
6. J.A. Anderson: *Automata Theory with Modern Applications*, Cambridge University Press, 2006.

B.Sc. (Hons.) Mathematics
Semester – VI
Syllabus

Code	Title of Paper	Period per week	Internal Assessment	Semester Examination
BHM-615 (DS-3) C2	**Bio Mathematics**	**4L**	**25**	**75**

Unit-I **Continuous Population Models for Single Species 1:** Continuous Growth Models, Insect Outbreak Model: Spruce Budworm, Population Models: Periodic Solutions, Delay Models in

Unit-II **Discrete Population Models for a Single Species :** Physiology: Periodic Dynamic Diseases, Harvesting a Single Natural Population, 7 Population Model with Age Distribution Introduction: Simple Models, Cobwebbing :A Graphical Procedure of Solution, Discrete Logistic- Stability, Periodic Solutions and Bifurcations

Unit-III **Models for Interacting Populations**
Type Model: Chaos: Discrete Delay Models. Fishery Management Model, EcologicaModels. Fis Implications and Caveats., Tumour Cell Growth, Predator , Predator–Prey Models: Lotka– Volterra Systems, Complexity and Stability,

Unit-IV **Some Realistic Models:** Realistic Predator–Prey Models, Analysis –Prey Competition Models: Competitive Exclusion Principle , Mutualism or Symbiosis, Di, Discrete Growth Models for Interacting Populations

Books Recommended:

1. J.D. Murray: *Mathematical Biology: An Introduction.* Springer Publication, 2002
2. Johannes Müller, Christina Kuttler: *Methods and Models in Mathematical Biology: Deterministic and Stochastic Approaches* (Lecture Notes on Mathematical Modelling in the Life Sciences)
3. Nicholas F. Britton: Essential Mathematical Biology, Ane Books Pvt. Ltd., 2007.