NEW SCHEME

Scheme of Examination of
5 -Years Integrated M.Sc. (Honours) Mathematics, Semester-I
(w.e.f. 2010-2011)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			
			Theory	Internal Assesment	Practicals	Total Marks
MHM 111	Algebra	4 Hours/ week	60	15	-	75
MHM 112	Calculus	4 Hours/ week	60	15	-	75
MHM 113	Solid Geometry	4 Hours/ week	60	15	-	75
MHM 114	Discrete Mathematics-I	4 Hours/ week	60	15	-	75
MHM 115	Descriptive Statistics	4 Hours/ week	60	15	-	75
MHM 116	Computer Fundamentals and MS-OFFICE	4 Hours/ week	60	15	-	75
MHM 117	Practical/ Computational work based on Papers MHM 115 and MHM 116	4 Hours/ week	-		50	50
MHM 118	English - I	As per university norms	50	-	-	50
Total marks of Semester-I						500

Note :

1. Paper MHM 118 will be the qualifying paper and its marks will not be included in the total marks obtained by the student for the course.
2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Algebra

Code: MHM 111

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections(***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Symmetric, Skew-symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices. Rank of a matrices. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Section – II

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

Section – III

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

Section – IV

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

Books Recommended :

1. H.S. Hall and S.R. Knight, Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan, A Text Books of Matrices.
3. Chandrika Prasad, Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

Calculus

Code: MHM 112

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Definition of the limit of a function. Basic properties of limits, Continuous functions and classification of discontinuities. Differentiability. Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions.

Section – II

Asymptotes in Cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates. Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves. Newton's method. Radius of curvature for pedal curves. Tangential polar equations. Centre of curvature. Circle of curvature. Chord of curvature, evolutes. Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points. Type of cusps.

Section – III

Tracing of curves in Cartesian, parametric and polar co-ordinates. Reduction formulae. Rectification, intrinsic equations of curve.

Section – IV

Quadrature (area) Sectorial area. Area bounded by closed curves. Volumes and surfaces of solids of revolution. Theorems of Pappu's and Guilden.

Books Recommended :

1. Differential and Integral Calculus, Shanti Narayan.
2. Murray R. Spiegel, Theory and Problems of Advanced Calculus. Schaun's Outline series. Schaum Publishing Co., New York.
3. N. Piskunov, Differential and integral Calculus. Peace Publishers, Moscow.
4. Gorakh Prasad, Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
5. Gorakh Prasad, Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

Solid Geometry

Code: MHM 113

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

Sphere: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres. Co-axal system of spheres
Cones. Right circular cone, enveloping cone and reciprocal cone.
Cylinder: Right circular cylinder and enveloping cylinder.

Section – III

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

Section – IV

Paraboloids: Circular section, Plane sections of conicoids.
Generating lines. Confocal conicoid. Reduction of second degree equations.

Books Recommended:

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

Discrete Mathematics-I

Code: MHM 114

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections(***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section -IV

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

Books Recommended :

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lipschutz, Finite Mathematics (International edition 1983), McGraw-Hill Book Company, New York.
4. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hilll Book Co.
5. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.

Descriptive Statistics

Code: MHM 115

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections(***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Introduction of Statistics, Basic knowledge of various types of data, Collection, classification and tabulation of data. Presentation of data: histograms, frequency polygon, frequency curve and ogives. Stem- and- Leaf and Box plots.

Section – II

Measures of Central Tendency and Location: Mean, median, mode, geometric mean, harmonic mean, partition values.
Measures of Dispersion: Absolute and relative measures of range, quartile deviation, mean deviation, standard deviation (σ), coefficient of variation.

Section – III

Moments, Skewness and Kurtosis: Moments about mean and about any point and derivation of their relationships, effect of change of origin and scale on moments, Sheppard's correction for moments (without derivation), Charlier's checks, Concepts of Skewness and Kurtosis.

Section – IV

Theory of Attributes: Symbolic notation, dichotomy of data, class frequencies, order of class frequencies, consistency of data, independence and association of attributes, Yule's coefficient of association and coefficient of colligation.
Correlation for Bivariate Data: Concept and types of correlation, Scatter diagram, Karl Pearson Coefficient (r) of correlation and rank correlation coefficient.

Books Suggested

1. A.M. Goon, M.K. Gupta, and B. Das Gupta: Fundamentals of Statistics, Vol-I.
2. S. Bernstein and R. Bernstein, Elements of Statistics, Schaum's outline series, McGraw-Hill.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.

Computer Fundamentals and MS-OFFICE

Code: MHM 116

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections(***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section-I

Fundamentals of Computer: Model of a digital computer, Functioning of a digital computer, Historical evolution of computers, classification of computers, Human being vs computer, Input / Output devices, Storage devices, Memory and mass storage devices, characteristics of memory systems, types of memory, RAM, ROM, concepts of Virtual and Cache memory, Types of software, Application and system software and its functions, time sharing, multiprocessing, Applications of Computer.

Section-II

Introduction to Windows: Types of windows, windows as an operating system, windows explorer, using clipboard, using paintbrush, control panel, installing a printer.
MS Power Point: Introduction, Power point slide creation, Slide-show, Adding graphics, Formatting Customizing and Printing.

Section-III

MS-Word: Introduction to MS-Word, Standard Toolbar, Word Wrap, Text formatting, Indents, Tabs, Formatting paragraphs, Applying Effects to text, Applying animation to text.

Section-IV

MS Excel: Introduction to MS Excel, Working with Toolbars, Formatting, Formulas, Data management, Graphs and Charts, Macros and other additional functions.

Books Recommended:

1. Donald Sanders, Computers Today, McGraw-Hill Publishers.
2. Davis, Introduction to Computers, McGraw-Hill Publishers.
3. V. Rajaraman, Fundamental of Computers, Prentice-Hall India Ltd., New Delhi.

Practical/ Computational Work

Code: MHM 117

(Based on papers MHM 115 and MHM 116)

Max. Marks : 50

i) Written Practical/ Lab work : 40 Marks

ii)Viva-voce and practical record : 10 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned sections). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each section.

Section – I

Practicals based on Paper MHM 115.

Section – II

Practicals based on Paper MHM 116.

English - I

Code: MHM 118

Max. Marks : 50
Time : 3 Hours

Note: The syllabus of this paper will be same as that of the 1st Semester of B.Sc-I (Pass) course.

NEW SCHEME

Scheme of Examination of
5- Years Integrated M.Sc. (Honours) Mathematics, Semester-II
(w.e.f. 2010-2011)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			
			Theory	Internal Assessment	Practicals	Total Marks
MHM 121	Number Theory and Trigonometry	4 Hours/ week	60	15	-	75
MHM 122	Ordinary Differential Equations	4 Hours/ week	60	15	-	75
MHM 123	Vector Calculus	4 Hours/ week	60	15	-	75
MHM 124	Discrete Mathematics-II	4 Hours/ week	60	15	-	75
MHM 125	Regression Analysis and Probability	4 Hours/ week	60	15	-	75
MHM 126	Programming in Visual Basic	4 Hours/ week	60	15	-	75
MHM 127	Practical / Computational work based on Papers MHM125 and MHM126	4 Hours/ week	-		50	50
MHM 128	English-II	As per university norms	50	-	-	50
Total Marks of Semester-II						500

Note:

1. Paper MHM128 will be the qualifying paper and its marks will not be included in the total marks obtained by the student for the course.
2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Number Theory and Trigonometry

Code: MHM 121

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections(***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Divisibility, G.C.D.(greatest common divisors), L.C.M.(least common multiple) Primes, Fundamental Theorem of Arithemetic. Linear Congruences, Fermat's theorem. Wilson's theorem and its converse. Linear Diophanatine equations in two variables

Section – II

Complete residue system and reduced residue system modulo m. Euler's ø function Euler's generalization of Fermat's theorem. Chinese Remainder Theorem. Quadratic residues. Legendre symbols. Lemma of Gauss; Gauss reciprocity law. Greatest integer function [x]. The number of divisors and the sum of divisors of a natural number n (The functions d(n) and σ(n)). Moebius function and Moebius inversion formula.

Section - III

De Moivre's Theorem and its Applications. Expansion of trigonometrical functions. Direct circular and hyperbolic functions and their properties.

Section – IV

Inverse circular and hyperbolic functions and their properties. Logarithm of a complex quantity. Gregory's series. Summation of Trigonometry series.

Books Recommended :

1. S.L. Loney, Plane Trigonometry Part – II, Macmillan and Company, London.
2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd. Allahabad.
3. Ivan Ninen and H.S. Zuckerman, An Introduction to the Theory of Numbers.

Ordinary Differential Equations

Code: MHM 122

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

Orthogonal trajectories: in Cartesian coordinates and polar coordinates. Self orthogonal family of curves.. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous

Section – III

Linear differential equations of second order: Reduction to normal form. Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations. Reduction of order of a differential equation. Method of variations of parameters. Method of undetermined coefficients.

Section – IV

Ordinary simultaneous differential equations. Solution of simultaneous differential equations involving operators x (d/dx) or t (d/dt) etc. Simultaneous equation of the form $dx/P = dy/Q = dz/R$. Total differential equations. Condition for $Pdx + Qdy + Rdz = 0$ to be exact. General method of solving $Pdx + Qdy + Rdz = 0$ by taking one variable constant. Method of auxiliary equations.

Books Recommended :

1. D.A. Murray, Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd., London
3. E.A. Codington, Introduction to Differential Equations.
4. S.L.Ross, Differential Equations, John Wiley & Sons
5. B.Rai & D.P. Chaudhary, Ordinary Differential Equations, Narosa Publishing House Pvt. Ltd.

Vector Calculus

Code: MHM 123

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Scalar and vector product of three vectors, product of four vectors. Reciprocal vectors. Vector differentiation. Scalar Valued point functions, vector valued point functions, derivative along a curve, directional derivatives

Section – II

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

Section – III

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

Section – IV

Vector integration; Line integral, Surface integral, Volume integral.
Theorems of Gauss, Green & Stokes and problems based on these theorms.

Books Recommended:

1. Murrary R. Spiegal, Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York.
2. Murrary R. Spiegal, Vector Analysis, Schaum Publisghing Company, New York.
3. N. Saran and S.N. Nigam, Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
4. Shanti Narayna, A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Discrete Mathematics-II

Code: MHM 124

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections***(I-IV)*** will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section -I

Lattices and their properties, lattice as algebraic system, Bounded, Complement and distributive lattices.

Section -II

Boolean algebra, definition and examples, properties, duality, distributive and complmented Calculus. Design and implementation of digital networks, switching circuits, Karnaugh map.

Section -III

Graph, definition, exemplary types of graphs, paths and circuits. Eulearian and Hermitian circuits. Seven bridges machine, shortest path traveling salesman problems. Planar graph. Matrix of graph.

Section -IV

Directed Graphs, Trees, Isomorphism of Trees, Representation of Algebraic Expressions by Binary Trees, Spanning Tree of a Graph, Shortest Path Problem, Minimal spanning Trees, Cut Sets, Tree Searching..

Books Recommended:

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lipschutz, Finite Mathematics (International edition 1983), McGraw-Hill Book Company, New York.
4. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hilll Book Co.
5. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.

Regression Analysis and Probability

Code: MHM 125

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections***(I-IV)*** will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section -I

Linear Regression: Concept of regression, principle of least squares and fitting of straight line, derivation of two lines of regression, properties of regression coefficients, standard error of estimate obtained from regression line, correlation coefficient between observed and estimated values. Angle between two lines of regression. Difference between correlation and regression.

Curvilinear Regression: Fitting of second degree parabola, power curve of the type $Y=ax^b$, exponential curves of the types $Y=ab^x$ and $Y=ae^{bx}$.

Section –II

Concepts in Probability: Random experiment, trial, sample point, sample space, operation of events, exhaustive, equally likely and independent events, Definition of probability—classical, relative frequency, statistical and axiomatic approach, Addition and multiplication laws of probability, Boole's inequality.

Section -III

Bayes' theorem and its applications.

Random Variable and Probability Functions: Definition and properties of random variables, discrete and continuous random variable, probability mass and density functions, distribution function.

Section –IV

Concepts of bivariate random variable: joint, marginal and conditional distributions.

Mathematical Expectation: Definition and its properties –moments, measures of location, dispersion, skewness and kurtosis.

Books Suggested:

1. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
2. Baisnab and M. Jas, Element of Probability and statistics, Tata McGraw Hill.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
4 P.L.Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.

Programming in Visual Basic

Code: MHM 126

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections ***(I-IV)*** will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section -I

Visual Basic : Introduction, Analyzing, Controls and Properties, Coding, Control structures : Decision & Loops, Control Array, Arrays

Section -II

Text Boxes, Command Buttons, Additional Controls – List Box, Option Buttons, Frames, Check Boxes, Scroll Bars, Timer Control,

Section -III

Menus: Menu Editor, Menu controls, Dialog Boxes, Procedures and Functions, Using Debugging Windows, Database Programming.

Section -IV

Crystal Reports. Simple Active X controls. Library Functions: String, Numeric, Time-related & Misc. Functions

Books Recommended

1. Reselman & Other, Using Visual Basic 6, Prentice Hall of India.
2. Donald & Oancea, Visual Basic 6 from Scratch, Prentice- Hall of India.
3. Noel Jerke, Visual Basic 6, Tata Mc-Graw Hill
4. Days Maver, Teach Yourself More VB in 21 days, Techmedia.

Practical/ Computational Work

Code: MHM 127

(Based on papers MHM125 and MHM126)

Max. Marks : 50

i) Written Practical/ Lab work : 40 Marks

ii)Viva-voce and practical record : 10 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned sections). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each section.

Section – I

Practicals based on Paper MHM 125.

Section – II

Practicals based on Paper MHM 126.

English - II

Code: MHM 128

Max. Marks : 50
Time : 3 Hours

Note: The syllabus of this paper will be same as that of the 2st Semester of B.Sc-I (Pass) course.

NEW SCHEME

Scheme of Examination of
5-Years Integrated M.Sc. (Honours) Mathematics, Semester-III
(w.e.f. 2011-2012)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			Total Marks
			Theory	Internal Assesment	Practicals	
MHM 231	Advanced Calculus	4 Hours/ week	60	15	-	75
MHM 232	Partial Differential Equations	4 Hours/ week	60	15	-	75
MHM 233	Statics	4 Hours/ week	60	15	-	75
MHM 234	Differential Geometry	4 Hours/ week	60	15	-	75
MHM 235	Probability Distributions	4 Hours/ week	60	15	-	75
MHM 236	Database Management and Oracle	4 Hours/ week	60	15	-	75
MHM 237	Practical/ Computational work (based on Papers MHM 235 and MHM 236)	4 Hours/ week	-		50	50
Total Marks of Semester-III						500

Note : The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Advanced Calculus

Code: MHM 231

Max. Marks: 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Continuity, Sequential Continuity, properties of continuous functions, Uniform continuity, chain rule of differentiability. Mean value theorems; Rolle's Theorem and Lagrange's mean value theorem and their geometrical interpretations. Taylor's Theorem with various forms of remainders, Darboux intermediate value theorem for derivatives, Indeterminate forms.

Section – II

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

Section – III

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

Section – IV

Curves: Tangents, Principal normals, Binormals, Serret-Frenet formulae. Locus of the centre of curvature, Spherical curvature, Locus of centre of Spherical curvature, Involutes, evolutes, Bertrand Curves. Surfaces: Tangent planes, one parameter family of surfaces, Envelopes.

Books Recommended:

1. C.E. Weatherburn , Differential Geometry of three dimensions, Radhe Publishing House, Calcutta
2. Gabriel Klaumber, Mathematical analysis, Marcel Dekkar, Inc., New York, 1975
3. R.R. Goldberg , Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
4. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd., Allahabad
5. S.C. Malik , Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
6. Shanti Narayan, A Course in Mathemtical Analysis, S.Chand and company, New Delhi
7. Murray, R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing co., New York

Partial Differential Equations

Code: MHM 232

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

Linear partial differential equations of second and higher orders, Linear and non-linear homogenious and non-homogenious equations with constant co-efficients, Partial differential eqution with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Section – III

Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method for partial differential equations of second order.

Section – IV

Cauchy's problem for second order partial differential equations, Characteristic equations and characteristic curves of second order partial differential equation, Method of separation of variables: Solution of Laplace's equation, Wave equation (one and two dimensions), Diffusion (Heat) equation (one and two dimension) in Cartesian Co-ordinate system.

Books Recommended:

1. D.A.Murray, Introductory Course on Differential Equations, Orient Longman, (India), 1967
2. Erwin Kreyszing, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999
3. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd.
4. Ian N.Sneddon, Elements of Partial Differential Equations, McGraw Hill Book Company, 1988
5. Frank Ayres, Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
6. J.N. Sharma and Kehar Singh, Partial Differential Equations

Statics

Code: MHM 233

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section – IV

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

Books Recommended:

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

Differential Geometry

Code: MHM 234

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

One Parameter family of Surfaces : Envelope, Characteristics , edge of regression , Developable surfaces.

Developables Associated with a Curve : Osculating developable, Polar developable, Rectifying developable.

Section – II

Two- parameter Family of Surfaces: Envelope, Characteristics points,

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

Section III

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

Section IV

Geodesics and Geodesic Parallels: Geodesics: Geodesic property, Equation of Geodesics, Surface of revolution, Torsion of Geodesic.

Curves in Relation to Geodesics: Bonnet's theorem, Joachimsthal's theorems, Vector curvature, Geodesic curvature κ_g, Other formulae for κ_g, Bonnet's formula.

Books Recommended:

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

Probability Distributions

Code: MHM 235

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Generating Functions: Moment generating function and cumulant generating function along with their properties and uses.

Tchebychev's inequality, Convergence in probability, Weak and strong laws of large numbers (Statements only).

Section – II

Bernoulli, binomial, Poisson, geometric and hyper-geometric distributions with their properties.

Section – III

Uniform, gamma, beta (first and second kinds) and exponential distributions with their properties.

Section – IV

Normal distribution with its properties. Central Limit Theorem (Statement only) and its applications.

Books Suggested:

1. Baisnab and M. Jas, Element of Probability and Statistics, Tata McGraw Hill.
2. P.L.Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.

Database Management System and Oracle

Code: MHM 236

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Basic Concepts: File systems versus DBMS, advantages and disadvantages of DBMS, objectives of a database. Database systems concepts and architecture.
Data Modeling for a database: records and files, abstraction and data integration.
Database Management System: Relational, Network, and Hierarchical.
Relational Data Manipulations: Relational Algebra, Relational Calculus, SQL.

Section – II

Relational Database Design: Functional dependencies, Finding keys; 1st to 3rd NFs, CNF, Lossess Join and Dependency preserving decomposition.
Query Processing: General strategies for query processing, query optimization, query processor.
Database security issues and recovery techniques.

Section – III

Introduction to Oracle: Modules of Oracle, Invoking SQLPLUS, Data types, Data Constraints, Operators, Data manipulation: Create, Modify, Insert, Delete and Update; Searching, Matching and Oracle Functions.
SQL*Forms: Form Construction, user-defined form, multiple-record form, Master-detail form. PL/SQL Blocks in SQL*Forms, PL/SQL syntax, Data types, PL/SQL functions, Error handling in PL/SQL, package functions, package procedures, Oracle transactions.

Section – IV

SQL*ReportWriter: Selective dump report, Master-detail Report, Control-break Report, Test report.
Database Triggers: Use & type of database Triggers, Database Triggers Vs SQL*Forms, Database Triggers Vs. Declarative Integrity Constraints, BEFORE vs AFTER Trigger Combinations, Creating a Trigger, Dropping a Trigger.

Books Suggested:

1. Austin, Using Oracle-8, Prentice-Hall of India
2. Ivan Bayross, Oracle 8, BPB Publication
3. Jr. Page, Special Edition Using Oracle 8/8i, Prentice-Hall of India
4. Days Maver, Teach Yourself More VB in 21 days, Techmedia

Practical/ Computational Work

Code: MHM 237

(Based on papers MHM 235 and MHM 236)

Max. Marks : 50

i) Written Practical/ Lab work : 40 Marks

ii)Viva-voce and practical record : 10 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned sections). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each section.

Section – I

Practicals based on Paper MHM 235.

Section – II

Practicals based on Paper MHM 236.

NEW SCHEME

Scheme of Examination of
5-Years Integrated M.Sc. (Honours) Mathematics Semester-IV
(w.e.f. 2011-2012)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			Total Marks
			Theory	Internal Assesment	Practicals	
MHM 241	Sequences and Series	4 Hours/ week	60	15	-	75
MHM 242	Special Functions and Integral transforms	4 Hours/ week	60	15	-	75
MHM 243	Programming in C and Numerical Methods	4 Hours/ week	45	-	30	75
MHM 244	Hydrostatics	4 Hours/ week	60	15	-	7
MHM 245	Elementary Inference	4 Hours/ week	60	15	-	75
MHM 246	Data Structures using C	4 Hours/ week	60	15	-	75
MHM 247	Practical/ Computational Work (Based on papers MHM 245 and MHM 246)	4 Hours/ week	-		50	50
Total Marks of Semester-IV						500

Note : The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Sequences and Series

Code: MHM 241

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

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

Section – III

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

Section – IV

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

Books Recommended:

1. R.R. Goldberg , Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik, Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
3. Shanti Narayan, A Course in Mathematical Analysis, S.Chand and Company, New Delhi
4. Murray, R. Spiegel, Theory and Problems of Advanced Calculus, Schaum Publishing Co., New York
5. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
6. Earl D. Rainville, Infinite Series, The Macmillan Co., New York

Special Functions and Integral Transforms

Code: MHM 242

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

Legendre and Hermite differentials equations and their solutions: Legendre and Hermite functions and their properties-Recurrence Relations and generating functions. Orhogonality of Legendre and Hermite polynomials. Rodrigues' Formula for Legendre & Hermite Polynomials, Laplace Integral Representation of Legendre polynomial.

Section – III

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

Section – IV

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

Books Recommended:

1. Erwin Kreyszing, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999
2. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd.
3. I.N. Sneddon, Special Functions on mathematics, Physics & Chemistry.
4. W.W. Bell, Special Functions for Scientists and Engineers.
5. I.N. Sneddon, The use of integral transform, McGraw Hill, 1972
6. Murray R. Spiegel, Laplace transform, Schaum's Series

Programming in C and Numerical Methods

Code: MHM 243

Part-A (Theory)

Max. Marks: 45
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

Decisions control structure: Decision statements, Logical and conditional statements, Implementation of Loops, Switch Statement & Case control structures. Functions, Preprocessors and Arrays.

Section – III

Strings: Character Data Type, Standard String handling Functions, Arithmetic Operations on Characters. Structures: Definition, using Structures, use of Structures in Arrays and Arrays in Structures. Pointers: Pointers Data type, Pointers and Arrays, Pointers and Functions.

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

Section – IV

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

Books Recommended:

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

Part-B (Practical)

Max. Marks: 30
Time: 3 Hours

There will be a separate practical paper consisting of simple programs in C and the implementation of Numerical Methods, studied in the paper MHM 243 (Part-A).

Hydrostatics

Code: MHM 244

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections(***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Pressure equation. Condition of equilibrium. Lines of force. Homogeneous and heterogeneous fluids. Elastic fluids. Surface of equal pressure. Fluid at rest under action of gravity. Rotating fluids.

Section – II

Fluid pressure on plane surfaces. Centre of pressure. Resultant pressure on curved surfaces. Equilibrium of floating bodies. Curves of buoyancy. Surface of buoyancy.

Section – III

Stability of equilibrium of floating bodies. Metacentre. Work done in producing a displacement. Vessels containing liquid.

Section – IV

Gas laws. Mixture of gases. Internal energy. Adiabatic expansion. Work done in compressing a gas. Isothermal atmosphere. Connective equilibrium.

Books Recommended

1. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Cambridge University Press, 1956.
2. A.S. Ramsey, Dynamics, Part I, Cambridge University Press, 1973.
3. W.H. Basant and A.S. Ramsey, A Treatise on Hydromechanics, Part I Hydrostatics, ELBS and G. Bell and Sons Ltd., London.

Elementary Inference

Code: MHM 245

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

Testing and interval estimation of a single mean, single proportion, difference between two means and two proportions. Fisher's Z transformation.

Section – IV

Definition of Chi-square statistic, Chi-square tests for goodness of fit and independence of attributes.
Definition of Student's 't' and Snedcor's F-statistics. Testing for the mean and variance of univariate normal distributions, Testing of equality of two means and two variances of two univariate normal distributions. Related confidence intervals. Analysis of variance(ANOVA) for one-way and two-way classified data.

Books Suggested:

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

Data Structures Using C

Code: MHM 246

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

Data structure and its essence, Data structure types.
Linear and list structures: Arrays, stacks, queues and lists; Sequential and linked structures; Simple lists, circular lists, doubly linked lists.
Inverted lists, threaded lists, Operations on all these structures and applications.

Section – II

Arrays, Multidimensional arrays, sequential allocation, address calculations, sparse arrays. Tree structures: Trees, binary trees and binary search trees. Implementing binary trees, Tree traversal algorithms, threaded trees, trees in search algorithms, AVL Trees.

Section – III

Graph data structure and their applications. Graph traversals, shortest paths, spanning trees and related algorithms.
Family of B-Trees: B-tree, B*-Trees, B+ Trees.

Section – IV

Sorting: Internal and External sorting. Various sorting algorithms, Time and Space complexity of algorithms.
Searching techniques and Merging algorithms. Applications of sorting and searching in computer science.

Suggested Readings:

1. Lipschutz, Data Structures (Schaum's Outline Series), Tata McGraw-Hill.
2.Adam Drozdek, Data Structures and Algorithms in C++, Vikas Pub. House (Thompson), New Delhi.
3. Amit Gupta, Data Structures Through C, Galgotia Booksource Pvt. Ltd., New Delhi.
4. S. Sofat, Data Structures With C and C++, Khanna Book Pub. Co.(P) Ltd, N. Delhi.
5. R.G Dromey, How to Solve it by Computer ?, Prentice Hall India.
6. Loomis, Data Structure and File Management, Prentice-Hall India Ltd.
7. Tannenbaum, Data Structure Using C, Tata McGraw-Hill.

Practical/ Computational Work

Code: MHM 247

(Based on papers MHM 245 and MHM 246)

Max. Marks : 50

i) Written Practical/ Lab work : 40 Marks

ii)Viva-voce and practical record : 10 Marks

Time:3 Hours

Note: The examiner is requested to set **4(four)** experiments (**2** from each of the following mentioned sections). The candidate is required to attempt **2(two)** of the allotted experiments selecting one from each section.

Section – I

Practicals based on Paper MHM 245.

Section – II

Practicals based on Paper MHM 246.

NEW SCHEME

Scheme of Examination of
5-Years Integrated M.Sc. (Honours) Mathematics Semester-V
(w.e.f. 2012-2013)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			
			Theory	Internal Assesment	Practicals	Total Marks
MHM 351	Real Analysis	4 Hours/ week	60	15	-	75
MHM 352	Groups and Rings	4 Hours/ week	60	15	-	75
MHM 353	Numerical Analysis	4 Hours/ week	45	-	30	75
MHM 354	Integral Equations	4 Hours/ week	60	15	-	75
MHM 355	Methods of Applied Mathematics	4 Hours/ week	60	15	-	75
MHM 356	Operations Research-I	4 Hours/ week	60	15	-	75
MHM 357	Practical/ Computational work to be performed on computers using EXCEL/SPSS)	4 Hours/ week	-		50	50
Total Marks in Semester-V						500

Note : The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Real Analysis

Code: MHM 351

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section – IV

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

Book s Recommended:

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

Groups and Rings

Code: MHM 352

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section – IV

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

Books Recommended:

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

Numerical Analysis

Code: MHM 353

Part-A (Theory)

Max. Marks: 45
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula.

Probability distribution of random variables, Binomial distribution, Poisson's distribution, Normal distribution: Mean, Variance and Fitting.

Section – III

Numerical Differentiation: Derivative of a function using interpolation formulae as studied in Sections –I & II.

Eigen Value Problems: Power method, Jacobi's method, Given's method, House-Holder's method, QR method, Lanczos method.

Section – IV

Numerical Integration: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one- third and three-eighth rule, Chebychev formula, Gauss Quadrature formula.

Numerical solution of ordinary differential equations: Single step methods-Picard's method. Taylor's series method, Euler's method, Runge-Kutta Methods. Multiple step methods; Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.

Books Recommended:

1. Babu Ram, Numerical Methods: Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
4. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999
5. C. E. Froberg, Introduction to Numerical Analysis (2nd Edition).
6. Melvin J. Maaron, Numerical Analysis-A Practical Approach, Macmillan Publishing Co., Inc., New York
7. R.Y. Rubnistein, Simulation and the Monte Carlo Methods, John Wiley, 1981

Part-B (Practical)

Max. Marks: 30
Time: 3 Hours

There will be a separate practical paper consisting of implementation of numerical methods in C Programming Language, studied in the theory paper MHM 353(Part-A).

Integral Equations

Code: MHM 354

Max. Marks : 60
Time : 3 Hours

Section I

Linear integral equations, Some basic identities, Initial-value problems reduced to Volterra integral equations, Method of successive approximation to solve Volterra integral equations of second kind, Iterated kernels and Neumann series for Volterra equation. Resolvent kernel as a series in λ, Laplace transform method for a difference kernel, Solution of a Volterra integral equation of the first kind.

Section II

Boundary value problems reduced to Fredholm integral equations, method of successive approximations to solve Fredholm equation of second kind, Iterated kernels and Neumann series for Fredholm equations, Resolvent kernel as a sum of series, Fredholm resolvent kernel as a ratio of two series. Fredholm equations with degenerate kernel, approximation of a kernel by a degenerate kernel, Fredholm Alternative.

Section III

Green's function. Use of method of variation of parameters to construction the Green's function for a nonhomogeneous linear second degree BVP, Basic four properties of the Green's function, Alternate procedure for construction of the Green's function by using its basic four properties. Method of series representation of the Green's function in terms of the solutions of the associated homogeneous BVP. Reduction of a BVP to a Fredholm integral equation with kernel as Green's function.

Section IV

Homogeneous Fredholm equations with symmetric kernels, Solution of Fredholm equations of the second kind with symmetric kernel, Method of Fredholm Resolvent Kernel, Method of Iterated Kernels, Fredholm Equations of the First Kind with Symmetric Kernels.

Books Recommended:

1. A.J. Jerri, Introduction to Integral Equations with Applications.
2. A.D. Polyanin and A.V. Manzhirov, Handbook of Integral Equations, CRC Press.
3. J. Kondo, Integral Equations, Oxford Applied mathematics and Computing Science Series.

Methods of Applied Mathematics

Code: MHM 355

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections***(I-IV)*** will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section - I

Solution of 3D Laplace, wave and heat equations in spherical polar co-ordinates and cylindrical polar co-ordinates by the method of separation of variables. Fourier series solution of the wave equation, transformation of boundary value problems.

Section - II

Fourier series solution of the heat equation, steady-state temperature in plates, The heat and wave equations in unbounded domains, Fourier transform solution of boundary value problems. The heat equation in an infinite cylinder and in a solid sphere.

Section - III

Hankel transform of elementary functions. Operational properties of the Hankel transform. Applications of Hankel transforms to PDE.
Definition and basic properties of finite Fourier sine and cosine transforms, its applications to the solutions of BVP's and IVP's.

Section - IV

Moments and products of inertia, Angular momentum of a rigid body, principal axes and principal moment of inertia of a rigid body, kinetic energy of a rigid body rotating about a fixed point, Momental ellipsoid and equimomental systems, coplanar mass distributions, general motion of a rigid body.

Books Recommended :

1. A.J. Jerri, Introduction to Integral Equations with Applications.
2. Lokenath Debnath, Integral Transforms and their Applications, CRC Press, Inc., 1995.
3. Peter V. O'Neil, Advanced Engineering Mathematics, 4th Edition, An International Thomson Publishing Company.
4. I.N. Sneddon, Elements of Partial Differential Equations, Prentice Hall, McGraw Hill.
5. I.N. Sneddon, Special Functions of Mathematical Physics and Chemistry.
6. F. Chorlton, Dynamics, CBS publishers and Distributors.

Operations Research-I

Code: MHM 356

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section- I

Definition, scope, methodology and applications of OR. Types of OR models.
Concept of optimization, Linear Programming: Introduction, Formulation of a Linear Programming Problem (LPP), Requirements for an LPP, Advantages and limitations of LP. Graphical solution: Multiple, unbounded and infeasible solutions.

Section-II

Principle of simplex method: standard form, basic solution, basic feasible solution.
Computational Aspect of Simplex Method: Cases of unique feasible solution, no feasible solution, multiple solution and unbounded solution and degeneracy. Two Phase and Big-M methods.

Section-III

Duality in LPP, primal-dual relationship.
Transportation Problem: Methods for finding basic feasible solution of a transportation problem, Modified distribution method for finding the optimum solution, Unbalanced and degenerate transportation problems, transshipment problem, maximization in a transportation problem.

Section-IV

Assignment Problem: Solution by Hungarian method, Unbalanced assignment problem, maximization in an assignment problem, Crew assignment and Travelling salesman problem.
Game Theory: Two person zero sum game, Game with saddle points, the rule of dominance; Algebraic, graphical and linear programming methods for solving mixed strategy games.

Books Recommended

1. J.K. Sharma, Mathematical Model in Operations Research, Tata McGraw Hill.
2. H.A. Taha, Operations Research – An Introduction.
3. Kanti Swarup, P.K. Gupta, and Manmohan, Operations Research.
4. P.K. Gupta and D.S. Hira, Operations Research, S. Chand & Co.
5. S.I. Gass, Linear Programming (3rd Edition), McGraw Hill, New York, 1985.
6. S.D. Sharma, Operations Research.
7. N.S. Kambo, Mathematical Programming.
8. G. Hadley, Linear Programming, Narosa Publishing House, 1987.

Practical/ Computational Work

Code: MHM 357

Max. Marks : 50
i) Written Practical/ Lab work : 40 Marks
ii)Viva-voce and practical record : 10 Marks
Time:3 Hours

Note: The examiner is requested to set **4** experiments. The candidate is required to attempt **2** of the allotted experiments.

This paper covers the practical/computational work to be performed on computer using EXCEL/SPSS.

NEW SCHEME

Scheme of Examination of
5-Years Integrated M.Sc. (Honours) Mathematics Semester-VI
(w.e.f. 2012-2013)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			
			Theory	Internal Assesment	Practicals	Total Marks
MHM 361	Real and Complex Analysis	4 Hours/ week	60	15	-	75
MHM 362	Linear Algebra	4 Hours/ week	60	15	-	75
MHM 363	Dynamics	4 Hours/ week	60	15	-	75
MHM 364	Elementary Topology	4 Hours/ week	60	15	-	75
MHM 365	Fluid Dynamics	4 Hours/ week	60	15	-	75
MHM 366	Operations Research-II	4 Hours/ week	60	15	-	75
MHM 367	Practical/ Computational work to be performed on computers using MATLAB/TORA)	4 Hours/ week	-		50	50
Total Marks in Semester-VI						500

Note : The conditions with regard to the above scheme will be as per the relevant ordinance and rules and regulations of the University.

Real and Complex Analysis

Code: MHM 361

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section – IV

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

Books Recommended:

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

Linear Algebra

Code: MHM 362

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section – IV

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

Books Recommended:

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

Dynamics

Code: MHM 363

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section – I

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

Section – II

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

Section – III

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

Section – IV

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

Books Recommended:

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

Elementary Topology

Code: MHM 364

Max. Marks : 60
Time : 3 hours

Note: The question paper will consist of **five** sections. Each of the first four sections***(I-IV)*** will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section - I

Statements only of (Axiom of choice, Zorn's lemma, Well ordering theorem and Continnum hypothesis).

Definition and examples of topological spaces, Neighbourhoods, Interior point and interior of a set , Closed set as a complement of an open set , Adherent point and limit point of a set, Closure of a set, Derived set, Properties of Closure operator, Boundary of a set , Dense subsets, Interior, Exterior and boundary operators.

Base and subbase for a topology, Neighbourhood system of a point and its properties, Base for Neighbourhood system.

Relative(Induced) topology, Alternative methods of defining a topology in terms of neighbourhood system and Kuratowski closure operator.

Comparison of topologies on a set, Intersection and union of topologies on a set.

Section - II

Continuous functions, Open and closed functions , Homeomorphism.

Connectedness and its characterization, Connected subsets and their properties, Continuity and connectedness, Components, Locally connected spaces,

Section - III

Compact spaces and subsets, Compactness in terms of finite intersection property,Continuity and compact sets, Basic properties of compactness, Closedness of compactsubset and a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and countably compact sets, Local compactness and one point compatification.

Section - IV

First countable, second countable and separable spaces, hereditary and topological property, Countability of a collection of disjoint open sets in separable and second countable spaces, Lindelof theorem. T_0, T_1, T_2 (Hausdorff) separation axioms,their characterization and basic properties.

Books Recommended :

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.
3. J. L. Kelly, General Topology, Affiliated East West Press Pvt. Ltd., New Delhi.
4. J. R. Munkres, Toplogy, Pearson Education Asia, 2002.
5. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.

Fluid Dynamics

Code: MHM 365

Max. Marks : 60
Time : 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections***(I-IV)*** will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section - I

Kinematics - Eulerian and Lagrangian methods. Stream lines, path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vortex lines. Equation of continuity. Boundary surfaces.

Section - II

Acceleration at a point of a fluid. Components of acceleration in cylindrical and spherical polar co-ordiantes, Pressure at a point of a moving fluid. Euler's and Lagrange's equations of motion. Bernoulli's equation. Impulsive motion. Stream function.

Section - III

Acyclic and cyclic irrotation motions. Kinetic energy of irrotational flow. Kelvin's minimum energy theorem. Axially symmetric flows. Liquid streaming past a fixed sphere. Motion of a sphere through a liquid at rest at infinity. Equation of motion of a sphere. Three-dimensional sources, sinks, doublets and their images. Stoke's stream function.

Section - IV

Irrotational motion in two-dimensions. Complex velocity potential. Milne-Thomson circle theorem. Two-dimensional sources, sinks, doublets and their images. Blasius theorem. Two- dimensional irrotation motion produced by motion of circular and co-axial cylinders in an infinite mass of liquid.

Books Recommended:

1. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
2. M.E. O'Neill and F. Chorlton, Ideal and Incompressible Fluid Dynamics, Ellis Horwood Limited, 1986.
3. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
4. W.H. Besant and A.S. Ramsay, A Treatise on Hydromechanics Part I and II, CBS Publishers, New Delhi.
5. Bansi Lal, Theoretical Fluid Dynamics, Skylark Pub., New Delhi.

Operations Research-II

Code: MHM 366

Max. Marks: 60
Time: 3 Hours

Note: The question paper will consist of **five** sections. Each of the first four sections (***I-IV***) will contain two questions and the students shall be asked to attempt **one** question from each section. **Section-V** will contain **six** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory.**

Section- I

Inventory Control: introduction of inventory, factors affecting inventory, Inventory models, Deterministic models: Economic order quantity model when shortages are allowed/not allowed, price discounts model, multi-item inventory models.

Section-II

Queuing Theory : Basic characteristics of queuing system, Birth-death equations, Steady state solution of Markovian queuing models with single and multiple servers (M/M/1 and M/M/c), with limited capacity (M/M/1/K and M/M/c/K).

Section-III

Sequencing problems: Processing of n jobs through 2 machines, n jobs through 3 machines, 2 jobs through m machines, n jobs through m machines.
Replacement problems: Replacement of items whose running cost increases with time, Replacement policies for the items that fail completely - Individual and the group replacement policies.

Section-IV

PERT and CPM: Introduction of PERT and CPM, Earliest and latest times, Determination of critical path and various types of floats, Probablistic and cost considerations in project scheduling

Books Recommended:

1. J.K. Sharma, Mathematical Model in Operations Research, Tata McGraw Hill.
2. H.A. Taha, Operations Research – An Introduction.
3. Kanti Swarup, Gupta, P.K. and Manmohan. Operations Research.
4. P.K. Gupta and D.S Hira, Operations Research, S. Chand & Co.
5. S.D. Sharma, Introduction to Operations Research.

Practical/ Computational Work

Code: MHM 367

Max. Marks : 50
i) Written Practical/ Lab work : 40 Marks
ii)Viva-voce and practical record : 10 Marks
Time:3 Hours

Note: The examiner is requested to set **4** experiments. The candidate is required to attempt **2** of the allotted experiments.

This paper covers the practical/Computational work to be performed on computer using MATLAB/TORA.