OLD SCHEME

Scheme of Examination of
B.Sc. (Honours) Mathematics, Semester-III
(only for the session 2010-2011)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			Time
			Theory	Internal Assesment	Practicals	
BMH 231	Advanced Calculus	4 Hours/ week	90	10	-	3 hours
BMH 232	Partial Differential Equations	4 Hours/ week	90	10	-	3 hours
BMH 233	Statics	4 Hours/ week	90	10	-	3 hours
BMH 234	Opt (i) Probability Theory + Opt (ii) Principles of Computer Sciences-I++	4 Hours/ week	90	10	-	3 hours
BMH 235	Advanced Number Theory	4 Hours/ week	90	10	-	3 hours

Subsidiary Subject

BMH 236	One of the following subjects* : Option (i) Physics Option (ii) Chemistry Option (iii) Computer Science Option (iv) Statistics

+ Option is not allowed to students offering Statistics as a subsidiary subject.
++ Option is not allowed to students offering Computer Science as a subsidiary subject.
* The syllabi of the subsidiary subject shall be the same as that of the corresponding syllabi for the pass course of B.Sc. Semester-III

Note: 1. Other requirements of the languages and/or qualifying subjects, if any, will remain the same as approved by the University for the Honours courses.

2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Advanced Calculus

Code: BMH 231

Max. Marks: 90
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, Mrcel 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: BMH 232

Max. Marks: 90
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 & Kehar Singh : Partial Differential Equations

Statics

Code: BMH 233

Max. Marks: 90
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

Probability Theory

Code: BMH 234 [Opt (i)]

Max. Marks : 90
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

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 – II

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 – III

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

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

Section – IV

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

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

Books recommended:

1. S.M. Ross, Introduction to Probability Models (Sixth edition) Academic Press, 1997.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
3. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
4. P.L.Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.
5. Baisnab and M. Jas, Element of Probability and statistics, Tata McGraw Hill.
6. J.L. Devore, Probability and Statistics for Engineers, Cengage Learning India Private Limited, 2008.

Principles of Computer Science-I

Code: BMH 234 [Opt (ii)]

Max. Marks : 90
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 Storage – Storage of bits. Main Memory. Mass storage. The Binary System, Storing integers, Storing fractions.

Data Manipulation – The Central Processing Unit. The Stored – Program Concept. Programme Execution.

Section – II

Arithmetic/Logic Instructions. Computer-Peripheral Communication. Operating System and Networks – The Evolution of Operating System. Operating System Architecture. Coordinating the Machine's Activities.

Section – III

Networks & Network Protocol. Algorithms – The Concept of an Algorithm. Algorithm Representation. Iterative Structures. Recursive Structures. Efficiency and Correctness.

Section – IV

Programming Languages – Historical Perspective. Traditional Programming Concepts, Program Units. Language Implementation. Parallel Computing. Declarative Computing.

Books Recommended

1. J. Glen Brookshear, Computer Science : An Overview, Addition – Wesley.
2. Rajaraman V., "Fundamentals of Computers", Prentice Hall of India.
3. Schaum's Outline Series, Data Structures, Tata McGraw Hill.
4. Gill, N.S., Essentials of Computer and Network Technology, Khanna Publishing Co.
5. Mano M., Computer System Architecture, Prentice Hall of India.
6. Leon & Leon, "Fundamental of Computer Science and Communication Engineering", Leon Techworld.
7. Pressman, "Software Engineering", Tata McGraw Hill.
8. Tannenbaum, "Operating System Concept", Prentice Hall of India.
9. Gills, N.S., "Software Engineering", Pub. Co., Khanna Pub. Co.

Advanced Number Theory

Code: BMH 235 **Max. Marks : 90**

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.**

Unit-I

Congruences and residues, Elementary results for congruences. The ϕ-function and reduced residue systems. Multiplicity of ϕ-function. Formula for $\phi(n)$. The order of an integer (modulo m). Necessary and sufficient condition for a linear congruence $ax \equiv b \pmod{m}$ to have a solution. Number of solutions of the linear congruence. Wilson's Theorem and Eulers criterion and Chinese Remainder Theorem.

Unit-II

Polynomial congruences. Polynomial congruences modulo a prime. Polynomial congruences modulo a power of a prime and their solutions. Primitive roots and their existence. Fundamental theorem of primitive roots.

Unit-III

Quadratic residues. The Legendre symbol. Elementary results for the Legendre symbol. Lemma of Gauss. Law of Quadratic Reciprocity. (Both the Number Theoretic and Geometrical proofs). Arithmetical functions. Mobius inversion formula and its applications.

Unit-IV

Finite continued fractions. Finite simple continued fractions. Expansion of a rational number into a finite simple continued fraction. The uniqueness of simple continued fraction if the last term is bigger than 1, partial quotients and its elementary properties, use of continued fractions to solve the equation $ax+by = 1$, Infinite irrational number into an infinite s.c.f., uniqueness of infinite s.c.f., complete quotients. Farey sequences and their application to approximation of irrationals by rationals Hurwitz's Theorem.

Books Recommended

1. David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa, 1989.
2. K. Ireland, and M. Rosen, A Classical Introduction to Modern Number Theory, GTM Vol. 84, Springer-Verlag, 1972.
3. G.A. Jones, and J.M. Jones, Elementary Number Theory, Springer, 1998.
4. W. Sierpinski, Elementary Theory of Numbers, North-Holland, 1988, Ireland.
5. K. Rosen and M. Rosen, A Classical Introduction to Modern Number Theory, GTM Vol. 84. Springer-Verlag, 1972.
6. I. Niven, S.H. Zuckerman, and L.H. Montgomery, A Introduction to the Theory of Numbers, John Wiley, 1991.
7. Car-Michael, R.D., The Theory of Numbers, John Wiley and Sons.
8. Davenport, H., The Higher Arithmetic, Hutchinson University Library.
9. Hardy, G.H. and E.M. Wright, An Introduction to the Theory of Numbers, Oxford.

OLD SCHEME

Scheme of Examination of
B.Sc. (Honours) Mathematics, Semester-IV
(only for the session 2010-2011)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			Time
			Theory	Internal Assesment	Practicals	
BMH 241	Sequences and Series	4 Hours/ week	90	10	-	3 hours
BMH 242	Special Functions and Integral transforms	4 Hours/ week	90	10	-	3 hours
BMH 243	Programming in C and Numerical Methods	4 Hours/ week	60	-	40	3 hours
BMH 244	Opt (i) Probability Distributions+ Opt (ii) Principles of Computer Sciences-II++	4 Hours/ week	90	10	-	3 hours
BMH 245	Differential Geometry	4 Hours/ week	90	10	-	3 hours

Subsidiary Subject

BMH 246	One of the following subjects* : Option (i) Physics Option (ii) Chemistry Option (iii) Computer Science Option (iv) Statistics

+ Option is not allowed to students offering Statistics as a subsidiary subject.
++ Option is not allowed to students offering Computer Science as a subsidiary subject.
* The syllabi of the subsidiary subject shall be the same as that of the corresponding syllabi for the pass course of B.Sc. Semester-IV

Note: 1. Other requirements of the languages and/or qualifying subjects, if any, will remain the same as approved by the University for the Honours courses.

2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Sequences and Series

Code: BMH 241

Max. Marks: 90
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: BMH 242

Max. Marks: 90
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 & 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: BMH 243

Part-A (Theory) **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

Programmer's model of a computer, Algorithms, Flow charts, Data types, Operators and expressions, Input / outputs 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. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
5. M.K. Jain, S.R.K. Iyengar, R.K. Jain : Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999
6. Computer Oriented Numerical Methods, Prentice Hall of India Pvt. Ltd.

7. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill Publishing Co. Ltd.

8. Babu Ram: Numerical Methods, Pearson Publication.

9. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Part-B (Practical)

Max. Marks: 40
Time: 3 Hours

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

Probability Distributions

Code: BMH 244 [Opt (i)]

Max. Marks: 90
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

Discrete uniform, Bernoulli, binomial and Poisson distributions with their properties.

Section – II

Negative binomial, geometric, multinomial and hyper-geometric distributions with their properties.

Section – III

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

Section – IV

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

Books recommended:

1. S.M. Ross, Introduction to Probability Models (Sixth edition) Academic Press, 1997.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
3. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
4. P.L.Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.
5. R.P.Hooda, Statistics for Business and Economics, MACMILLAN INDIA LTD., 2003.

Principles of Computer Science-II

Code: BMH 244 [Opt (ii)]

Max. Marks: 90
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

Software Engineering – The Software Engineering Discipline. The Software Life Cycle. Modularity. Development Tools and techniques. Documentation. Object-Oriented Programming.

Section – II

Data Structures – Arrays. Lists. Stacks. Queues. Trees. Customised Data Types.

Section – III

File Structure – Sequential Files. Text Files. Indexed Files. Hashed Files. The Role of the Operating System.

Database Structure – General Issues. The Relational Model.

Section – IV

Object-Oriented Database. Maintaining Database Integrity. E-R models.

Theory of Computation – Turing Machines. Computable functions. A Non computable Function. Complexity and its Measures. Problem Classification.

Books Recommended:

1. J. Glen Brookshear, Computer Science : An Overview, Addition – Wesley.
2. Rajaraman V., "Fundamentals of Computers", Prentice Hall of India.
3. Schaum's Outline Series, Data Structures, Tata McGraw Hill.
4. Gill, N.S., Essentials of Computer and Network Technology, Khanna Publishing Co.
5. Mano M., Computer System Architecture, Prentice Hall of India.
6. Leon & Leon, "Fundamental of Computer Science and Communication Engineering", Leon Techworld.
7. Pressman, "Software Engineering", Tata McGraw Hill.
8. Tannenbaum, "Operating System Concept", Prentice Hall of India.
9. Gills, N.S., "Software Engineering", Pub. Co., Khanna Pub. Co.

Differential Geometry

Code: BMH 245

Max. Marks: 90
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. Weatherburn, C.E., Differential Geometry of Three Dimensions, Radhe Publishing House.
2. Erwin Kreyszig, Differential Geometry.
3. Singh, A.K., Mittal, P.K., A Textbook of Differential Geometry, Har-Anand Publications.

OLD SCHEME

Scheme of Examination of
B.Sc. (Honours) Mathematics, Semester-V
(only for the session 2011-2012)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			Time
			Theory	Internal Assesment	Practicals	
BMH 351	Real Analysis	4 Hours/ week	90	10	-	3 hours
BMH 352	Groups and Rings	4 Hours/ week	90	10	-	3 hours
BMH 353	Numerical Analysis	4 Hours/ week	60	-	40	3 hours
BMH 354	Integral Equations	4 Hours/ week	90	10	-	3 hours
BMH 355	Fluid Dynamics	4 Hours/ week	90	10	-	3 hours

Subsidiary Subject

BMH 356	One of the following subjects* : Option (i) Physics Option (ii) Chemistry Option (iii) Computer Science Option (iv) Statistics

* The syllabi of the subsidiary subject shall be the same as that of the corresponding syllabi for the pass course of B.Sc. Semester-V

Note: 1. Other requirements of the languages and/or qualifying subjects, if any, will remain the same as approved by the University for the Honours courses.

2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Real Analysis

Code: BMH 351

Max. Marks: 90
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. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
3. R.R. Goldberg : Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
4. D. Somasundaram and B. Choudhary : A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997
5. Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi
6. E.T. Copson, Metric Spaces, Cambridge University Press, 1968.
7. G.F. Simmons : Introduction to Topology and Modern Analysis, McGraw Hill, 1963.

Groups and Rings

Code: BMH 352

Max. Marks: 90
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: BMH 353

Part-A (Theory)

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

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, R.K. Jain : Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
4. M.K. Jain, S.R.K. Iyengar, 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: 40
Time: 3 Hours

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

Integral Equations

Code: BMH 354

Max. Marks : 90
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. Jerri, A.J., Introduction to Integral Equations with Applications.
2. Polyanin, A.D., Manzhirov, A.V., handbook of Integral Equations, CRC Press.
3. Kondo, J., Integral Equations, Oxford Applied mathematics and Computing Science Series.

Fluid Dynamics

Code: BMH 355

Max. Marks : 90
Time : 3 Hours

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.

OLD SCHEME

Scheme of Examination of
B.Sc. (Honours) Mathematics, Semester-VI
(only for the session 2011-2012)

Paper Code	Title of the paper	Teaching Hours	Max. Marks			Time
			Theory	Internal Assesment	Practicals	
BMH 361	Real and Complex Analysis	4 Hours/ week	90	10	-	3 hours
BMH 362	Linear Algebra	4 Hours/ week	90	10	-	3 hours
BMH 363	Dynamics	4 Hours/ week	90	10	-	3 hours
BMH 364	Elementary Topology	4 Hours/ week	90	10	-	3 hours
BMH 365	Methods of Applied Mathematics	4 Hours/ week	90	10	-	3 hours

Subsidiary Subject

BMH 366	One of the following subjects* : Option (i) Physics Option (ii) Chemistry Option (iii) Computer Science Option (iv) Statistics

* The syllabi of the subsidiary subject shall be the same as that of the corresponding syllabi for the pass course of B.Sc. Semester-VI

Note: 1. Other requirements of the languages and/or qualifying subjects, if any, will remain the same as approved by the University for the Honours courses.

2. The other conditions will remain the same as per relevant Ordinance and rules and regulations of the University.

Real and Complex Analysis

Code: BMH 361

Max. Marks: 90
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 & J.W. Brown: Complex Variables and Applications, 5^{th} Edition, McGraw-Hill, New York, 1990
6. Shanti Narayan : Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.

Linear Algebra

Code: BMH 362

Max. Marks: 90
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 Liner 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 (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.

Dynamics

Code: BMH 363

Max. Marks: 90
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: BMH 364

Max. Marks : 90
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.

Methods of Applied Mathematics

Code: BMH 365

Max. Marks : 90
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. Jerri, A.J., 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. Sneddon, I.N., Elements of Partial Differential Equations, Printice Hall, McGraw Hill.
5. Sneddon, I.N., Special Functions of Mathematical Physics and Chemistry.
6. Chorlton, F., Dynamics, CBS publishers and Distributors.