### Scheme of examination for B.A./B.Sc. – I, II & III (i.e. from Semester – I to VI)

**Annexure-I**

**w.e.f 2011-12**

**Time : 3 Hours**

<table>
<thead>
<tr>
<th>B.A./B.Sc. - I year (Semester – I)</th>
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</thead>
<tbody>
<tr>
<td><strong>Paper No.</strong></td>
<td><strong>Paper Name</strong></td>
</tr>
<tr>
<td>BM – 111</td>
<td>Algebra</td>
</tr>
<tr>
<td>BM – 112</td>
<td>Calculus</td>
</tr>
<tr>
<td>BM – 113</td>
<td>Solid Geometry</td>
</tr>
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<table>
<thead>
<tr>
<th>B.A./B.Sc. - I year (Semester – II)</th>
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<tr>
<td><strong>Paper No.</strong></td>
<td><strong>Paper Name</strong></td>
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<tr>
<td>BM – 121</td>
<td>Number Theory</td>
</tr>
<tr>
<td>BM – 122</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>BM – 123</td>
<td>Vector Calculus</td>
</tr>
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</table>

<table>
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<tr>
<th>B.A./B.Sc. - II year (Semester – III)</th>
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<tbody>
<tr>
<td><strong>Paper No.</strong></td>
<td><strong>Paper Name</strong></td>
</tr>
<tr>
<td>BM – 124</td>
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<td>BM – 125</td>
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<td>BM – 126</td>
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<td>Course Code</td>
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<tr>
<td>BM – 231</td>
<td>Advanced Calculus</td>
</tr>
<tr>
<td>BM – 232</td>
<td>Partial Differential Equations</td>
</tr>
<tr>
<td>BM – 233</td>
<td>Statics</td>
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### B.A. /B.Sc. - II year (Semester – IV)

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Paper Name</th>
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<th>B.Sc.</th>
<th>B.A.</th>
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</thead>
<tbody>
<tr>
<td>BM – 241</td>
<td>Sequences and Series 40 Marks</td>
<td>10 Marks</td>
<td>27 Marks</td>
<td>6</td>
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</tr>
<tr>
<td>BM – 242</td>
<td>Special Functions 40 Marks</td>
<td>10 Marks</td>
<td>26 Marks</td>
<td>7</td>
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</tr>
<tr>
<td></td>
<td>And Integral Transforms</td>
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</tr>
<tr>
<td>BM – 243</td>
<td>Programming in C &amp; Numerical Methods 30 Marks + Practical 20 Marks, no Sessional (B.Sc.)</td>
<td>Theory 30 Marks + Practical 20 Marks, no Sessional (B.Sc.)</td>
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</tbody>
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### B.A./B.Sc. – III year (Semester –V)

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Paper Name</th>
<th>B.Sc.</th>
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<th>B.A.</th>
<th>B.A.</th>
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</thead>
<tbody>
<tr>
<td>BM – 351</td>
<td>Real Analysis 40 Marks</td>
<td>10 Marks</td>
<td>27 Marks</td>
<td>6</td>
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<tr>
<td>BM – 352</td>
<td>Groups and Rings 40 Marks</td>
<td>10 Marks</td>
<td>26 Marks</td>
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### B.A./B.Sc. – III year (Semester –VI)

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Paper Name</th>
<th>B.Sc.</th>
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<th>B.A.</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Total Marks</td>
<td>Theory Marks</td>
<td>Practical Marks</td>
<td>Total Marks</td>
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<tr>
<td>BM – 361</td>
<td>Real &amp; Complex Analysis</td>
<td>40</td>
<td>10</td>
<td>27</td>
<td>6</td>
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<tr>
<td>BM – 362</td>
<td>Linear Algebra</td>
<td>40</td>
<td>10</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>BM – 363</td>
<td>Dynamics</td>
<td>40</td>
<td>10</td>
<td>27</td>
<td>7</td>
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</table>
B.A/B.Sc. in Mathematics

1. The qualification for admission to B.A/B.Sc. in Mathematics: A student who has studied Mathematics as one of the subject at Senior School level (XII/10+2/Equivalent examination thereto).
2. Scheme of Examination (Annexure – I)
3. Teaching hours for each theory paper will be minimum six periods per week.
4. Minimum two hours per week per group will be devoted for practical classes, where applicable. Practical group will be formed as per university norms for science subjects.
5. Duration of the examination for each paper will be three hours.
6. Pass percentage : 35% (aggregate in all the three papers of a semester).
B.A./B.Sc. – Ist Year (Semester – I)
BM – 111 : Algebra

Time : 3 Hours

<table>
<thead>
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Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five parts distributed over all the four sections. Candidates are required to attempt five questions, selecting at least one question from each section and the compulsory question.

Section – I

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

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:

Pothishala Private Ltd., Allahabad.

B.A./B.Sc. – Ist Year (Semester – I)
BM – 112 : Calculus

Time : 3 Hours

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Section – I


Section – II


Section – III


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:

Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five parts distributed over all the four sections. Candidates are required to attempt five questions, selecting at least one question from each section and the compulsory question.

**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-oxal system of spheres
Cones. Right circular cone, enveloping cone and reciprocal cone.
Cylinder: Right circular cylinder and enveloping cylinder.

**Section – III**


**Section – IV**

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

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**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-oxal system of spheres
Cones. Right circular cone, enveloping cone and reciprocal cone.
Cylinder: Right circular cylinder and enveloping cylinder.

**Section – III**


**Section – IV**

Paraboloids: Circular section, Plane sections of conicoids.
Generating lines. Confocal conicoid. Reduction of second degree equations.
four sections. Candidates are required to attempt five questions, selecting at least one question from each section and the compulsory question.

Section – I

Section – II
Complete residue system and reduced residue system modulo m. Euler’s 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 \(\sigma(n)\)). 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:

B.A./B.Sc. – Ist Year (Semester – II )
BM – 122 : Ordinary Differential Equations

Time : 3 Hours

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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


Section – III


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:

4. S.L.Ross: Differential Equations, John Wiley & Sons
Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five parts distributed over all the four sections. Candidates are required to attempt five questions, selecting at least one question from each section and the compulsory question.

**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 \( \Phi \), character of gradient as a point function. Divergence and curl of vector point function, characters of \( \text{Div } \vec{f} \) and \( \text{Curl } \vec{f} \) 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:

Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question.

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

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, Involute, 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


6. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi

B.A./B.Sc. - IIInd Year (Semester-III)
BM -232 : Partial Differential Equations

Time : 3 Hours

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**SECTION-I**

**SECTION-II**
Linear partial differential equations of second and higher orders, Linear and non-linear homogenous and non-homogenous equations with constant co-efficients, Partial differential equation 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**

**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


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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. Poi nTs central axis.

SECTION-IV
Wrenches. Null lines and planes. Stable and unstable equilibrium.

Books Recommended:
Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question from each section and the compulsory question.

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:
3. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi
5. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question.

SECTION-I

SECTION-II

SECTION-III

SECTION-IV
Books Recommended:
3. I.N. Sneddon: Special Functions on mathematics, Physics & Chemistry.
4. W.W. Bell: Special Functions for Scientists & Engineers.
6. Murray R. Spiegel: Laplace transform, Schaum’s Series
B.A. /B.Sc. - IIInd Year (Semester – IV)
BM -243 : PROGRAMMING IN C & NUMERICAL METHODS

Time : 3 Hours (Theory)
Time : 2 Hours (Practical)

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<td>Practical :</td>
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<td>14</td>
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Part-A (Theory)

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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

SECTION-IV
Part-B (Practical)
Simple programs in C and the implementation of Numerical Methods, studied in the theory paper, in ‘C’ programming Language.

Books Recommended:
B.A./B.Sc. - IIIrd Year (Semester-V)
BM -351 : REAL ANALYSIS

Time : 3 Hours

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**SECTION-I**

**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.
**Books Recommended:**


2. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985


5. Shanti Narayan: A Course of Mathematical Analysis, S. Chand & Co., New Delhi


B.A./B.Sc. - IIIrd Year (Semester-V)  
BM -352 : Groups and Rings

Time : 3 Hours

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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
Homomorphisms, isomorphisms, 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[X1 , X2……Xn]
Books Recommended:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975


B.A./B.Sc.- IIIrd Year (Semester-V)
BM -353 : NUMERICAL ANALYSIS

Time : 3 Hours (Theory)
Time : 2 Hours (Practical)

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Part-A (Theory)

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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.

SECTION-IV

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

Part-B (Practical)

Implementation of numerical methods, studied in the theory paper, in ‘C’ Programming Language.
Books Recommended:

6. Computer Oriented Numerical Methods, Practice Hall of India Pvt. Ltd.

B.A./B.Sc. - IIIrd Year (Semester – VI)
BM -361 : REAL & COMPLEX ANALYSIS
Time : 3 Hours

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SECTION-I
Jacobians, Beta and Gamma 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 points, Cross ratio, Inverse Points and critical mappings.
Books Recommended:
1. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
4. Shanti Narayan: A Course of Mathematical Analysis, S. Chand & Co., New Delhi
B.A./B.Sc. - IIIrd Year (Semester-VI)
BM -362 : LINEAR ALGEBRA

Time : 3 Hours

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<th>B.Sc.</th>
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<td>Theory : 40</td>
<td>Theory : 26</td>
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Note: The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question from each section and the compulsory question.

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 vector 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 vector spaces, Vector space of all the linear transformations Dual Spaces, Bidual spaces, annihilator of subspaces of finite dimensional vector 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
B.A./B.Sc. - IIIrd Year (Semester-VI)
B.M -363: Dynamics

Time : 3 Hours

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

SECTION-II

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:
2. F. Chorlton: Dynamics, CBS Publishers, New Delhi
3. A.S. Ramsey: