TRIPURA UNIVERSITY

(A Central University)
Suryamaninagar-799022

Syllabus
OF

Mathematics
(General & Major)

Semester – III

2014

B.A. / B. Sc. Semester-I (General)
MATHEMATICS
Paper-I
Mark : 20+80=100

Unit-I(20+20=40)

(Classical Algebra & Vector Algebra)

1. Inequalities : A. M. ≥G.M ≥ H.M. Their generalization like the theorem of weighted mean and m^{th} power theorem. Statement of Cauchy-Schwartz inequality. Weierstrass inequality and their application. DeMoivre's theorem and its applications.

2. Exponential sine, cosine and logarithm of complex number. Direct and inverse circular and hyperbolic functions. Expansion of trigonometry functions. Gregory's series. Summation of series. Revision of definition of vectors and its algebra. Rectangular solution of vector. linear dependent and independent of vectors. Two vectors are linier dependent iff one is scalar multiple of other. Every super set of linearly dependent set of vectors is linearly dependent. The set of non-zero vectors are linearly iff one of them is scalar combination of others.

3. Scalar and vector product of two vectors. Scalar and vector triple product. Product of four vectors. Reciprocal vectors. Simple applications to geometry. Vector equations of straight line, plane and circle. Applications to mechanics: work done, torque.

Unit-II(20+20=40)

(Abstract Algebra & Linear)

1. Revision of set theory, relation and mapping. Equivalence relation, partition of a set, equivalence classes, composition of functions. Congruence modulo n. Binary operation. Group Theory: Group, Abelian group, identity and inverse element in a group is unique. Subgroups, necessary and sufficient condition of a non-empty subset of a group is a subgroup, cyclic group, order of a group and order of an element.

2. Rings and Fields: Properties of Rings directly following from the definition, Unitary and commutative rings. Divisors of zero, Integral domain, Every field is an integral domain, every finite integrals domain is a field. Definitions of Sub-ring and sub-field. Statement of Necessary of sufficient condition for a subset of a ring (field) to be sub-ring (resp. subfield). Matrix: Matrices of real and complex numbers : Algebra of matrices. Symmetric and skew-symmetric matrices, Solution of linear equation with not more than three unknown by matrix method. Rank of a matrix. Characteristics polynomial, characteristics equations, Eigen value & Eigen Vector. Cayley Hamilton theorem(statement only).

3. Vector space/Linear space (Def. and examples), Linear combination, independence and dependence, linear span, basis and dimention (Def. and examples). Subspace (Def. and examples), intersection and union of subspaces, linear sum of two subspaces, direct sum of subspaces, dimension of sum and subspaces. Linear transformation and their representation as matrices, kernal and range of a linear transformation, the algebra of linear transformations, the rank nullity theorem(statement only).

Reference:

1. Advanced Higher Algebra: Ghosh and Chakraborty, U. N, Dhur.
2. Algebra: R.M.Khan, Central
3. Higher Algebra: Mapa, Ashok Pub.
4. Cordinate Geometry: S.B.Sengupta

B.A. / B. Sc. Semester-II (General)
MATHEMATICS
Paper-II
Mark : 20+80=100

Unit-I(20+20=40)
Differential Calculus

1. Idea of $\varepsilon-\delta$ definition of limit and continuity of a function. Indeterminate forms, statement of L'Hospital rule and its applications. Successive differentiation, leibnitz's theorem and its applications. Rolle's theorem and its geometric interpretation. Mean value theorem of Lagrange and Cuchy. Geometric interpretation of Lagrange's mean value theorem Statement of Taylor's and Maclaurin's theorem with Lagrange's and Cauchy's form of remainder. Taylor's and Maclaurin's series (Statement only). Expansions of functions in finite and infinite series like sin(X), Cos(X), exp(X), a_x, $(1+x)_n$, log(1+x) (with restrictions whenever necessary)

2. Sequence and series: Limit of sequence. Convergent and non convergent Cauchy sequence. Convergence of infinite. Statement and use of different tests for convergence of series of non-negative terms.

3. Functions of several variables: Limits and continuity (definition and examples only), Partial derivative. Total differentials. Statement of Schwartza and Youns's theorem on commutative property of mixed derivative. Euler's theorem of homogeneous functions of two variables. Statement of Taylor's theorem for functions of two variables. Jacobian, maxima, minima, saddle points of functions of two points (examples only). Application : Tangent normal sub tangent and sub normal. Length of tangent and normal. Differential of are length. Curvature and rectilinear asymptote for Cartesian and polar curve.

Unit-II(20+20=40)
Integral Calculus

1. Definition of improper integrals, example. Definition and simple properties of beta & Gamma functions & their uses (convergence and important relations being assumed)

3. Reduction formulae such as $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int \sin^n x \cos^m x dx$, $\int \sin^n x \cos mx dx$ etc where m and n are non-negetive inetegers.

4.1 Rectification of plane curves. Volume and surface area of solid formed by revolution of plane curves and areas about x-axis and y-axis.

4.2 Working knowledge of double and triple integrals, change of order of integration.

4.3 Differentiability and integrability of an integral of a function of a parameter. Differentiability under the sign of integration, statements of necessary theorems. Centroid. Centroid of arc, plane area, volume and surface area of revolution.

Reference:

1. Differential Calculus: Das and Mukherjee, U.N.Dhur
2. Integral Calculus: Das and Mukherjee, U.N.Dhur

B.A. / B. Sc. Semester-III (General)
MATHEMATICS
Paper-III
Mark : 20+80=100

Unit-I(20+20)
(Geometry-Two Dimension and Three Dimension)

1. Transformation of rectangular axes, translation, rotation and their combinations, theory of invariants. General equation of second degree in two variables, reduction into canonical form, lengths and position of the axes. Pair of straight lines: Condition that the general equation of second degree in two variables may represent a pair of straight lines. Point of intersection of two intersecting straight lines, angle between two lines given by $ax_2+2hxy+by_2$, equation of bisectors of the angle between the pair of straight lines, equation of two lines joining the origin to the point in which two curves meet. Polar coordinates, polar equation of straight lines, circles and conic referred to a focus as pole, equation of chord, tangent and normal.

2. Rectangular Cartesian co-ordinates in space, concept of geometric vector (directed line segment), projection of vector on a co-ordinate axis, inclination of a vector with an axis, co-ordinates of a vector, direction ratio and direction cosine of a vector. Distance between two points, division of directed line segment in given ratio. Equation of a plane in general form, intercept and normal form, signed distance of a point from a plane, equation plane passing through the intersection of two planes, angle between two intersecting planes, parallel and perpendicularity of two planes.

3. Straight lines in space, equation in symmetric and parametric form, canonical equation of line of intersection of two intersecting planes, angle between two lines, distance of a point from a line, condition of coplanarity of two lines. General equation of sphere , circle, sphere through the intersection of two sphere, radical plane, tangent, normal.

References:

1. Co-ordinate Geometry-S.B.Sengupta.
2. Co-ordinate Geometry-S.L.Lony, Macmillan and Co.

Unit-II(20+20=40)
(Differential Equations)

1. Significance of ordinary differential equation. Geometrical and physical consideration. Formation of differential equation by elimination of arbitrary constant. Meaning of the solution of ordinary differential equation. Concept of linear and non-linear differential equations. Equations of first order and first degree : Statement of existence theorem. Separable, Homogeneous and Exact equation. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevant results only),Equations reducible to first order linear equations.

2. Equations of first order but not of first degree, Clairaut's equation, Singular solution, Applications : Geometric applications, Orthogonal trajectories. Higher order linear equations with constant co-efficients : Complementary function, Particular Integral, Symbolic operator D.

3. Method of undetermined co-efficients, Method of variation of parameters. Euler's homogeneous equation and Reduction to an equation of constant coefficients. Ordinary simultaneous differential equations.

References:

1. Differential Equations: Ghosh and Chakraborty, U.N.Dhur
2. Differential Equations: M.D.Raisinghania, S. Cand.

B.A. / B. Sc. Semester-I (Honours)
MATHEMATICS
Paper-I
Mark : 20+80=100

Unit-I(20)
(Classical Algebra & Number Theory)

1. Inequalities : A. M. ≥G.M ≥ H.M. Their generalization like the theorem of weighted mean and m^{th} power theorem. Statement of Cauchy-Schwartz inequality, Weierstrass inequality and their application. DeMoivre's theorem and its applications. Expotential sine, cosine and logarithm of complex number.

2. Direct and inverse circular and hyperbolic functions. Expansion of trigonometrical functions. Gregory's series. Summation of series. Statements of well ordering principle, first principle of mathematical induction, second principle of mathematical induction. Proofs of some simple mathematical results by induction. The division algorithm, The greatest common divisor (g.c.d.) of two integers a and b. Relatively prime integers.

3. The equation ax+ by = c has integral solution iff (a,b) divides c. (a , b, c are integers). Prime numbers. Euclid's first theorem: If some prime p divides ab, then p divides either a or b. Euclid's second theorem: There are infinitely many prime integers. Unique factorization theorem. Statement of Chinese Remainder Theorem and simple problems. Euler ϕ function.

Unit-II(20)
(Abstract Algebra-I)

1. Set theory: Revision of set theory and algebra, relation and mapping. Order relations, equivalence relations and partitions. Congruence modulo n. Further theory of sets and mapping, Cardinality of sets, countable and uncountable sets, $\aleph_0$ and $\aleph_1$. Binary operation.

2. Group Theory: Semi-group, Definition, examples and simple properties of Group, Some special groups like Z_n, U(n), Dihedral groups, etc., Abelian group. Subgroup, the necessary and sufficient condition of a non-empty subset of a group is a subgroup, intersection and union of two subgroups.

3. Cyclic groups and its various properties. Order of a group and order of an element of a group, Permutation : Cycle, transposition, Statement of the result that every permutation can be expressed as a product of disjoint cycles. Even and odd permutations, Permutation Group. Symmetric group. Alternating Group. Order of an alternating group.

UNIT-III(20)
(Abstract Algebra-II)

1. Group Homomorphism, Automorphism, Endomorphism and Isomorphism. Cosets and their various properties, index of a subgroup, Lagrange's theorem and its applications, Normal subgroups:Definition, examples and properties.

2. Rings and Fields: Properties of Rings directly following from the definition, Unitary and commutative rings. Divisors of zero, Integral domain, Every field is an integral domain, every finite integrals domain is a field.

3. Definitions of Sub-ring and sub-field. Necessary of sufficient condition for a subset of a ring (field) to be sub-ring (resp. subfield). Characteristic of ring and integral domain. Ring and field Homomorphism, Isomorphism. Quotient-ring.

Unit-IV(20)
(Vector Algebra)

1 Vector Algebra: Vector (directed line segment) Equality of two free vectors. Addition of Vectors. Multiplication by a Scalar. Position vector. Point of division. Conditions of collinearity of three points and co-planarity of four points. Rectangular components of a vector in two and three dimensions. Product of two or more vectors. Scalar and vector products, scalar triple products and Vector triple products. Product of four vectors.

2. Direct application of Vector Algebra in (i) Geometrical and Trigonometrical problems (ii) Work done by a force, Moment of a force about a point.

3. Vector equations of straight lines and planes. Volume of a tetrahedron. Shortest distance between two skew lines.

Reference:

1. Advanced Higher Algebra: Ghosh and Chakraborty, U.N.Dhur.
2. Algebra: R.M.Khan, Central
3. Higher Algebra: Mapa, Ashok Pub.
4. Number Theory: S.B.Malik, New Age Pub.
5. Cordinate Geometry: S.B.Sengupta

B.A. / B. Sc. Semester-II (Honours)
MATHEMATICS
Paper-II
Mark : 20+80=100

Unit-I (20)
(Linear Algebra-I)

1 Matrix: Matrices of real and complex numbers : Algebra of matrices. Symmetric and skew-symmetric matrices. Hermitian and skew-Hermitian matrices. Orthogonal matrices. Inverse of a Matrix, Solution of linear equation with not more than three unknown by matrix method. Rank of a matrix, Row rank, Column Rank, determination of rank either by considering minor or sweep out process. Row rank = column rank = Rank of the matrix, Rank (A+B)<RankA + RankB, Rank(AB)< Min(RankA, RankB)(statement only).

2. Characteristics polynomial & minimal polynomials, characteristics equations, Eigen value & Eigen Vector. Cayley Hamilton theorem(statement only), Simple properties of eigenvalues and eigenvectors.

3. Vector / Linear space : Definitions and examples, Subspace, Union and intersection of subspaces. Linear sum of two subspaces.

Unit II (20)
(Linear Algebra-II)

1. Linear combination, independence and dependence. Linear span. Basis of vector space. Finite dimensional vector space. Replacement Theorem, Extension theorem, Statement of the result that any two bases of a finite dimensional vector space have same number of elements. Dimension of a vector space. Extraction of basis, formation of basis with special emphasis on $R^n (n \leq 4)$.

2. Row space and column space of matrix. Row rank and column rank of matrix. Equality of row rank, column rank and rank of a matrix. Linear homogeneous system of equations : Solution space. For a homogeneous system AX = 0 in n unknowns, Rank X(A) + Rank A = n; AX = 0

contains non-trivial solution if Rank A < n. Necessary and sufficient condition for consistency of a linear non-homogeneous system of equations. Solution of system of equations (Matrix method).
3. Linear transformations and their representation as matrices. The algebra of linear transformations. rank and nullity theorem.

Reference:

1. Advanced Higher Algebra: Ghosh and Chakraborty, U. N. Dhur.
2. Algebra: R.M.Khan, Central
3. Higher Algebra: Mapa, Ashok Pub.

Unit-III(20)

(Geometry-Two Dimension)

1 Transformation of rectangular axes, translation, rotation and their combinations, theory of invariants. General equation of second degree in two variables, reduction into canonical form, lengths and position of the axes.

2 Pair of straight lines: Condition that the general equation of second degree in two variables may represent a pair of straight lines. Point of intersection of two intersecting straight lines, angle between two lines given by $ax_2+2hxy+by_2$, equation of bisectors of the angle between the pair of straight lines, equation of two lines joining the origin to the point in which two curves meet.

3 Polar coordinates, polar equation of straight lines, circles and conic referred to a focus as pole, equation of chord, tangent and normal.

Unit-IV(20)

(Geometry-Three Dimension)

1 Rectangular Cartesian co-ordinates in space, concept of geometric vector (directed line segment), projection of vector on a co-ordinate axis, inclination of a vector with an axis, co-ordinates of a vector, direction ratio and direction cosine of a vector. Distance between two points, division of directed line segment in given ratio. Equation of a plane in general form, intercept and normal form, signed distance of a point from a plane, equation plane passing through the intersection of two planes, angle between two intersecting planes, parallel and perpendicularity of two planes.

2 Straight lines in space, equation in symmetric and parametric form, canonical equation of line of intersection of two intersecting planes, angle between two lines, distance of a point from a line, condition of coplanarity of two lines, shortest distance between two skew lines.

3 General equation of sphere , circle, sphere through the intersection of two sphere, radical plane, tangent, normal. General equation of cone and cylinder, right circular cone and cylinder.

References:

1. Co-ordinate Geometry-S.B.Sengupta.
2. Co-ordinate Geometry-S.L.Lony, Macmillan and Co.

B.A. / B. Sc. Semester-III (Honours)
MATHEMATICS
Paper-III

Mark : 20+80=100

UNIT I(20)

(Calculus-I)

1. Limit and continuity of a real valued function at a point (the point must be a limit point of the domain set of the function). Algebra of limits. Sandwich rule. Continuity of composite functions. Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and maintenance of same sign. Continuous function on [a,b] is bounded and attains its bounds. Intermediate value theorem.

2. Discontinuity of function, type of discontinuity. Step function. Piecewise continuity. Monotone function. Monotone function can have only jump discontinuity. Set of points of discontinuity of a monotone function is at most countable. Definition of uniform continuity and examples. Lipschitz condition and uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous.

3. Infinite Series of real numbers: Convergence, Cauchy's criterion of convergence. Series of non-negative real numbers: Tests of convergence – Cauchy's condensation test. Comparison test (ordinary form and upper limit and lower limit criteria), Ratio Test , Root test, Raabe's test, Bertrand's test, Logarithmic test and Gauss's test. Alternating series, Leibnitz's test. Absolute and conditional convergent series. Rearrangement of series through examples.

Unit-II(20)

(Calculus-II)

1. Definition of differentiability. Meaning of sign of derivative. Chain rule.
Successive differentiation : Leibnitz theorem and its applications. Statement of L' Hospital's rule and its applications. Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy – as an application of Rolle's theorem.

2. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Maclaurin's theorem as a consequence of Taylor's theorem. Statement of Maclaurin's Theorem on infinite series expansion. Expansion of e^x, $\log(1+x)$, $(1+x)^m$, $\sin x$, $\cos x$ with their range of validity.

3. Functions of several variables: Limits and continuity (definition and examples only), Partial derivative. Total differentials. Statement of Schwartzs and Young's theorem on commutative property of mixed derivative. Euler's theorem of homogeneous functions of two variables. Statement of Taylor's theorem for functions of two variables.

Unit-III(20)

(Calculus-III)

1. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. Jacobian, maxima, minima, saddle points of functions of two variables (example only).

2. Tangent, normal, sub tangent and sub normal. Length of tangent and normal. Angle of intersection of curves. Pedal equation of a curve, pedal of a curve. Differential of arc lrngth. Curvature-Radius of curvature, centre of curvature, chord of curvature, evolute of a curve. Rectilinear asymptotes for Cartesian and polar curves. Envelopes of families of straight lines and curves (Cartesian and parametric equations only).

3. Reduction formulae such as $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int \sin^n x \cos^m x dx$, $\int \sin^n x \cos mx dx$ etc.

References:

1. Differential Equations: Ghosh and Chakraborty, U.N.Dhur
2. Differential Equations: M.D.Raisinghania, S. Cand.

Unit-IV(20)
(Vector Calculus)

1 Vector function, limit and continuity, derivative of vector, derivative of sums and product of vector functions. A necessary and sufficient condition that a proper vector $\hat{a}$ (i) has a constant length that $\hat{a}.d\hat{a}/dt = 0$, (ii) always remains parallel is that $\hat{a} \times d\hat{a}/dt = \hat{O}$.

2 Vector integration, scalar and vector fields, directional derivatives, gradient of a scalar point function, ∇ operator, divergence, curl and Laplacian.

3 Line, surface and volume integral. Gauss's, Stoke's theorem and problem based on these.

References:

Vector Analysis-Maity and Ghosh, New Central Book Agency.
Vector Analysis- Schaum's series, Tata McGrawHill

B.A. / B. Sc. Semester-IV (Honours)
MATHEMATICS
Paper-IV
Mark : 20+80=100

Unit-II(20)
(Differential Equations-I)

1. Significance of ordinary differential equation. Geometrical and physical consideration. Formation of differential equation by elimination of arbitrary constant. Meaning of the solution of ordinary differential equation. Concept of linear and non-linear differential equations. Equations of first order and first degree : Statement of existence theorem. Separable, Homogeneous and Exact equation. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevant results only),Equations reducible to first order linear equations.

2. Equations of first order but not of first degree, Clairaut's equation. Singular solution. Applications : Geometric applications, Orthogonal trajectories. Higher order linear equations with constant co-efficients : Complementary function, Particular Integral, Symbolic operator D.

3. Method of undetermined co-efficients, Method of variation of parameters. Euler's homogeneous equation and Reduction to an equation of constant coefficients.

Unit-II(20)
(Differential Equations-II)

1. Exact differential equations of higher order, method of solution, Non-linear exact equations, linear equations of some special forms.