UNIVERSITY DEPARTMENT OF MATHEMATICS

SIDO KANHU MURMU UNIVERSITY

DUMKA

Syllabus

for

B.Sc. (Hons.) Mathematics

under

Choice Based Credit System

2017

Scheme for Choice Based Credit System in B.Sc. (Hons.) Mathematics

Semester	Core Course (C-14)	Ability Enhancement Compulsory Course (AECC-2)	Skill Enhancement Course (SEC-2)	Discipline Specific Elective (DSE-4)	Generic Elective (GE-4)
1.	C-1 Set Theory and Abstract Algebra C-2 Trigonometry and Linear Algebra	AECC-1			GE-1 1. Algebra 2. Trigonometry
2.	C-3 Differential Calculus and Two dimensional Geometry C-4 Integral Calculus and Three dimensional Geometry	AECC-2			GE-2 1. Differential Calculus 2. Integral Calculus
3.	C-5 Real Analysis C-6 Infinite Series C-7 Ordinary differential Equation		SEC-1 (choose any one) 1. Logic and Sets 2. Computer Graphics		GE-3 1. Set Theory 2. Abstract Algebra
4.	C-8 Vector Analysis C-9 Partial differential Equation C-10 Statics and Dynamics		SEC-2 (choose any one) 1. Graph Theory 2. Computer Programming in C		GE-4 1. Ordinary differential Equation 2. Real Analysis
5.	C-11 Real Analysis C-12 Complex Analysis and Optimization			DSE-1 (choose any one) 1. Metric Space and Topological Space 2. Industrial Mathematics DSE-2 (choose any one) 1. Mechanics 2. Probability and Statistics	
6.	C-13 Abstract Algebra and Ring Theory C-14 Vector Space and Numerical Analysis			DSE-3 (choose any one) 1. Theory of Equations 2. Bio-Mathematics DSE-4 (choose any one) 1. Spherical Trigonometry and Spherical Astronomy 2. Differential Geometry	

(Dr. D.N. Garain)
Head, Univ. Deptt. Of Maths & Chairman

(Dr. P.K. Parida)
Central University of Jharkhand External Member

(Dr. N.K. Singh)
Member

(Dr. S.N.Adhikary)
Member

(Zia ul Hoque)
Member

(P) means course with practical

Discipline Specific Electives (DSE)

Choices for DSE 1 (choose one)

1. Metric Space and Topological Space
2. Industrial Mathematics

Choices for DSE 2 (choose one)

1. Mechanics
2. Probability and Statistics

Choices for DSE 3 (choose one)

1. Theory of Equations
2. Bio-Mathematics

Choices for DSE 4 (choose one)

1. Spherical Trigonometry and Spherical Astronomy
2. Differential Geometry

Skill Enhancement Course (SEC)

Choices for SEC 1 (choose one)

1. Logic and Sets
2. Computer Graphics

Choices for SEC 2 (choose one)

1. Graph Theory
2. Computer Programming in C

Generic Electives (GE)

Choices for GE 1

1. Algebra
2. Trigonometry

Choices for GE 2

1. Differential Calculus
2. Integral Calculus

Choices for GE 3

1. Set Theory
2. Abstract Algebra

Choices for GE 4

1. Ordinary differential Equation
2. Real Analysis

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FULL MARKS: 80 **TIME: 3 hours**

Nine questions will be set out of which candidates are required to answer ***five*** questions.
Question number **1** is compulsory consists of ***eight*** short answer type questions each of ***two*** marks covering entire syllabus uniformly .Rest four questions each of ***sixteen*** marks (may be divided into two parts 8+8 marks) will be answered selecting at least one from each unit.

C-1

Set theory :- Cartesian product of sets, Relation, Kinds of Relation, partition of a set, Fundamental theorem of equivalence relation, Mapping.

Abstract Algebra :- Group, Properties of groups, subgroup, and cyclic group, Definitions and examples of Ring, Field and Integral domain.

C-2

Trigonometry :- Application of De-Moive's Theorem, Complex Argument, Gregoryh Series, Hyperbolic functions and summation of Series.

Linear Algebra :- Adjoint and Inverse of a matrix, Orthogonal matrix, Rank, Solution of Simulataneous linear equation.

Books Recommended

Trigonometry	:-	Das and Mukherjee
Trigonometry	:-	Lalji Prasad
Matrix	:-	A. R. Vasishtha
Set theory	:-	K. K. Jha
Set theory	:-	A. R. Vasishtha
Abstract Algebra	:-	K. K. Jha
Abstract Algebra	:-	A. R. Vasishtha

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C-3

Differential Calculus :- Successive differentiation and Leibnitz Theorem, Partial Differentiation and Euleris Theorem, Tangants and Normals, Curvature.

Two dimensional Geometry :- System of Circles, Standard equation of Parabola, Hyperbola and Ellipse, Polar equation of Conics.

C-4

Integral Calculus :- Indefinite Integral, Definite Integral, Reduction Formula, Area (Both Cartisian and Polar curve).

Three dimensional Geometry :- Direction Cosine and Direction ratio, Straight line, Plane, Shortcut distance between two skew Straight line and related problem**.**

Books Recommended

Integral Calculus	:-	Lalji Prasad
Integral Calculus	:-	Das and Mukherjee
Solid Geometry	:-	Lalji Prasad
Differential Calculus	:-	Prasad and Mishra
Differential Calculus	:-	Lalji Prasad
Co-ordinate Geometry	:-	M. L. Khanna

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C-5

Real Analysis :- Limits, continuity and Differentiability of a function of Single Variable, Rolle's theorem, Lagranges Mean value theorem, Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, and limit of a sequence.

C-6

Infinite Series :- Convergence and divergence of a series, Absolute and conditional convergence.

C-7

Ordinary differential Equation :- Formation of differential equation, order and degree of a differential equation, Differential equation of first order and first degree, Differential equation of first order but not first degree, Equation in which the Variables and Separable, Homogenous equations, Linear equations and equations reducible to the linear form, Exact Differential equations. First order higher degree, equations solvable for x, y, p, Clairaut's form and singular Solutions .

Books Recommended

Real Analysis	:-	Dr. A. Mukherjee & Dr. R.K. Choudhary
Real Analysis	:-	Dr. K.K. Jha
Real Analysis	:-	J. N. Sharma
Ordinary differential Equation	:-	Garrett Birkhoff Gian Carlo Rota
Differential Equation	:-	Gupta, Malik, Mittal & Pundir

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C-8

Vector Analysis :- Scalar and vector product of three and four vectors, reciprocal vectors, Application of vectors to mechanics - moment of a localised vector about a directed line, work done by a force, Vector differentiation and elementary properties, gradient, divergence and curl.

C-9

Partial differential Equation :- Partial differential Equation of first order, Langrange's solution, Charpit general method of solution, Partial differential Equation of 2^{nd} order, classification of linear partial differential Equation of 2^{nd} order, Homogenous equations with constant co-efficients, Partial differential Equations reducible to those with constant co-efficients, Monge's method.

C-10

Statics :- Principle of virtual work for a system of coplanar forces, Common catenary and its properties.

Dynamics :- Simple harmonic motion, velocities and acceleration (radial, transverse, tangential and Normal) of a particle in motion on a plane, Motion of a particle under central force, central Orbits, Kepler's laws of planetary motion (statement only).

Books Recommended

Vector Analysis	:-	Dr. K.K. Jha
Partial differential Equation	:-	J. N. Sharma & Kehar Singh
Statics	:-	M. Roy & H. S. Sharma
Dynamics	:-	R. K. Gupta
Dynamics	:-	Nand, Tyagi & Sharma
Statics	:-	Goyal and Gupta

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C-11

Real Analysis :- Repeated and simultaneous limits of a real valued function of two variables, Continuity, Partial derivation and differentiability, Schwarz and Young's theorem, Implicit function theorem. Fourier series and its convergence, Fourier series expansion of piecewise monotonic Functions. Riemann integral, integrability of continuous and monotonic functions, fundamental theorem of integral calculus, mean value theorems of integral calculus. Improper integrals and their convergence, comparison tests, Abel's and Dirichlet's tests, Beta and Gamma functions and their relations, differentiation of an integral of a function of one parameter.

C-12

Complex Analysis :- Complex numbers as ordered pairs, geometrical representation of complex numbers, Continuity and differentiability of complex functions. Cauchy Riemann equations, harmonic functions. Elementary functions, mapping by elementary functions, Mobius transformation, fixed points, cross ratio, Inverse and critical points, continuous mapping.

Optimization :- The linear programming problem, problem formulation, L. P. in matrix form, Feasible And optimum solutions of L. P. P., some basic properties of convex sets, examples of convex sets. Graphical solution of L. P. P., Theory and application of simplex method solution of L. P. P.

Books Recommended

Complex Analysis	:-	Laljee Prasad
Complex Analysis and Application	:-	Ruel V. Chuchchila
Linear Programming	:-	G. Hadley
Real Analysis	:-	Shanti Narayan
Real Analysis	:-	N. P. Bali

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C-13

Abstract Algebra :- Coset decomposition, Lagrange's theorem, Homomorphism and isomorphism, Elementary idea of normal subgroups, quotient groups, centre of a group, fundamental theorem of Group homomorphisms. Automorphism, inner automorphism, automorphism groups and their computations, Conjugacy reletion and normalizer, counting principle and the class equation of finite groups

Ring Theory :- Definition and examples of rings, properties of rings, subrings, characteristic of a ring. Ideals and quotient ring, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms, field of quotients of an integral domain, polynomial rings, embedding of rings and integral domain in suitable rings and fields, Euclidean rings, unique factorization domain.

C-14

Vector Space :- Definition and examples of vector spaces, subspaces, algebra of subspaces, quotient spaces , linear combination of vectors, sums and direct sums of subspaces, linear span, linear dependence and independence and their basic properties, basis, existence theorem for bases, invariance of the number of elements of a basic set.

Numerical Analysis :- Solution of equations – Method of Bisections, Regula Falsi method, Newton Raphson method,

Linear equation – Gauss elimination method, Choleske's method, Gauss seidel method, method of Relaxation.

Ordinary Differential Equations - Euler's method, single step method, Runge - Kutta method, Milne – Simpson method.

Books Recommended

Numerical Analysis	:-	Jain & Iyengar Jain
Numerical Analysis	:-	Laljee Prasad
Abstract Algebra	:-	A.R. Vasistha
Vector Space	:-	A.R. Vasistha
Abstract Algebra	:-	Laljee Prasad

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GE-1

1. Algebra :- Adjoint and Inverse of a matrix, Orthogonal matrix, Rank Solution of Simulataneous linear equation, Eigen value and Eigen vector.

2. Trigonometry :- Application of De-Moive's Theorem, Gregoryh Series, Hyperbolic functions and summation of Series.

Books Recommended

Trigonometry	:-	Das and Mukherjee
Trigonometry	:-	Lalji Prasad
Matrix	:-	A. R. Vasishtha
Matrics	:-	M. D. Raisinghania, H. E. Saxena a nd H. K. Das

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GE-2

1. Differential Calculus :- Successive differentiation and Leibnitz Theorem, Partial Differentiation and Euleris Theorem, Tangants and Normals, Curvature.

2. Integral Calculus :- Indefinite Integral, Definite Integral, Reduction Formula, Area (Both Cartisian and Polar curve).

Books Recommended

Integral Calculus	:-	Lalji Prasad
Integral Calculus	:-	Das and Mukherjee
Differential Calculus	:-	Prasad and Mishra
Differential Calculus	:-	Lalji Prasad

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GE-3

1. Set Theory :- Cartesian product of sets, Relation, Kinds of Relation, partition of a set, Fundamental theorem of equivalence relation, Mapping

2. Abstract Algebra :- Group, Properties of groups, subgroup, and cyclic group, Definitions and examples of Ring, Field and Integral domain.

Books Recommended

Set theory	:-	K. K. Jha
Set theory	:-	A. R. Vasishtha
Abstract Algebra	:-	K. K. Jha
Abstract Algebra	:-	A. R. Vasishtha

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GE-4

1. Ordinary differential Equation :- Formation of differential equation, order and degree of a differential equation, Differential equation of first order and first degree, Differential equation of first order but not first degree, Equation in which the Variables and Separable, Homogenous equations, Linear equations and equations reducible to the linear form, Exact Differential equations. First order higher degree, equations solvable for x, y, p, Clairaut's form and singular Solutions.

2. Real Analysis :- Limits, continuity and Differentiability of a function of Single Variable, Rolle's theorem, Lagranges Mean value theorem, Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, and limit of a sequence.

Books Recommended

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DSE-1 (choose any one)

1. Metric Space and Topological Space :- Definition and examples of metric spaces, neighbourhoods, interior points, limit points, open sphere, open and closed sets closure and interior. Convergent and Cauchy sequences. Completeness, contraction principle, real number system as a complete metric spaces, real numbers as complete ordered field, dense subsets, Baire's Category theorem. Definition and examples of topological spaces, open sets, closed sets, neighbourhood, closure and interior and their properties, limit points, derived sets and properties. Relative topology and sub – spaces, base and subbase , comparison of topologies. Continuity and Homeomorphism and their characterization by closed sets, closure, basic and Subbasic open sets. Compactness, characterization of compactness by closed sets, compactness and continued Mappings. Notion of connectedness, continuity and connectedness, connectedness of real line. Separation axioms (T_0, T_1, T_2)

2. Industrial Mathematics :-

Medical Imaging and Inverse Problems. The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices. Introduction to Inverse problems : Why should we teach Inverse Problems ? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth's interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.

X-ray : Introduction, X - ray behavior and Beers Law (The fundament question of image construction) Lines in the place.

Radon Transform :- Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms).

Back Projection :- Definition, properties and examples.

Books Recommended

Topology :- J. N. Sharma

Advanced Topology :- Dr K. K. Jha

An Introduction to the Mathematical Theory of Inverse Problems :- Andreas Kirsch

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DSE-2 (choose any one)

1. Mechanics :-

Analytical conditions of equilibrium of coplanar forces, forces in three dimension, Central axis, Null lines and planes, stable and unstable equilibrium.

Elastic string and Hook's law, Central orbit, Newtonion Law of graviatation and kepler's laws of motion.

Law of motion and simple pendulum, Motion of particle (in a plane) under inverse square law .

2. Probability and Statistics :-

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions : uniform, binomial, Poisson, geometric, negative binomial, continuous distributions : uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance.

Books Recommended

Introduction to Mathematical Statistics :- Robert V. Hogg, Joseph W. McKean and Allen T. Craig

Mathematical Statistics with Applications :- Irwin Miller and Marylees Miller, John E. Freund

Mechanics :- Dinesh

Statics :- Dr. Md Motiur Rahman

Statics :- S. L. Loney

Dynamics of Rigid Bodies :- Nand, Tyagi & Sharma

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DSE-3 (choose any one)

1. Theory of Equations :- General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, Elementary properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations. Symmetric functions of the roots, Transformation of equations. Solutions of cubic equations (Cardon's method) Solution of biquadratic equations.

Solution of numerical equations (Newton's and Horner's method)

2. Bio-Mathematics :-

Mathematical Biology and the modeling process : an overview. Continuous models : Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis -Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC).

Activator-Inhibitor system, Insect Outbreak Model : Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models : Steady state solutions, stability and linearization, multiple species communities and Routh - Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial Models : One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population.

Books Recommended

Theory of Equation	:-	M.L. Khanna
Theory of Equation	:-	Laljee Prasad
The Theory of Equations	:-	W.S. Burnside and A.W. Panton
Theory of Equations	:-	C. C. MacDuffee
Mathematical Models in Biology	:-	L.E. Keshet
Mathematical Biology	:-	J. D. Murray

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DSE-4 (choose any one)

1. Spherical Trigonometry :-

Spherical triangle, fundamental formulas (Sine, Cosine, Sine-cosine, Cotangent) and polar triangles. Delambre's and Napier's analogies, right angled triangle and Napier's rule.

Spherical Astronomy :-

Calestial sphere – Definitions of basic terms, different co-ordinate systems and conversion of one System into another, rising and setting of stars.

Twilight – Condition of twilight to last whole night, problems relating to twilights.

Refraction – Refraction, Simpson's, Bradley's and Cassini's formula, effect of Refraction in the position of a body.

Kepler's Law – Kepler's law of planetary motion, energy integral, Laplace integral.

2. Differential Geometry :-

Theory of Space Curves : Space curves, Planer curves, Curvature, torsion and Serret – Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Theory of Surfaces : Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Developables : Developable associated with space curves and curveson surfaces, Minimal surfaces.

Geodesics : Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss - Bonnet theorem.

Books Recommended

Spherical Trigonometry :- M. L. Khanna
Spherical Astronomy :- M. L. Khanna
Spherical Astronomy :- G. S. Malik
Astronomy :- K. K. Dey
Differentional Geometry of Three diamension :- C. E. Weatherburn
Differentional Geometry :- Mital and Aggarwal

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SEC-1 (choose any one)

1. Logic and Sets :-

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence : Logical equivalences. Predicates and quantifiers : Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and Infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. countability of a set.

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation : Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, equivalence relations, Partial ordering relations, n-ary relations, lattices.

2. Computer Graphics :-

Development of computer Graphics : Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

Points, lines and curves : Scan conversion, line - drawing algorithms, circle and ellipse generation, Conic - section generation, polygon filling anti aliasing.

Two dimensional viewing : Coordinate systems, linear transformations, line and polygon clipping algorithms.

Books Recommended

Naive Set Theory	:-	P.R. Halmos
Theory of Sets	:-	E. Kamke
Computer Graphics	:-	D. Hearn and M.P. Baker
Procedural Elements in Computer Graphics	:-	D.F. Rogers
Mathematical Elements in Computer Graphics	:-	D.F. Rogers and A.J. Admas

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SEC-2 (choose any one)

1. Graph Theory :-

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi−Partite graphs, isomorphism of graphs.

Eulerian circuits, Eulerial graph, semi Eulerian graph, theorems, Hamiltonian cycles theorems.

Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph.

Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.

2. Computer Programming in C :-

Introduction to Computers, Block Diagram of Computer, Functioning of Computer, Generations of Computer, Classification of Computers, Characteristics, Advantages & Limitations of Computer. Computer Memory, Primary & Secondary, Types of Primary Memory.

Number System, Decimal, Binary, Octal, Hexadecimal number systems, features and conversions, binary arithmetic, ASCII & EBCDIC codes. Algorithm and Flow chart, Algorithm for problem solving, An Introduction, Properties of an algorithm, Classification, Algorithm logic, Flowchart.

C Programming, An overview of Programming, Programming language classification, history of C, inpotance of C, basic structure of C programme, excuting a C programme, compiling and linking.

Scalar data types, Declarations, Different types of integers, Different kinds of integer constants, Floating point types, Initialization, Mixing ypes Enumeration types, The void data type, Typedefs, Find the address of an object, Pointers.

Operators and expressions, introduction, arithmatic operators, relational operators, logical operators, assignment operators, increment and decrement operator, Bitwise operators, Arithmetic expressions, evaluation of expression, precedence of arithmetic operators.

Books Recommended

Introduction to Lattices and Order	:-	B. A. Davey and H. A. Priestley
Discrete Mathematics with Graph Theory	:-	Edgar G. Goodaire and Michael M. Parmenter
Fundamental of Computer Sciences	:-	Pundir & Pundir
programming in C	:-	S. Dey
programming in C	:-	V. Rajaraman
programming in C	:-	Balaswamy

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