

RAJA NARENDRA LAL KHAN WOMEN'S COLLEGE (AUTONOMOUS)



Proposed Syllabus of 4 years
Bachelor of Science (Honours) in Mathematics
[w.e.f 2024-25]
[under NEP-2020]

SEMESTER-III

Raja N.L Khan Women's College (Autonomous)
Gope Palace, Midnapore- 721 102, West Bengal

➤ Semester - III

Course Type	Course Code	Course Details		L-T-P	Credit	Marks Distribution			
						IA	CA	ESE	Total
MAJOR-03	MTMHMJ-301	Group-A	Algebra-I	3-1-0	4	10	5	60	75
		Group-B	Group Theory-I						
	MTMHMJ-302	Real Analysis-I	3-1-0	4	10	5	60	75	
SEC	MTM SEC-03		MATLAB	2-1-1	3	5	5	40	50
MINOR-03	MTM MI-301	Group-A	Calculus	3-1-0	4	10	5	60	75
		Group-B	Geometry						
		Group-C	Linear Algebra-I						

SEC-Skill Enhancement Course, L-T-P=Lecture-Tutorial-Practical, IA-Internal Assessment; CA-Class Attendance; ESE-End Semester Examination

MAJOR-03

Course Code: MTMHMJ-301

Course Title: Algebra--I & Group Theory-I

Credit: 04

No of Lectures: 60 hours

Full Marks: 75

Group-A: Algebra-I

Marks: 23

Equivalence relations, functions, composition of functions, Invertible functions, one to one correspondence and cardinality of a set. Well-ordering property of positive integers, division algorithm, divisibility and Euclidean algorithm. Congruence relation between integers. principles of mathematical induction, statement of fundamental theorem of arithmetic, arithmetic functions, some arithmetic functions such as ϕ , σ , τ and their properties

Group-B : Group Theory-I

Marks: 37

Unit-I: Binary operation, definition of group, example of groups, elementary properties of groups, symmetries of a square, dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices), elementary properties of groups.

Unit-II: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Unit-III: Abelian groups, cycle groups, properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

Text Books:

- M.K.Sen, S. Ghosh, P. Mukhopadhaya & S. K. Maity, Topics in Abstract Algebra, 3rd Ed, Universities Press
- S. K.Mapa, Higher Algebra: Abstract and Linear, 11th Ed, Levant Books

Reference Books:

- Jeremy Gray, A History of Abstract Algebra, Springer, 2018
- Charles C Pinter, A text Bok of Abstract Algebra, 2nd Ed, Dover Publication
- D.S. Mallick, John H Moderson & M.K.Sen, Fundamentals of Abstract Algebra, McGraw Hill
- Gertrude Ehrlich, Fundamentals Concepts of Abstract Algebra, Dover Publication
- John Fraleigh, A First Course in Abstract Algebra, 7th Ed, Pearson.
- S.K.Mapa, Higher Algebra, 11th Ed., Levant Books
- V. K. Khanna and S.K. Bhambri, A Course in Abstract Algebra, 5th Ed, Vikas Publishing

- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
- Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.
- I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
- Thomas W. Hungerford, Abstract Algebra: An Introduction , 3rd Ed. CENGAGE Pub.
- M.Pal, Higher Algebra, PHI

Learning Outcomes of the course

After completion of the course, the student will learn the following

- (a) Know about the mathematical structure and define the groups.
- (b) Link the fundamental concepts of groups and symmetries of geometrical objects.
- (c) Explain the significance of the notions of cosets, normal subgroups and factor groups.
- (d) Analyze consequences of Lagrange's theorem.
- (e) Learn about structure preserving maps between groups and their consequences.
- (f) Familiarize with relations, equivalence relations, partitions and basic properties of numbers and its application

Course Code: MTMHMJ-302

Course Title: Real Analysis-I

Credit: 04

No of Lectures: 60 hours

Full Marks: 75

Unit-I:

Review of algebraic and order properties of \mathbb{R} , ε -neighbourhood of a point in \mathbb{R} . Idea of countable sets, uncountable sets and uncountability of \mathbb{R} . Bounded above sets, bounded below sets, bounded sets, unbounded sets. Suprema and infima. Completeness property of \mathbb{R} and its equivalent properties. The Archimedean property, density of rational (and irrational) numbers in \mathbb{R} , intervals. Limit points of a set, isolated points, open set, closed set, derived set, Illustrations of Bolzano-Weierstrass theorem for sets, compact sets in \mathbb{R} , Heine-Borel Theorem.

Unit-II:

Sequences: bounded sequence, convergent sequence, limit of a sequence, \liminf , \limsup . Limit theorems. Monotone sequences, monotone convergence theorem. Subsequence, divergence criteria. Monotone subsequence theorem (statement only), Bolzano Weierstrass theorem for sequences. Cauchy sequence, Cauchy's convergence criterion.

Unit-III:

Infinite series: convergence and divergence of infinite series, Cauchy criterion, tests for convergence: comparison test, limit comparison test, D'Alembert's ratio test, Raabes test, Cauchy's

nth root test, integral test. Logarithmic test, Cauchy's condensation test, Gauss's test, Alternating series, Leibniz test, Abel's test, Dirichlet's test. Absolute and conditional convergence

Text Books:

- R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003
- S.K.Mapa, An Introduction to Real Analysis, Levant Books

Reference Books:

- Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
- K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
- Mattuck, Introduction to Analysis, Prentice Hall, 1999.
- S.R. Ghorpade and B.V. Limaye, a Course in Calculus and Real Analysis, Springer, 2006.
- T. Apostol, Mathematical Analysis, Narosa Publishing House
- Courant and John, Introduction to Calculus and Analysis, Vol II, Springer
- W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill
- Terence Tao, Analysis II, Hindustan Book Agency, 2006.
- S. Goldberg, Calculus and mathematical analysis.
- Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones& Bartlett, 2010.

Learning Outcomes of the course

After completion of the course, the student will learn the following

- (a) Understand basic structure and properties real number set and its extension
- (b) Basic knowledge of topology of a real number set and theorems.
- (c) Understanding of bounded, convergent, divergent, Cauchy and monotonic sequences and their properties.
- (d) Different types series and its convergence and divergence using D'Alembert ratio test, Cauchy's root test, Raabe's test etc

Skill Enhancement Course (SEC)

MTM SEC-301: MATLAB

Course Code: MTM SEC-301

Course Title: MATLAB

No of Lectures: 40 hours

Full Marks: 50

Group -A (Theory)**Marks-20****MATLAB-I**

MATLAB interface, data types, variables, Flow control statements, arrays: creating, indexing, operations, Matrix creating, indexing, operations, Input and output function, Mathematical library functions, user-defined function: anonymous function.

Plotting of two dimensional functions: Graph plotting, Graph formatting (title, axis, line styles, colors, etc.), multiple plots, matrix plots, polar plots, 3D plotting (line, surface, mesh, and contour) of three dimensional functions.

MATLAB-II

Introduction to M-file: scripts and function, flow control statements, standard arrays library functions, standard matrix library functions, User-defined function: primary function, sub-function, private function, eval function, function handles, function of functions, library functions.

Importing and Exporting data, read spread sheet data, write spread sheet data, MAT-file

Group-B [MATLAB Practical]**Marks-20****MATLAB-I**

- I Find the sum, product, max, min of a list of number in an array, in a sub-array
- II. Find a sub-matrix of the given matrix.
- III. Find the column sum, product, max, min of the given matrix without library function.
- IV. Find the row sum, product, max, min of the given matrix without library function.
- V. Define any transcendental function and then find and show the table of its functional values.
- VI. Plotting of graph of functions e^{ax+b} , $\log(ax+b)$, $\sin(\sin + \sin)$, $\cos(\cos + \cos)$, $|\sin + \sin|$ and to illustrate the effect of a and b on the graph.
- VII. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
- VIII. Sketching parametric curves (eg. trochoid, cycloid, epicycloids, hypocycloid).
- XI. Differential equation with example.
- X. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, and hyperbolic paraboloid using Cartesian coordinates.

MATLAB-II

- I. Fitting a curve for given data.
- II. Plotting of given data: Graph plotting, multiple plots, matrix plots, polar plots, 3D plotting (line, surface, mesh, and contour) of three dimensional data.
- III. Obtaining surface of revolution of curves.
- IV. Find the sum, product, max, min, sort of a list of number in an array, in a sub-array using library function.
- V. Find the column sum, product, max, min, sort of the given matrix using library function.
- VI. Find the row sum, product, max, min of the given matrix using library function.

Reference Books:

- Amos Gilat, An Introduction with Applications, 4th Ed, John Willey & Sons
- B.B. Chaudhury & Y. Kirani Singh, Matlab Programming, PHI Learning Pvt. Ltd.
- William J. Palm, MATLAB for Engineering Applications, 5th Ed, McGraw Hill

Learning Outcomes of the course

After completion of the course, the student will learn the following

- Student learns the mathematical operations, expression. Logical operations using MATLAB coding.
- Evaluate the matrix addition, subtraction and multiplications using MATLAB coding.
- Sketch the graph of different mathematical functions, trigonometric functions etc.
- Solving the basic mathematical problems using MATLAB coding.

MINOR-03

Course Code: MTM MI-301

Course Title: Calculus, Geometry & Linear Algebra-I

Credit: 04

No of Lectures: 60 hours

Full Marks: 75

Group-A:Calculus

23

Unit-I : Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, concavity and inflection points, curvature, envelopes, asymptotes, L'Hospital's rule (Statement and example)

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \cos^m x dx$, parametric equations, parameterizing a curve, arc length of a curve, arc length of parametric curves

Group-B:Geometry

23

Reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics.

Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, quadric surfaces like cone, cylinder, ellipsoid and hyperboloid.

Group-C: Linear Algebra-I

Marks:

Marks:

Marks:

Linear dependence and independence, system of linear equations: row reduction, echelon form, rank of a matrix, solution of a system of linear equation $Ax=b$ and its applications. Eigen values, eigen vectors and its properties, characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

Text Books:

- Maity & Ghosh, An Introduction to Analysis (Differential Calculus), Books and Allied Pvt Ltd
- Ghosh & Chakraborty, Analytical Geometry, U.N Dhar and Sons Pvt Ltd
- S.K.Mapa, Linear Algebra, Sarat Book Publishing House
- Maity & Ghosh, Integral Calculus, New Central Book Agency

Reference Books:

- G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi,2005.
- M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi,2007.
- H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
- R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
- T. Apostol, Calculus, Volumes I and II.
- S. Goldberg, Calculus and mathematical analysis.

Learning Outcomes of the course

After completion of the course, the student will learn the following

- (a) Tracing of curves in Cartesian and polar coordinates
- (b) nth order differentiation of hyperbolic function, trigonometric function, algebraic function and product of two functions using Leibnitz rule.
- (c) Techniques to find the area under curve, area and volume of surface of revolution, length of curve
- (d) Explain the properties and equation of three dimension shapes like sphere, cone, cylinder, ellipsoid, hyperboloid of one and two sheet, elliptic paraboloid etc
- (e) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank
- (f) Find eigenvalues and corresponding eigenvectors for a square matrix