DEBRA THANA SAHID KSHUDIRAM SMRITI MAHAVIDYALAYA

Gangaram Chak, Chak Shyampur, Debra, West Bengal

PROPOSED SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH MATHEMATICS
(MULTIDISCIPLINARY STUDIES)

3 – YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2024-2025)

Based on

Curriculum & Credit Framework for Undergraduate Programmes (CCFUP), 2023 & NEP, 2020

SEMESTER – 1

Course Type	Course Code	Course Title	Course Details		L-T-P	Credit	Marks Distribution			
							IA	CA	ESE	Total
MAJOR-01 (Disc. – A1)	MATPMJ01	Calculus, Geometry & Ordinary Differential Equation	Unit I	Differential Calculus	3-1-0	4	10	5	60	75
			Unit II	Integral Calculus						
			Unit III	Geometry						
			Unit IV	Ordinary Differential Equations						
SEC-01	MATPSEC01	MATLAB -1		MATLAB -1	0-0-6	3	5	5	30	40
MINOR-01 (Disc. – C1)	MATPMI101	Calculus, Geometry & Ordinary Differential Equation	Unit I	Differential Calculus	3-1-0	4	10	5	60	75
			Unit II	Integral Calculus						
			Unit III	Geometry						
			Unit IV	Ordinary Differential Equations						

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, CA= Continuous Assessment, ESE= End Semester Examination, L-T-P = Lecture-Tutorial-Practical

MAJOR (MJ)

MATPMJ101: Calculus, Geometry & Ordinary Differential Equations **Credits 04, Full Marks: 75**

MATPMJ101T: Calculus, Geometry & Ordinary Differential Equations **Credits 04, Full Marks: 75**

Course contents:

UNIT-1 (Differential Calculus):

Higher order derivatives, Leibnitz rule, and its applications to problems of type $e^{ax+b\sin x}, e^{ax+b\cos x}, (ax+b)^n \sin x, (ax+b)^n \cos x$, Hyperbolic functions; Concavity and inflection points; Curvature; Envelopes; Asymptotes; Curve tracing in cartesian coordinates, tracing in polar coordinates of standard curves; L' Hospital's rule; Applications in business, economics, and life sciences.

UNIT-2 (Integral Calculus):

Reduction formulae, derivations, and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n dx$, $\int \sin nx \sin mx\,dx$; Parametric equations; Parameterizing a curve; Arc length of a curve, arc length of parametric curves; area under a curve; area and volume of surface of revolution,

UNIT-3 (Geometry):

Geometry 2D

Reflection properties of conics, rotation of axes, and second-degree equations; Classification of conics using the discriminant, canonical form of a conic; Polar equations of conics.

Geometry 3D

Recapitulation of the coordinate system, Plane and Straight Line, Tangent and Normal; Spheres; Cylindrical surfaces; Central conicoids; Paraboloids; Plane sections of conoids; Generating lines; Classification of quadrics

UNIT-4 (Ordinary Differential Equations):

General, Particular, Explicit, Implicit, and Singular solutions of a Differential equation; First order but not first-degree differential equation; Exact differential equations and integrating factors, and equations reducible to this form; Linear equation; Bernoulli equation and special integrating factors and transformations.

Marking scheme on question paper

MATPMJ01T: Calculus, Geometry & Ordinary Differential Equations

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UNIT	Marks	QUESTION PATTERN	
		Mark of each question	Number of Questions to be attempted
UNIT-I (Differential Calculus)	16	2 10	3 1
UNIT-II (Integral Calculus)	14	2 5	2 2
UNIT-III (Geometry)	21	2 5 10	3 1 1
UNIT-IV (Ordinary Differential Equations)	9	2 5	2 1

Suggested Readings:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
3. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
4. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989.
5. G. F. Simmons, Differential Equations, Tata Mcgraw Hill.
6. S. Goldberg, Calculus and mathematical analysis.
7. S. K. Mapa, Introduction to Real Analysis, 8th Edition, Sarat Book House, 2014.
8. Maity & Ghosh, An Introduction to Analysis (Differential Calculus), New Central Book Agency (P) Limited.
9. Maity & Ghosh, An Introduction To Differential Equations, New Central Book Agency (P) Limited.
10. Chakravorty & Ghosh, Advance Analytical Geometry, U. N. Dhur & Sons Private Limited.
11. A. N. Das, Analytical Geometry of Two and Three Dimensions, New Central Book Agency (P) Limited.
12. Mukharjee & Bej, Analytic Geometry of Two & Three Dimensions (Advanced Level), Books and Allied (P) Ltd.
13. R. M. Khan, Analytical Geometry and Vector Algebra, New Central Book Agency (P) Limited.
14. K. C. Pal, Analytic Geometry including Vector Analysis, Books and Allied (P) Ltd.
15. Maity and Ghosh, An Introduction To Analysis (integral Calculus), New Central Book Agency (P) Limited.
16. D.A. Murray, Introductory Course In Differential Equations, Orient Longman Limited.
17. Shepley L. Ross, Differential Equations, 3rd Ed, Wiley India Pvt. Limited.
18. Chakravorty and Ghosh, Differential Equations, U. N. Dhur & Sons Private Limited.
19. Tom M. Apostol, Calculus (Vol – I and Vol – II), Wiley India Pvt. Limited.

SKILL ENHANCEMENT COURSE (SEC)

MATPSEC01: MATLAB-1 **Credits 03, Full Marks: 50**

MATPSEC01P: MATLAB -1 **Credits 03, Full Marks: 50**

Course Outline:

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.

I. Find the sum, product, max, min of a list of number in an array, in a sub-array without library function.

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 $e^{ax+b}, \log(ax + b), \log\frac{1}{ax+b}, \sin(ax + b), \cos(ax + b), |ax + b|$ 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).

IX. Tracing of conics in cartesian coordinates/ polar coordinates.

X. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using cartesian coordinates.

Marking scheme on question paper

MATPSEC01P: MATLAB -1

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Marks	QUESTION PATTERN			
	Note Book	Viva	Mark of each Question	Number of Questions to be attempted
40	5	5	10	3

*Selection of questions for practical examination shall solely be made on lottery basis in the presence of external examiners.

Suggested Readings:

1. Etter, Delores M., Introduction to MATLAB for Engineers and Scientists, Prentice-Hall.
2. R. Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford University Press.
3. A. Gilat, MATLAB: an Introduction with Applications, New York: Wiley.
4. Fausett, Laurene, Applied Numerical Analysis Using MATLAB, Prentice-Hall.
5. J. P. William, Introduction to MATLAB for Engineers, New York: McGraw-Hill.
6. C. Lopez, MATLAB programming for numerical analysis, Apress; 2014.

MINOR (MI)

MATPMI01: Calculus, Geometry & Ordinary Differential Equations **Credits 04 , Full Marks: 75**

MATPMI101T: Calculus, Geometry & Ordinary Differential Equations **Credits 04, Full Marks: 75**

Course contents:

UNIT-1 (Differential Calculus):

Higher order derivatives, Leibnitz rule, and its applications to problems of type $e^{ax+b}\sin x, e^{ax+b}\cos x, (ax+b)^n \sin x, (ax+b)^n \cos x$, Hyperbolic functions; Concavity and inflection points; Curvature; Envelopes; Asymptotes; Curve tracing in cartesian coordinates, tracing in polar coordinates of standard curves; L' Hospital's rule; Applications in business, economics, and life sciences.

UNIT-2 (Integral Calculus):

Reduction formulae, derivations, and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n dx$, $\int \sin nx \sin mx\,dx$; Parametric equations; Parameterizing a curve; Arc length of a curve, arc length of parametric curves; area under a curve; area and volume of surface of revolution,

UNIT-3 (Geometry):

Geometry 2D

Reflection properties of conics, rotation of axes, and second-degree equations; Classification of conics using the discriminant, canonical form of a conic; Polar equations of conics.

Geometry 3D

Recapitulation of the coordinate system, Plane and Straight Line, Tangent and Normal; Spheres; Cylindrical surfaces; Central conicoids; Paraboloids; Plane sections of conoids; Generating lines; Classification of quadrics

UNIT-4 (Ordinary Differential Equations):

General, Particular, Explicit, Implicit, and Singular solutions of a Differential equation; First order but not first-degree differential equation; Exact differential equations and integrating factors, and equations reducible to this form; Linear equation; Bernoulli equation and special integrating factors and transformations.

Marking scheme on question paper

MTMPMI01T: Calculus, Geometry & Ordinary Differential Equations

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UNIT	Marks	QUESTION PATTERN	
		Mark of each question	Number of Questions to be attempted
UNIT-I (Differential Calculus)	16	2 10	3 1
UNIT-II (Integral Calculus)	14	2 5	2 2
UNIT-III (Geometry)	21	2 5 10	3 1 1
UNIT-IV (Ordinary Differential Equations)	9	2 5	2 1

Suggested Readings:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
3. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
4. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989.
5. G. F. Simmons, Differential Equations, Tata Mcgraw Hill.
6. S. Goldberg, Calculus and mathematical analysis.
7. S. K. Mapa, Introduction to Real Analysis, 8th Edition, Sarat Book House, 2014.
8. Maity & Ghosh, An Introduction to Analysis (Differential Calculus), New Central Book Agency (P) Limited.
9. Maity & Ghosh, An Introduction To Differential Equations, New Central Book Agency (P) Limited.
10. Chakravorty & Ghosh, Advance Analytical Geometry, U. N. Dhur & Sons Private Limited.
11. A. N. Das, Analytical Geometry of Two and Three Dimensions, New Central Book Agency (P) Limited.
12. Mukharjee & Bej, Analytic Geometry of Two & Three Dimensions (Advanced Level), Books and Allied (P) Ltd.
13. R. M. Khan, Analytical Geometry and Vector Algebra, New Central Book Agency (P) Limited.
14. K. C. Pal, Analytic Geometry including Vector Analysis, Books and Allied (P) Ltd.
15. Maity and Ghosh, An Introduction To Analysis (integral Calculus), New Central Book Agency (P) Limited.
16. D.A. Murray, Introductory Course In Differential Equations, Orient Longman Limited.
17. Shepley L. Ross, Differential Equations, 3rd Ed, Wiley India Pvt. Limited.
18. Chakravorty and Ghosh, Differential Equations, U. N. Dhur & Sons Private Limited.
19. Tom M. Apostol, Calculus (Vol – I and Vol – II), Wiley India Pvt. Limited.

SEMESTER – 2

Course Type	Course Code	Course Title	Course Details		L-T-P	Credit	Marks Distribution			
							IA	CA	ESE	Total
MAJOR-02	MATPMJ02	Algebra	Unit I	Classical Algebra	3-1-0	4	10	5	60	75
			Unit II	Sets and Integers						
			Unit III	System of Linear Equations						
			Unit IV	Linear Transformation and Eigenvalues						
SEC-02	MATPSEC02	MATLAB -2		MATLAB – 2	0-0-6	3	5	5	30	40
MINOR-02	MATPMI02	Algebra	Unit I	Classical Algebra	3-1-0	4	10	5	60	75
			Unit II	Sets and Integers						
			Unit III	System of Linear Equations						
			Unit IV	Linear Transformation and Eigenvalues						

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, CA= Continuous Assessment, ESE= End Semester Examination, L-T-P = Lecture-Tutorial-Practical

MAJOR (MJ)

MATPMJ02: Algebra **Credits 04, Full Marks: 75**

MATPMJ02T: Algebra **Credits 04, Full Marks: 75**

Course contents:

UNIT-1 (Classical Algebra):

Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications; Theory of equations: Relation between roots and coefficients, transformation of equation, Descartes rule of signs, cubic and biquadratic equation.; Inequality: The inequality involving AM≥ GM≥ HM, Cauchy-Schwartz inequality.

UNIT-2 (Sets and Integers):

Equivalence relations, Equivalence Class; 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.

UNIT-3 (System of Linear Equations):

Systems of linear equations; row reduction and echelon forms; vector equations; the matrix equation Ax=b; solution sets of linear systems; applications of linear systems; linear independence.

UNIT-4 (Linear Transformation and Eigenvalues):

Inverse of a matrix; Characterizations of invertible matrices; Definition of vector space of $\mathbb{R}^n$; Subspaces of $\mathbb{R}^n$; Dimension of subspaces of $\mathbb{R}^n$; Rank of a matrix; Eigenvalues; Eigenvectors and characteristic equation of a matrix; Cayley-Hamilton theorem and its use in finding the inverse of a matrix; Introduction to linear transformations; Matrix of a linear transformation.

Marking scheme on question paper

MATPMJ02T: Algebra

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UNIT	Marks	QUESTION PATTERN	
		Mark of each question	Number of Questions to be attempted
UNIT – I (Classical Algebra)	22	2 5 10	1 2 1
UNIT-II (Sets and Integers)	15	2 5	5 1
UNIT-III (System of Linear Equations)	9	2 5 10	2 1 1
UNIT-IV (Linear Transformation and Eigenvalues)	14	2 10	2 1

Suggested Readings:

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
4. K.B. Dutta, Matrix and linear algebra.
5. K. Hoffman, R. Kunze, Linear algebra.
6. W.S. Burnstine and A.W. Panton, Theory of equations.
7. Sadhan Kumar Mapa, Higher Algebra Classical, Roman Books.
8. Sadhan Kumar Mapa, Higher Algebra Abstract and Linear, Roman Books.
9. R. M. Khan, Algebra Classical, Modern, Linear and Boolean, New Central Book Agency (P) Limited.
10. Rao, Bhimasankaram, Linear Algebra, Hindustan Book Agency.
11. S. Kumaresan, Linear Algebra: A Geometric Approach, PHI Learning Pvt. Ltd.
12. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, Pearson Education.
13. Vijay K. Khanna & S. K. Bhambri, A Course In Abstract Algebra, Vikas Publishing House Pvt Limited.
14. Joseph A. Gallian, Contemporary Abstract Algebra, CRC Press.
15. Sen, Ghosh, Mukhopadhyay, Topics in Abstract Algebra, University Press (India) Private Limited.
16. I. N. Herstein, Topics in algebra, Wiley.
17. Dummit, Foote, Abstract Algebra, Wiley India Pvt. Limited.

SKILL ENHANCEMENT COURSE (SEC)

MATPSEC02: MATLAB-2 **Credits 03, Full Marks: 50**

MATPSEC02P: MATLAB -2 **Credits 03, Full Marks: 50**

Course Outline:

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

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.

VII. Conversion of one number system to another number system among decimal, binary, octal, hexadecimal.

VIII. Solution of a square, under determined and over determined system of linear equation.

IX. Different problems for root, eigenvalues and eigenvectors of the matrix.

X. Plotting of recursive sequences.

XI. Study the convergence of sequences through plotting.

XII. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.

XIII. Study the convergence/divergence of in finite series by plotting their sequences of partial sum.

XIV. Cauchy's root test by plotting nth roots.

XV. Ratio test by plotting the ratio of nth and (n+1)th term.

Marking scheme on question paper

MATPSEC02P: MATLAB -2

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Marks	QUESTION PATTERN			
	Note Book	Viva	Mark of each Question	Number of Questions to be attempted
40	5	5	10	3

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Suggested Readings:

1. Etter, Delores M., Introduction to MATLAB for Engineers and Scientists, Prentice-Hall.
2. R. Pratap, Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford University Press.
3. A. Gilat, MATLAB: an Introduction with Applications, New York: Wiley.
4. Fausett, Laurene, Applied Numerical Analysis Using MATLAB, Prentice-Hall.
5. J. P. William, Introduction to MATLAB for Engineers, New York: McGraw-Hill.
6. C. Lopez, MATLAB programming for numerical analysis, Apress; 2014.

MINOR (MI)

MATPMI02: Algebra **Credits 04, Full Marks: 75**

MATPMI02T: Algebra **Credits 04, Full Marks: 75**

Course contents:

UNIT-1 (Classical Algebra):

Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications; Theory of equations: Relation between roots and coefficients, transformation of equation, Descartes rule of signs, cubic and biquadratic equation.; Inequality: The inequality involving AM≥ GM≥ HM, Cauchy-Schwartz inequality.

UNIT-2 (Sets and Integers):

Equivalence relations, Equivalence Class; 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.

UNIT-3 (System of Linear Equations):

Systems of linear equations; row reduction and echelon forms; vector equations; the matrix equation Ax=b; solution sets of linear systems; applications of linear systems; linear independence.

UNIT-4 (Linear Transformation and Eigenvalues):

Inverse of a matrix; Characterizations of invertible matrices; Definition of vector space of $\mathbb{R}^n$; Subspaces of $\mathbb{R}^n$; Dimension of subspaces of $\mathbb{R}^n$; Rank of a matrix; Eigenvalues; Eigenvectors and characteristic equation of a matrix; Cayley-Hamilton theorem and its use in finding the inverse of a matrix; Introduction to linear transformations; Matrix of a linear transformation.

Marking scheme on question paper

MATPMI02T: Algebra

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UNIT	Marks	QUESTION PATTERN	
		Mark of each question	Number of Questions to be attempted
UNIT – I (Classical Algebra)	22	2 5 10	1 2 1
UNIT-II (Sets and Integers)	15	2 5	5 1
UNIT-III (System of Linear Equations)	9	2 5 10	2 1 1
UNIT-IV (Linear Transformation and Eigenvalues)	14	2 10	2 1

Suggested Readings:

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
4. K.B. Dutta, Matrix and linear algebra.
5. K. Hoffman, R. Kunze, Linear algebra.
6. W.S. Burnstine and A.W. Panton, Theory of equations.
7. Sadhan Kumar Mapa, Higher Algebra Classical, Roman Books.
8. Sadhan Kumar Mapa, Higher Algebra Abstract and Linear, Roman Books.
9. R. M. Khan, Algebra Classical, Modern, Linear and Boolean, New Central Book Agency (P) Limited.
10. Rao, Bhimasankaram, Linear Algebra, Hindustan Book Agency.
11. S. Kumaresan, Linear Algebra: A Geometric Approach, PHI Learning Pvt. Ltd.
12. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, Pearson Education.
13. Vijay K. Khanna & S. K. Bhambri, A Course In Abstract Algebra, Vikas Publishing House Pvt Limited.
14. Joseph A. Gallian, Contemporary Abstract Algebra, CRC Press.
15. Sen, Ghosh, Mukhopadhyay, Topics in Abstract Algebra, University Press (India) Private Limited.
16. I. N. Herstein, Topics in algebra, Wiley.
17. Dummit, Foote, Abstract Algebra, Wiley India Pvt. Limited.