VIDYASAGAR UNIVERSITY

Paschim Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN MATHEMATICS

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN MATHEMATICS
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1st	I	**SEMESTER-I**							
			Major-1	**MATHMJ101**	**T: Calculus, Geometry & Ordinary Differential Equation**	**4**	**3-1-0**	**15**	**60**	**75**
			SEC	**MATSEC01**	**P: MATLAB-1**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC01**	Communicative English -1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC01**	Multidisciplinary Course -1 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC01**	ENVS (***common for all programmes***)	**4**	**2-0-2**	**50**	**50**	**100**
			Minor MAT (Disc.-I)	**MATMI01**	**T: Calculus, Geometry & Ordinary Differential Equation** ***(To be taken by students of other Disciplines)***	**4**	**3-1-0**	**15**	**60**	**75**
					Semester-I Total	**20**				**400**
		II	**SEMESTER-II**							
			Major-2	**MATHMJ102**	**T: Algebra**	**4**	**3-1-0**	**15**	**60**	**75**
			SEC	**MATSEC02**	**P: MATLAB-2**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC02**	MIL-1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC02**	Multi Disciplinary Course-02 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC02**	Value Added Course-02 (***to be chosen from the list***)	**4**	**4-0-0**	**10**	**40**	**50**
			Minor (Disc.-II)	**MATMI02**	**T: Algebra** ***(To be taken by students of other Disciplines)***	**4**	**3-1-0**	**15**	**60**	**75**
			Summer Intern.	**CS**	Community Service	**4**	**0-0-4**	**-**	**-**	**50**
					Semester-II Total	**24**				**400**
					TOTAL of YEAR-1	**44**				**800**

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

MAJOR (MJ)

MJ-1: Calculus, Geometry & Ordinary Differential Equation Credits 04 (Full Marks: 75)

MJ-1T: Calculus, Geometry & Ordinary Differential Equation Credits 04

Course contents:

UNIT-1:
Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of typeeax+bsinx, eax+bcosx, (ax+b)nsinx, (ax+b)ncosx, 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:
Reduction formulae, derivations and illustrations of reduction formulae of the type ∫sin nx dx, ∫cosnx dx, ∫tan nx dx, ∫sec nx dx, ∫(log x)n dx, ∫sinnx sinmx 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, techniques of sketching conics.

UNIT-3:
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, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid.

UNIT-4:
General, particular, explicit, implicit and singular solutions of a differential equation. First order but not first degree. Exact differential equations and integrating factors, and equations reducible to this form, linear equation, Bernoulli equation and special integrating factors and transformations.

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. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
6. Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
7. G.F.Simmons, Differential Equations, Tata Mcgraw Hill.
8. T. Apostol, Calculus, Volumes I and II.
9. S. Goldberg, Calculus and mathematical analysis.

MJ-2: Algebra **Credits 04 (Full Marks: 75)**

MJ-2T: Algebra **Credits 04**

Course contents:

UNIT-1:
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:
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.

UNIT-3:
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:
Definition of vector space of $R^{n;}$, introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n, rank of a matrix, Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

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.

MINOR (MI)

MI – 1: Calculus, Geometry & Ordinary Differential Equation **Credits 04**

MI – 1T: Calculus, Geometry & Ordinary Differential Equation **Full Marks: 75**

Course contents:

UNIT-1:
Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of typeeax+bsinx, eax+bcosx, (ax+b)nsinx, (ax+b)ncosx, 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:
Reduction formulae, derivations and illustrations of reduction formulae of the type ∫sin nx dx, ∫cosnx dx, ∫tan nx dx, ∫sec nx dx, ∫(log x)n dx, ∫sinnx sinmx 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, techniques of sketching conics.

UNIT-3:
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, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid.

UNIT-4:
General, particular, explicit, implicit and singular solutions of a differential equation. First order but not first degree. Exact differential equations and integrating factors, and equations reducible to this form, linear equation, Bernoulli equation and special integrating factors and transformations.

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. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
6. Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
7. G.F.Simmons, Differential Equations, Tata Mcgraw Hill.
8. T. Apostol, Calculus, Volumes I and II.
9. S. Goldberg, Calculus and mathematical analysis.

MI-2: Algebra **Credits 04 (Full Marks: 75)**

MI-2: Algebra **Credits 04**

Course contents:

UNIT-1:
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:
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.

UNIT-3:
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:
Definition of vector space of $R^{n:}$, introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n, rank of a matrix, Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

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.

SKILL ENHANCEMENT COURSE (SEC)

SEC 1: MATLAB-1 **Credits 03**

SEC1P: MATLAB -1 **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.

SEC 2: MATLAB-2 **Credits 03**

SEC 2P: MATLAB-2 **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.