SYLLABI AND SCHEME OF EXAMINATIONS FOR DISCIPLINE SPECIFIC COURSES OF MULTIDISCIPLINARY PROGRAMS WITH HONS. IN ONE MAJOR DISCIPLINE

B.A. (Multidisciplinary) with Hons. in Mathematics/

B.Sc. (Physical Sciences) with Hons. in Mathematics

(Based on Curriculum and Credit Framework for UG Programs under NEP)

WITH EFFECT FROM THE SESSION 2024-25

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

Credit Structure for Undergraduate Programmes (Multidisciplinary with Hons. in One Major Discipline)

Semester	Discipline-Specific Courses (DSC) / Major courses	Minor(MIC)/ Vocational (VOC)/ Skill Enhancement Courses (SEC)/ Internship	Multidisciplinary courses(MDC)	Ability Enhancement courses(AEC)	Research project/ Dissertation	Value-Added Courses (VAC)	Total Credits
I	DSC - A1 @ 4 credits	MIC1 @ 4 credits	MDC1 @ 3 credits	AEC1 @ 2 credits	----------	----------	24
	DSC - B1 @ 4 credits	SEC1@ 3 credits**					
	DSC - C1 @ 4 credits						
II	DSC - A2 @ 4 credits	SEC2 @ 3 credits**	MDC2 @ 3 credits	AEC2 @ 2 credits	----------	VAC1 @ 2 credits VAC2 @ 2 credits	24
	DSC – B2 @ 4 credits						
	DSC – C2 @ 4 credits						
Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/ Subject							
III	DSC – A3 @ 4 credits	MIC2 @ 4 credits	MDC3 @ 3 credits	AEC3 @ 2 credits		----------	24
	DSC – B3 @ 4 credits	SEC3@ 3 credits**					
	DSC – C3 @ 4 credits						
IV	DSC – A4 @ 4 credits	MIC3(VOC)@ 4 credits	----------	AEC4 @ 2 credits	----------	VAC3 @ 2 credits	20
	DSC – B4 @ 4 credits						
	DSC – C4 @ 4 credits						
Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	DSC – A5 @ 4 credits	MIC4(VOC)@ 4 credits	----------	----------	----------	----------	20
	DSC – B5 @ 4 credits	Internship @ 4 credits#					
	DSC – C5 @ 4 credits						
VI	DSC – A6 @ 4 credits	MIC5 @ 4 credits	----------	----------	----------	----------	20
	DSC – B6 @ 4 credits	MIC6(VOC)@ 4 credits					
	DSC – C6 @ 4 credits						
Students will be awarded 3-year UG Degree in the relevant Discipline/Subject upon securing 132 credits.							
VII*	DSC – H1 @ 4 credits	SEC4 @ 4 credits OR MIC7 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	----------	----------	24
	DSC – H2 @ 4 credits						
	DSC – H3 @ 4 credits						
	DSC – H4 @ 4 credits						
	DSC – H5 @ 4 credits						
VIII* (4yr UG Hon.)	DSC – H6 @ 4 credits	SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	----------	----------	24
	DSC – H7 @ 4 credits						
	DSC – H8 @ 4 credits						
	DSC – H9 @ 4 credits						
	DSC – H10 @ 4 credits						
VIII* (4yr UG Hon. with Research)	DSC – H6@ 4 credits	SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits	----------	----------	Research project/ Dissertation@ 12 credits	----------	24
	DSC – H7@ 4 credits						
	----------					TOTAL CREDITS	180
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* Student should select one major discipline (Out of A, B, or C studied during first three years of UG Programmes) in which he/she wishes to pursue Honors. This framework is subject to modification as per UGC guidelines at the University level. The universities may decide to offer the Honors degree Programmes subject to the fulfillment of credit point table

** SEC for imparting practical skills related to Major (A, B and C)/minor.
#Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programmes without taking exit option.

Semester I (Session 2024-25)															
Discipline Specific Courses/ Major Course			**Credits Distribution**			**Total Credits**	**Workload**			**Total Workload**	**Marks**				
	Nomenclature of Course	**Course Code**	**L**	**T**	**P**		**L**	**T**	**P**		**Theory**		**Practical**		**Total Marks**
											Internal	**External**	**Internal**	**External**	
DSC @ 4 credits	Functions and Algebra	**24MATM401DS01**	3	0	1	4	3	0	2N	3+2N	25	50	5	20	100
Semester II (Session 2024-25)															
DSC @ 4 credits	Calculus	**24MATM402DS01**	3	0	1	4	3	0	2N	3+2N	25	50	5	20	100
Semester III (Session 2025-26)															
DSC @ 4 credits	Ordinary Differential Equations	**25MATM403DS01**	3	0	1	4	3	0	2N	3+2N	25	50	5	20	100
Semester IV (Session 2025-26)															
DSC @ 4 credits	Real Analysis	**25MATM404DS01**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
Semester V (Session 2026-27)															
DSC @ 4 credits	Group and Rings	**26MATM405DS01**	3	0	1	4	3	0	2N	3+2N	25	50	5	20	100
Semester VI (Session 2026-27)															
DSC @ 4 credits	Linear Algebra	**26MATM406DS01**	3	0	1	4	3	0	2N	3+2N	25	50	5	20	100
Semester VII (Session 2027-28)															
DSC – H1 @ 4 credits	Abstract Algebra	**27MATH407DS01**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H2 @ 4 credits	Mathematical Analysis	**27MATH407DS02**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H3 @ 4 credits	Complex Analysis	**27MATH407DS03**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H4 @ 4 credits	Mathematical Statistics	**27MATH407DS04**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
Any One of the Following															
DSC – H5 @ 4 credits	Analytical Number Theory	**27MATH407DS05**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
	Mechanics of Solids	**27MATH407DS06**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
	Fuzzy Set Theory	**27MATH407DS07**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100

	Data and File Structure	**27MATH407DS08**	2	0	2	4	2	0	4N	2+4N	15	35	15	35	100
Semester VIII* (4-Year B.Sc. Honours in Mathematics) (Session 2027-28)															
DSC – H6 @ 4 credits	Theory of Field Extensions	**27MATH408DS01**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H7 @ 4 credits	Measure and Integration Theory	**27MATH408DS02**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H8 @ 4 credits	Integral Equations and Calculus of Variations	**27MATH408DS03**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H9 @ 4 credits	Operations Research Techniques	**27MATH408DS04**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
Any One of the Following															
DSC – H10 @ 4 credits	Algebraic Number Theory	**27MATH408DS05**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
	Applied Solid Mechanics	**27MATH408DS06**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
	Stochastic Processes	**27MATH408DS07**	3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
	Data Communication and Networking	**27MATH408DS08**	2	0	2	4	2	0	4N	2+4N	15	35	15	35	100
Semester VIII* (4-Year B.Sc. Honours in Mathematics with REsearch) (Session 2027-28)															
DSC – H6 @ 4 credits	**Any two courses from the Major courses offered in semester VIII (B.Sc. Honours in Mathematics)**		3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
DSC – H7 @ 4 credits			3	1	0	4	3	1N	0	3+1N	30	70	00	00	100
Research project/ Dissertation @ 12 credits	Research Project/ Dissertation	**27MAT408PD01**	0	0	12	12	0	0	0	24	--	--	90	210	300

N : Total Number of Groups in the class

L: Lecture; T: Tutorial; P: Practical

Note:The Syllabi and Scheme of Examinations (SOE) for Discipline Specific Courses/Major Courses for UG Semester 7 and Semester 8 will be same as applicable for Syllabi and S.O.E. for Post Graduate semester 1 and semester 2 respectively.

Syllabi for Under Graduate Programme with Hons. in Mathematics

Semester - I

Session: 2024-25

Name of Program		**Program Code**	
Name of the Course	**Functions and Algebra**	**Course Code**	**24MATM401DS01**
Hours per Week	**5**	**Credits**	**4**
Maximum Marks	**100 (75 Theory + 25 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1 Determine the type of matrices and compute the elementary operations on the matrices**.**

CLO2 Compute the Eigen values, Eigen function, characteristic equation and minimal polynomial of a given matrix.

CLO3 Use the concept of rank of matrices to solve systems of linear equations.

CLO4 Familiar with transformation of equation which is very helpful to find the solution of the given problem.

CLO5 Use the Descarte's rule of sign to find the nature of roots.

Section – I (Relations and Functions)

Relations, Functions along with domain and range, Composition of functions, Invertibility and inverse of functions, One-to-one correspondence and the cardinality of a set.

Section-II (Theory of Equations)

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. Nature of the roots of an equation Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.

Section-III (Rank of a Matrix & its applications)

Matrix and its types. Symmetric, Skew-symmetric, Hermitian and Skew Hermitian matrices. Unitary and Orthogonal Matrices, Idempotent, Involuntary, Nilpotent Matrices.

Rank of a Matrix & its applications. Rank of a matrices, Row rank and column rank of a matrix, Elementary Operations on matrices, Inverse of a matrix , Normal Form, PAQ Form, Linear dependence and independence of rows and columns of matrices , Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations, Theorems on consistency of a system of linear equations.

Section-IV (Eigenvalues, Eigenvectors and Diagonalization of matrix)

Cayley Hamilton theorem. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix. Diagonalization of matrix.

Practical/ Computational Work

(Based on course Functions and Algebra)

Max. Marks : 25{External (term-end exam) – 20}
(Internal – 5)

Time : 3 Hours

There will be five questions in all, and the students must attempt any three questions. The question paper will set

on the spot jointly by the internal and external examiners.
Distribution of Marks will be as follows:

Marks for Question Paper:	12
Marks for Practical Record Book:	05
Marks for Viva-Voce:	03
Total:	20

List of Practicals

Following is the list of programmes to be performed in the Lab using MATLAB Programming:

1. Matrix operations (addition, multiplication, inverse, transpose, determinant, rank, eigenvectors, eigenvalues, Characteristic equation and verification of Cayley Hamilton equation, system of linear equations)
2. Practical based on System of Homogenous Equation and application to solve balance chemical equation.
3. Practical based on System of Non- Homogenous Equation and applications to solve network flow problems, Nutrition and Economic Input-Output Models.
4. Problems based Markov process a type of Mathematical Modeling .
5. Applications and Uses of Matrix in Coding theory.
6. Study of reflection, shear, dilation, contraction of figure using matrix transformation as application of computer graphics.
7. Application of System of Equations to Solve Electric Circuits.
8. Applications of Eigen values to solve a Diffusion Process and Dynamical Systems.
9. Plotting of graphs of following functions (i) $y = x^n$, Rational function (ii) $f(x) = \frac{1}{x^n}$ Irrational function (iii) $f(x) = x^{1/n}$ where $n \in N$ (discuss both cases on n is even or odd) (iv) Piecewise Function (Modulus function, Signum function, Greatest integer function, Fractional part function, Least integer function).
10. Plotting of graphs of following transcendental and standard functions (i) Sin(x), Cos(x), Tan(x), Cot(x), Sec(x), Cosec(x), $e^x, a^x (a > 1, a < 1)$, $log_a(x)$ (a>1, a<1) and Standard Geometrical functions (i) Straight Line (ii) Circle (iii) Parabola (iv) Ellipse (v) Hyperbola.
11. (i) Plotting of graphs of six inverse trigonometric functions and hyperbolic functions (ii) Solution of Transcendental equation using graph for example $sinx = \frac{x}{10}$, cos(x)=x (iii) Plotting of graphs of functions $sin^{-1}(sinx)$, $sin(sin^{-1}x)$.
12. Study of various graphical transformations by which $f(x)$ transform to $f(x) \mp a$, $f(x \mp a)$, $af(x), f(ax), |f(x)|, f(|x|), |f(|x|)|, |y| = f(x), |y| = |f(x)|, \quad |y| = |f(|x|)|, \quad y = [f(x)], y = f([x]), y = [f([x])]$.

References:

1. Goodaire, Edgar G., &Parmenter, Michael M. (2005). Discrete Mathematics with Graph Theory (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2015.
2. Dickson, Leonard Eugene (1922). First Course in The Theory of Equations. John Wiley & Sons, Inc. New York. The Project Gutenberg EBook.
3. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi.
4. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill.
5. H.S. Hall and S.R. Knight : Higher Algebra, H.M. Publications 1994.
6. Shanti Narayan : A Text Books of Matrices.

7. Chandrika Prasad : Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.
8. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi.
9. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill.
10. B. Kolman, David R. Hill, Introductory Linear Algebra An Applied First Course, 8th Edition, Prentice Hall.
11. Jim DeFranza and Dan Gagliardi, Introduction to Linear Algebra with Applications, McGraw Hill Education (India) Pvt Ltd, New Delhi.

Semester - II

Name of Program		**Program Code**	
Name of the Course	**Calculus**	**Course Code**	**24MATM402DS01**
Hours per Week	**5**	**Credits**	**4**
Maximum Marks	**100 (75 Theory + 25 Practical)**	**Time of Examinations**	**3 Hours**

Note:
Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1 Understand the method of successive differentiation and Taylor series expansions.

CLO2 Be familiar with concepts of asymptotes, curvature and singular points.

CLO3 Apply the concepts of calculus for tracing and rectification of the curves in cartesian, parametric and polar coordinates.

CLO4 Understand the concepts of functions of several variables, their continuity and various properties.

Section – I

Limit and Continuity ($\varepsilon - \delta$ definition), Discontinuity & its types, Differentiability of the functions, Successive differentiation, Leibnitz rule and its applications, L' Hospital's rule: Indeterminate forms. Taylor's theorem with Lagrange's and Cauchy's forms of remainders, Maclaurin's and Taylor's series expansions.

Section – II

Tangent and Normal, Asymptotes of Curves in Cartesian and polar co-ordinates, Curvature, Radius of Curvature for Cartesian curves, parametric, polar and pedal form of curves, Circle of Curvature, Chord of Curvature. Concavity, Convexity and Inflexion points.

Section – III

Tracing of curves in Cartesian, parametric and polar co-ordinates of Standard curves (Cubic curves, Semicubical Parabola, Folium of Descartes, Cardioid, Lemniscate of Bernoulli, Astroid, Rose curve, Logarithmic Spiral, Epispiral, Cycloid, Catenary).

Section – IV

Functions of Several Variables, Limits and Continuity, Partial Differentiation and Euler's theorem on homogenous functions, Chain rule, Directional derivatives, Gradient vector and Tangent Plane.

Practical/ Computational Work

(Based on course Functions and Algebra)

Max. Marks : 25{External (term-end exam) – 20}
(Internal – 5)

Time : 3 Hours

There will be five questions in all, and the students must attempt any three questions. The question paper will set on the spot jointly by the internal and external examiners.
Distribution of Marks will be as follows:

Marks for Question Paper:	12
Marks for Practical Record Book:	05
Marks for Viva-Voce:	03
Total:	20

List of Practicals

Following is the list of programmes to be performed in the Lab using MATLAB Programming:

1. Study of Concavity, Convexity and point of inflexion using graph (i) $f(x) = (x-\alpha)(x-\beta)$ (ii)

$f(x) = (x-\alpha)(x-\square)(x-\gamma)$ (iii) $f(x) = |x-\alpha|(x-\beta)$ (iv) $f(x) = \frac{x+1}{x^2+3}$.

2. Plotting of graphs of the function $sin(ax+b)$, $cos(ax+b)$, $sinh(ax+b)$, $cosh(ax+b)$ for various values of a and b.
3. Plotting of graphs of the function e^{ax+b}, $log(ax+b)$, $\frac{c}{ax+b}$, c^{ax+b} for various values of a, b and c.
4. Sketching parametric curves (E.g. Trochoid, Cycloid , Epicycloids, Hypocycloid).
5. Determine Asymptotes in Curve using graphs (i) $y = \frac{1}{x-3}$ (ii) y=tanx (iii) $y = e^{1/x}$ (iv) $y = x + 1/x$ (v) $y = \frac{x^2+2x-1}{x}$.
6. Form the table for Sine function, Cosine function for $0^o, 1^o, 2^o, \ldots, 90^o$ using Maclaurin's series expansion.
7. Plotting the graphs of polynomials of degree 2, 3, 4 and 5, the derivative graph , second derivative graph and comparing them.
8. Trace the curves (i) $y^2(a^2+x^2) = x^2(a^2-x^2)$ (ii) $a^2y^2 = a^2x^4 - x^6$ (iii) $9ay^2 = (x-2a)(x-5a)^2$ (iv) $x^2 = (y-1)(y-2)(y-3)$.
9. Trace the curves (i) $x^2y^2 = x^2+1$ (ii) $y = \frac{x+1}{x^3}$ (iii) $x^2y^2 = a^2(y^2-x^2)$.
10. Sketching parametric curves (E.g. Trochoid, Cycloid , Epicycloids, Hypocycloid, Catenary).
11. Trace the curves (i) $y^2(a^2+x^2) = x^2(a^2-x^2)$ (ii) $a^2y^2 = a^2x^4 - x^6$ (iii) $9ay^2 = (x-2a)(x-5a)^2$ (iv) $x^2 = (y-1)(y-2)(y-3)$.
12. Trace the curves (i) $x^2y^2 = x^2+1$ (ii) $y = \frac{x+1}{x^3}$ (iii) $x^2y^2 = a^2(y^2-x^2)$.
13. Sketching Polar Curves (Cardioid, Astroid, Rose Curve, Logarthmicsprial).

References:

1. G.B Thomas and R.L. Finney, *Calculus*, 9th edition, Pearson Education Delhi,2005
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3. M.J Strauss, G.L. Bradley and K.J Smith, *Calculus*, 3rd edition, Dorling Kindersley (India) P Ltd (Pearson Education), Delhi, 2007
4. R. Courant and F. John, *Introduction to Calculus and Analysis,(Volume I &II), Springer-Verlag, New York, Inc 1989*
5. Murray R. Spiegel ,*Theory and Problems of Advanced Calculus*. Schaun's Outline series. Schaum Publishing Co., New York.
6. N. Piskunov ,*Differential and integral Calculus.* Peace Publishers, Moscow.