

FOUR-YEAR UNDERGRADUATE PROGRAM (FYUGP)
WITH MAJOR IN MATHEMATICS
UNDER
THE NEW CURRICULUM AND CREDIT FRAMEWORK, 2022

NEW SYLLABUS

for

UNDERGRADUATE
MATHEMATICS
(w.e.f. the academic session 2023-2024)



UNIVERSITY OF NORTH BENGAL

Raja Rammohunpur, P.O. - NBU Campus

District - Darjeeling, Pin - 734013, West Bengal, India



B.SC. MATHEMATICS SYLLABUS

NEW SYLLABUS		2023 FOUR-YEAR UNDERGRADUATE PROGRAM (FYUGP)
REVISED SYLLABUS		2023 THREE-YEAR UG HONS/PROG COURSE (CBCS)
NEW SYLLABUS		2018 THREE-YEAR UG HONS/PROG COURSE (CBCS)

SESSION	1 ST SEM	2 ND SEM	3 RD SEM	4 TH SEM	5 TH SEM	6 TH SEM	7 TH SEM	8 TH SEM
2023-2027 & onwards								
2022-2025								
2021-2024								
2020-2023								
2019-2022								
2018-2021								



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MATHEMATICS 4-YEAR UNDERGRADUATE PROGRAM



CREDIT AND HOURS			
L	Lecture	1 Credit	1 Hour
T	Tutorial	1 Credit	1 Hour
P	Practical		
PNLB	Practical Non-Lab Base	1 Credit	2 Hours
PLB	Practical Lab Based	1 Credit	2 Hours
PAPER TYPE			
TH	Theory		
TH+PNLB	Theory + Practical Non-Lab Base		
TH+PLB	Theory + Practical Lab Based		

CREDIT & MARK DISTRIBUTION

Sl. No.	Course Type		Course Level	Course Credit	Full Marks	Marks Distribution	
						Non-practical Based Course (TH)	Practical Based Course (TH+PLB/TH+PNLB)
1	Major Course	MAJ	100-400	4 (3+1)	75	60+10+5	40+20+10+5
2	Minor Course	MIN	100-300	4 (3+1)	75	60+10+5	40+20+10+5
3	Value Added Course	VAC	100	4 (3+1)	75	60+10+5	-----
4	Multidisciplinary Course	MDC	100	3	75	60+10+5	-----
5	Skill Enhancement Course	SEC	100	3 (2+1)	75	-----	40+20+10+5
6	Ability Enhancement Course	AEC	100	2	50	30+15+5	-----
7	Vocational Course #	VOC	----	4	----	-----	-----

Optional – In case of Certificate Level/ Diploma Level Exit

4-Year Undergraduate Mathematics Course Structure (Semester 1 & 2)

SEMESTER-1

Paper Code	Paper Level	Paper	Paper Description	Paper Type	Full Marks	Credit		Page No.
						L	T/P	
UMATMAJ11001	100	MAJ	Classical and Linear Algebra	TH	75	3	1	1
UMATSEC11001	100	SEC	Logic, Integers, and Boolean Algebra	TH+PNLB	75	2	1	2
UMATMIN10001	100	MIN	Classical and Linear Algebra	TH	75	3	1	4
UPOAMDC 11001-11021	100	MDC	MDC-POOL A	TH	75	3	---	----
UBNG/UHIN/UNEP/ USAN/UURD/UENG AEM10001	100	AEC	MIL Bengali/MIL Hindi/MIL Nepali/ MIL Sanskrit/MIL Urdu/Alternative English	TH	50	2	---	----
UINDVAC 1202A/1202B	100	VAC	Understanding India/ Digital Marketing	TH	75	4	---	----

SEMESTER-2

Paper Code	Paper Level	Paper	Paper Description	Paper Type	Full Marks	Credit		Page No.
						L	T/P	
UMATMAJ12002	100	MAJ	Calculus and Geometry	TH	75	3	1	5
UMATSEC12002	100	SEC	Graph Theory	TH+PNLB	75	2	1	6
UMATMIN10001	100	MIN	Classical and Linear Algebra	TH	75	3	1	8
UPOBMDC 12022-12042	100	MDC	MDC-POOL B	TH	75	3	---	----
UENGAEL10001	100	AEC	Compulsory English	TH	50	2	---	----
UENVVAC11001	100	VAC	Environmental Education	TH	75	4	---	----

DETAILED SYLLABUS

SEMESTER-1

(MAJOR, SKILL ENHANCEMENT, AND MINOR COURSES)

Semester-1											
Paper Description	Classical and Linear Algebra			Paper Code				UMATMAJ11001			
Paper (Type)	Major Course (Theory)			Credit				Marks			
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	4 Hours/week	2 Hr. 30 Min	3	1	--	4	60	---	10	5	75

CLASSICAL AND LINEAR ALGEBRA

Classical Algebra

Unit 1: **10 classes**

Complex numbers: Polar representation, De Moivre's theorem for rational indices and its applications. Trigonometric, logarithm, exponential and hyperbolic functions of complex variable.

Unit 2: **15 classes**

Theory of equations: Fundamental theorem of Classical Algebra (statement only), relation between roots and coefficients, symmetric functions of roots, transformation of equation, Descartes' rule of signs, Sturms' theorem, cubic equation (Cardan's method), biquadratic equation (Ferrari's method).

Unit 3: **5 classes**

Inequality: $AM \geq GM \geq HM$, theorem of weighted means and m -th power theorem (statement only), Cauchy-Schwartz inequality (statements only) and its application.

Linear Algebra

Unit 4: **15 classes**

Matrices: Inverse of a matrix, characterizations of invertible matrices, elementary operations and matrices, echelon matrix, row/column reduced echelon matrix, rank of matrix, normal forms, equivalency and congruency of matrices.

Unit 5: **10 classes**

Systems of linear equations: Consistency in equivalence system, Solution of homogeneous system $AX=O$, Solution of nonhomogeneous system $AX=B$ using row reduced echelon form.

Unit 6: **5 classes**

Eigen values and eigen vectors of a square matrix, characteristic equation of a matrix, Cayley-Hamilton theorem, and its use in finding the inverse of a matrix.

Suggested Reading Books:

- S. Lang, Introduction to Linear Algebra, *Springer*.
- S.K. Mapa, Higher Algebra: Classical, *Levant*.
- S.K. Mapa, Higher Algebra: Abstract & Linear, *Levant*.
- W.S. Burnstine and A.W. Panton, Theory of equations, *Creative Media*.
- S.H. Friedberg, A.J. Insel and L.E. Spence, Linear Algebra, *Pearson Edu. Pub. (Indian)*.
- K. Hoffman and R. Kunze, Linear algebra, *Prentice Hall India*.
- T. Andreescu and D. Andrica, Complex Numbers from A to Z, *Birkhause*.
- V. Sahai and V. Bist, Linear Algebra, *Narosa Pub. House*.
- D.C. Lay, Linear Algebra and its Applications, *Pearson Edu. Pub. (Indian)*.

Semester-1											
Paper Description	Logic, Integers, and Boolean Algebra			Paper Code				UMATSEC11001 (A)			
Paper (Type)	Skill Enhancement Course (Theory)			Credit				Marks			
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	2 Hours/week	2 Hours	2	--	--	2	40	---	10	5	55

LOGIC, INTEGERS, AND BOOLEAN ALGEBRA

Logic

Unit 1 :

10 classes

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.

Integers

Unit 2 :

10 classes

Well-ordering property of positive integers, principles of mathematical induction, division algorithm, divisibility and Euclidean algorithm, congruence relation between integers, Fundamental Theorem of Arithmetic (statement only), solution of linear congruence equations, Chinese remainder theorem.

Boolean Algebra

Unit 3 :

10 classes

Boolean algebra, Boolean polynomials, minimal and maximal forms of Boolean polynomials, method of Quinn-McCluskey, Karnaugh diagrams. Logic gates, switching circuits and applications of switching circuits.

Suggested Reading Books:

- R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, *Pearson Edu. India.*
- E.G. Goodaire and M.M. Parmenter, Discrete Mathematics with Graph Theory, *Pearson Edu. India.*
- J.A. Gallian, Contemporary Abstract Algebra, *Narosa Pub. House.*
- R. Lidl and G. Pilz, Applied Abstract Algebra, Undergraduate Texts in Mathematics, *Springer, Indian.*
- H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, Elements of the Theory of Computation, *PHI.*
- M.K. Sen, S. Ghosh, P. Mukhopadhyay and S. K. Maity, Topics in Abstract Algebra, *Universities Press.*
- L. Mohapatra, Elements of Discrete Mathematics, *Tata McGraw Hill.*
- I.M. Copi, Symbolic Logic, *Pearson Edu. India.*
- K.H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, *Tata McGraw Hill.*

Semester-1											
Paper Description	Logic, Integers, and Boolean Algebra			Paper Code				UMATSEC11001 (B)			
Paper (Type)	Skill Enhancement Course (Practical Non-Lab Based)			Credit				Marks			
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	2 Hours/week	2 Hour	---	--	1	1	---	20	---	---	20

LOGIC, INTEGERS, AND BOOLEAN ALGEBRA (PRACTICAL)

(Using hand calculation or any mathematical software)

- Using congruence, find the remainder when a large integer is divided by an integer:
(E.g. (a) 7 divides 333^{333}
(b) 15 divides 17^{404}
(c) 16 divides 777^{777}
(d) 42 divides $3^{1000020}$
(e) $4|1^5 + 2^5 + 3^5 + 4^5 + \dots + 100^5$
(f) $13|1! + 2! + \dots + 70!$
(g) $17|(2^{3n+1} + 3 \cdot 5^{2n+1}), n \geq 1$ etc.)
- Find the last digit/last two digits of a large integer (using congruence):
(E.g. (a) $19^{19^{19}}$ (b) 73^{73} (c) 33^{100} (d) 13^{13} (e) 7^{100} etc.)
- Code validation problems: ISBN code, UPC code, EAN codes, Credit card number, GST number (GSTIN).
- Sketch XOR, NAND, NOR, and XNOR Gates, and find their truth table. Simplify the logical circuits using these gates and draw the simplest form.
- Sketch the logic circuits corresponding to simple real-life situations.
(E.g.: Doorbell, Burglar Alarm, Freezer warning Buzzer, Mixed Task (mixing colors), inverter, Coffee/Soup vending machine, Automatic watering system, Automatic car door open warning system, temperature detector circuits, etc.)

Semester-1											
Paper Description	Classical and Linear Algebra			Paper Code				UMATMIN10001			
Paper (Type)	Minor Course (Theory)			Credit				Marks			
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	4 Hours/week	2 Hr. 30 Min	3	1	--	4	60	---	10	5	75

CLASSICAL AND LINEAR ALGEBRA

Classical Algebra

Unit 1: **10 classes**

Complex numbers: Polar representation, De Moivre's theorem for rational indices and its applications. Trigonometric, logarithm, exponential and hyperbolic functions of complex variable.

Unit 2: **15 classes**

Theory of equations: Fundamental theorem of Classical Algebra (statement only), relation between roots and coefficients, symmetric functions of roots, transformation of equation, Descartes' rule of signs, Sturms' theorem, cubic equation (Cardan's method), biquadratic equation (Ferrari's method).

Unit 3: **5 classes**

Inequality: $AM \geq GM \geq HM$, theorem of weighted means and m -th power theorem (statement only), Cauchy-Schwartz inequality (statements only) and its application.

Linear Algebra

Unit 4: **15 classes**

Matrices: Inverse of a matrix, characterizations of invertible matrices, elementary operations and matrices, echelon matrix, row/column reduced echelon matrix, rank of matrix, normal forms, equivalency and congruency of matrices.

Unit 5: **10 classes**

Systems of linear equations: Consistency in equivalence system, Solution of homogeneous system $AX=O$, Solution of nonhomogeneous system $AX=B$ using row reduced echelon form.

Unit 6: **5 classes**

Eigen values and eigen vectors of a square matrix, characteristic equation of a matrix, Cayley-Hamilton theorem, and its use in finding the inverse of a matrix.

Suggested Reading Books:

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- S.K. Mapa, Higher Algebra: Classical, *Levant*.
- S.K. Mapa, Higher Algebra: Abstract & Linear, *Levant*.
- W.S. Burnstine and A.W. Panton, Theory of equations, *Creative Media*.
- S.H. Friedberg, A.J. Insel and L.E. Spence, Linear Algebra, *Pearson Edu. Pub. (Indian)*.
- K. Hoffman and R. Kunze, Linear algebra, *Prentice Hall India*.
- T. Andreescu and D. Andrica, Complex Numbers from A to Z, *Birkhause*.
- V. Sahai and V. Bist, Linear Algebra, *Narosa Pub. House*.
- D.C. Lay, Linear Algebra and its Applications, *Pearson Edu. Pub. (Indian)*.

DETAILED SYLLABUS

SEMESTER-2

(MAJOR, SKILL ENHANCEMENT, AND MINOR COURSES)

Semester-2											
Paper Description	Calculus and Geometry			Paper Code				UMATMAJ12002			
Paper (Type)	Major Course (Theory)			Credit				Marks			
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	4 Hours/week	2 Hr. 30 Min	3	1	-- -	4	60	---	10	5	75

CALCULUS AND GEOMETRY

Calculus

Unit 1 : **15 classes**

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \sec^n x dx$, $\int \tan^n x dx$, $\int (\log x)^n dx$, $\int \sin nx \cos^m x dx$, $\int \sin nx \cos mx dx$ etc.

Arc length of a curve including parametric curves, area enclosed by a curve, area between two curves.

Unit 2 : **15 classes**

Higher order derivatives, Leibnitz rule and its applications to the problems of the type $e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax + b)^n \sin x$, $(ax + b)^n \cos x$ etc. L'Hospital's rule and its applications.

Concept of simple and closed curves and their parameterizations, Pedal equation, envelopes, evolute, asymptotes, radius of curvature. Concavity, convexity, cusps and inflection points.

Geometry

Unit 3 : **15 classes**

2D: Reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics.

Unit 4 : **15 classes**

3D: Spheres, cylindrical surfaces, cones, ellipsoids, paraboloids, hyperboloids, plane sections of conicoids, generating lines, classification of quadrics.

Suggested Reading Books:

- G.B. Thomas and R.L. Finney, Calculus, Pearson Education, Delhi.
- M.J. Strauss, G. L. Bradley, and K. J. Smith, Calculus, Pearson Education, Delhi.
- H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd., Singapore.
- R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer Verlag.
- S.K. Mapa, Introduction to Real Analysis, *Levant*.
- S.C. Malik and S. Arora, Mathematical Analysis, *New Age International*.
- R.K. Ghosh and K.C. Maity, An Introduction to Analysis, *New Central Book Agency*.
- R.K. Ghosh and K.C. Maity, Integral Calculus, *New Central Book Agency*.
- J.G.Chakravorty and P.R. Ghosh, Advanced Mathematical Geometry, Dhar & Sons.
- U. Chatterjee and N. Chatterjee, Advanced Analytical Geometry of Two and Three Dimensions, *Academic Pub*.
- R.M.Khan, Analytical Geometry of Two and Three Dimensions & Vector Analysis, *New Central Book Agency*.

Semester-2											
Paper Description	Graph Theory			Paper Code				UMATSEC12002 (A)			
Paper (Type)	Skill Enhancement Course (Theory)			Credit				Marks			
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	2 Hours/week	2 Hours	2	--	--	2	40	---	10	5	55

GRAPH THEORY

Unit 1 : **9 classes**

Definition, examples, basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs, isomorphism of graphs, paths, and cycles.

Unit 2 : **9 classes**

Eulerian circuits, Hamiltonian cycles, Eulerian and Hamiltonian graphs, representation of a graph by a matrix, adjacency matrix, incidence matrix, and weighted graphs.

Unit 3 : **12 classes**

Traveling salesman's problem, shortest path, Dijkstra's algorithm, Warshall algorithm, Tree and their properties, spanning tree, Kruskal's Algorithm, Forest, Connectivity, matching in bipartite graphs, matching in general graphs.

Suggested Reading Books:

- D.S. Malik, M.K. Sen, and S. Ghosh, Introduction to Graph Theory, *Cengage Learning Asia*.
- B.A. Davey and H.A. Priestley, Introduction to Lattices and Order, Cambridge University Press.
- E.G. Goodaire and M.M. Parmenter, Discrete Mathematics with Graph Theory, *Pearson Edu. India*.
- D.B. West, Introduction to Graph Theory, *PHI*.
- N. Deo, Graph Theory with Applications to Engineering and Computer Science, *PHI*.
- R. Diestel, Graph Theory, *Springer-Verlag*.

Semester-2											
Paper Description	Graph Theory					Paper Code			UMATSEC12002 (B)		
Paper (Type)	Skill Enhancement Course (Practical Non-Lab Based)					Credit			Marks		
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	2 Hours/week	2 Hours	---	--	1	1	---	20	---	---	20

GRAPH THEORY (PRACTICAL)

(Using hand calculation or any mathematical software)

- Travelling salesman problems:
E.g.: Given a list of tourist spots in Darjeeling district and mention the distances between each pair of spots. If we start from Siliguri, what is the possible shortest path that visits each one exactly once and returns to the original place at Siliguri?."
- Without lifting pencil puzzles (Euler Paths & Circuits):
E.g.: How can you sketch a given shape on paper without taking off the pen as well as without tracing the same line twice?
- Draw bipartite graphs for different networks like ecological networks, epidemiological networks, biomedical networks, biomolecular networks, etc.
- Find the solution to matching problems (matching job seekers with job vacancies or assigning students to project supervisors, Stable Marriage problem), social network problems (connections between users and interests), etc. using bipartite graphs.
- Sketch the graph of real-life situations like landing cables, LAN networks, a network of pipes for drinking water or natural gas, an electric grid, tour operations, etc., and find the solution using **Kruskal's algorithm**.
- Sketching graphs related to the problems of digital mapping services in google maps (like GPS, to calculate the shortest or quickest route), social networking applications, robotic paths (like robot car to take to reach a specific location while avoiding obstacles), logistics, and transportation (most efficient routes for vehicles and to optimize delivery schedule), Emergency Services (ambulance, fire truck, or police car) and then find the shortest path using **Dijkstra's algorithm**.

Semester-2											
Paper Description	Classical and Linear Algebra		Paper Code				UMATMIN10001				
Paper (Type)	Minor Course (Theory)		Credit				Marks				
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH	PRC	CE	ATT	Total
100	4 Hours/week	2 Hr. 30 Min	3	1	-- -	4	60	---	10	5	75

CLASSICAL AND LINEAR ALGEBRA

Classical Algebra

Unit 1: **10 classes**

Complex numbers: Polar representation, De Moivre's theorem for rational indices and its applications. Trigonometric, logarithm, exponential and hyperbolic functions of complex variable.

Unit 2: **15 classes**

Theory of equations: Fundamental theorem of Classical Algebra (statement only), relation between roots and coefficients, symmetric functions of roots, transformation of equation, Descartes' rule of signs, Sturms' theorem, cubic equation (Cardan's method), biquadratic equation (Ferrari's method).

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Inequality: $AM \geq GM \geq HM$, theorem of weighted means and m -th power theorem (statement only), Cauchy-Schwartz inequality (statements only) and its application.

Linear Algebra

Unit 4: **15 classes**

Matrices: Inverse of a matrix, characterizations of invertible matrices, elementary operations and matrices, echelon matrix, row/column reduced echelon matrix, rank of matrix, normal forms, equivalency and congruency of matrices.

Unit 5: **10 classes**

Systems of linear equations: Consistency in equivalence system, Solution of homogeneous system $AX=O$, Solution of nonhomogeneous system $AX=B$ using row reduced echelon form.

Unit 6: **5 classes**

Eigen values and eigen vectors of a square matrix, characteristic equation of a matrix, Cayley-Hamilton theorem, and its use in finding the inverse of a matrix.5

Suggested Reading Books:

- S. Lang, Introduction to Linear Algebra, *Springer*.
- S.K. Mapa, Higher Algebra: Classical, *Levant*.
- S.K. Mapa, Higher Algebra: Abstract & Linear, *Levant*.
- W.S. Burnstine and A.W. Panton, Theory of equations, *Creative Media*.
- S.H. Friedberg, A.J. Insel and L.E. Spence, Linear Algebra, *Pearson Edu. Pub. (Indian)*.
- K. Hoffman and R. Kunze, Linear algebra, *Prentice Hall India*.
- T. Andreescu and D. Andrica, Complex Numbers from A to Z, *Birkhause*.
- V. Sahai and V. Bist, Linear Algebra, *Narosa Pub. House*.
- D.C. Lay, Linear Algebra and its Applications, *Pearson Edu. Pub. (Indian)*.

Semester-2											
Paper Description	Introduction to Linear Programming		Paper Code				UPOBMDC12034				
Paper (Type)	Multidisciplinary Course (Theory)		Credit				Marks				
Paper Level	Class Hours	Sem. End Exam.	L	T	P	Total	TH		CE	ATT	Total
100	3 Hours/week	2 Hours 30 Min	3	---	---	3	60	---	10	5	75

INTRODUCTION TO LINEAR PROGRAMMING

Unit 1 :

30 classes

Introduction to linear programming problem (LPP), definition of related terminology such as constraints, objective functions, optimization, different types of LPP, and mathematical formation of LPP. Feasible and infeasible regions. Definition of type of solutions: basic solution (BS), feasible solution (FS), basic feasible solution (BFS), degenerate and non-degenerate BFS. Matrix notation of LPP, graphical method of solution for LPP in two variables. Slack and surplus variables, standard form of LPP.

Unit 2 :

15 classes

Mathematical formulation of Transportation models. Matrix formation of transportation problem (TP), Determine the initial basic feasible solution of TP using North-West corner method, and Vogel approximation method (optimality not required).

Suggested Reading Books:

- M.S. Bazaraa, J.J. Jarvis and H.D. Sherali, Linear Programming and Network Flows, John Wiley and Sons, India.
- F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, Tata McGraw Hill, Singapore.
- H.A. Taha, Operations Research: An Introduction, Prentice-Hall India.
- G. Hadley, Linear Programming, Narosa Publishing House, New Delhi.
- P. M. Karak, Linear Programming, *New Central Book Agency*.
- J.G. Chakravorty and P.R. Ghosh, Linear Programming, *Dhur & Sons*.
- D. C. Sanyal and K. Das, Introduction to Linear Programming, *Dhur & Sons*.

Dr. Paltu Sarkar (Chairperson)
UG Board of Studies in Mathematics
University of North Bengal

QUESTION PATTERN
MAJOR, MINOR, SKILL ENHANCEMENT PAPER

THEORY EXAM.

For 60 Marks paper:

Group	Total Questions	Question to be answered	Mark of each Question	Total Marks
A	6	4	3	$12 = 4 \times 3$
B	6	4	6	$24 = 4 \times 6$
C	4	2	12	$24 = 2 \times 12$
Total Marks				60

For 40 Marks paper:

Group	Total Questions	Question to be answered	Mark of each Question	Total Marks
A	8	5	1	$5 = 5 \times 1$
B	5	3	5	$15 = 3 \times 5$
C	4	2	10	$20 = 2 \times 10$
Total Marks				40

PRACTICAL EXAM.

Practical Lab Based (PLB)	20 Marks	Exam. Duration
Note Book + Viva	6 Marks	-----
2 Problems \times 7 Marks Each	14 Marks	2 Hours
Practical Non-Lab Based (PNLB)	20 Marks	Exam. Duration
Note Book + Viva	5 Marks	-----
3 Problems \times 5 Marks Each	15 Marks	2 Hours

ANNEXURE

Further List of Suggested Reading Books

Classical, Abstract and Linear Algebra, Group Theory, Ring Theory, Boolean Algebra

1. Topics in Algebra: I. N. Herstein (*Wiley Eastern Ltd.*)
2. Abstract Algebra: N. P. Chaudhuri (*Tata McGraw Hill*)
3. A First Course in Abstract Algebra: J. B. Fraleigh (*Pearson Education*)
4. A course in abstract algebra, V.K. Khanna and S.K. Bhambri, (*Vikas Publishing House*)
5. University Algebra: N. S. Gopala Krishnan (*New Age International*)
6. CBCS Mathematics: D. Chatterjee and B.K. Pal, (*U.N Dhur & Sons*)
7. Algebra: R. M. Khan (*New Central Book Agency*)
8. CBCS Integral Calculus and Differential Equations, D. Chatterjee and B.K. Pal, (*U.N Dhur & Sons*)
9. CBCS Algebra, D. Chatterjee and B.K. Pal, (*U.N Dhur & Sons*)
10. Higher Algebra, J.G. Chakravorty and P.R. Ghosh, (*U.N Dhur & Sons*)
11. Linear Algebra, P.K. Saikia (*Pearson, India*)
12. Linear Algebra, A.R. Vasistha, J.N. Sharma and A.K. Vasistha, (*Krishna Prakashan*)

Integral and Differential Calculus

13. Introduction to Real Analysis: D. R. Sherbert and R. G. Bartle (*Wiley*)
14. Advanced Mathematical Analysis: Utpal Chatterjee (*Academic Publishers*)
15. Mathematical Analysis: Problems and Solutions: S. Bandyopadhyay (*Academic Publishers*)
16. Mathematical Analysis: S. N. Mukhopadhyay and A. K. Layek (*U. N. Dhur and Sons*)
17. A Course of Mathematical Analysis: S. Narayan (*S. Chand & Co.*)
18. Problems in Mathematical Analysis: B. P. Demidovich (*Mir Publication*)
19. An Introduction to Analysis-Differential Calculus, Part I & II: R. K. Ghosh and K. C. Maity (*New Central Book Agency*)
20. Integral Calculus & Differential Equations: B. C. Das and B. N. Mukherjee (*U.N. Dhur and Sons*)
21. Differential Calculus: B. C. Das & B. N. Mukherjee (*U.N. Dhur and Sons*)
22. Differential Calculus: S. Narayan (*S. Chand & Co.*)
23. Application of Calculus: S. K. Maity & S. Bandyopadhyay (*Academic Publishers*)
24. Application of Calculus: D. Sengupta (*Books & Allied*)
25. Calculus and its Applications: Goldstein, Lay, Schneider, Asmar (*Pearson Education*)
26. Integral Calculus: S. Narayan (*S. Chand & Co.*)
27. An Introduction to Analysis-Integral Calculus: R. K. Ghosh and K. C. Maity (*New Central Book Agency*)
28. Integral Calculus and Differential Equations: D. Chatterjee (*Tata McGraw Hill*)
29. Calculus: Volume I and II: T. Apostol (*Narosa Publishing House*)

Analytical Geometry (Two & Three Dimension)

30. Analytical Geometry and Vector Algebra: N. Datta and R. N. Jana (*Shreedhar Prakashani*)
31. Co-ordinate Solid Geometry: B. Nand, B. S. Tyagi and B. D. Sharma (*Kedar Nath Ram Nath*)
32. Analytical Geometry of two and three Dimensions: A. N. Das (*New Central Book Agency*)
33. Vector Geometry & Elements of Calculus, A. Dey, (*Pearson India*)

Discrete Mathematics and Graph Theory

34. Discrete Mathematics: J. K. Sharma (*Macmillan*)
35. Introduction to Discrete Mathematics: M. K. Sen and B. C. Chakraborty (*Books & Allied*)
36. Discrete Mathematics with Graph Theory: E. G. Goodaire and M. M. Parmenter (*Pearson Education*)
37. Discrete Mathematics, S. Lipschutz and M.L. Lipson, (*Tata McGrawHill*)

Outlines of 4-year Undergraduate Program with Major in Mathematics

A student taking Mathematics as a Major course has to opt

1. Any two from the following Science group as Minor Courses:

SCIENCE							
1	Anthropology	2	Botany	3	Chemistry	4	Computer Science
5	Economics	6	Food Technology	7	Geology	8	Microbiology
9	NCC	10	Physics	11	Physiology	12	Statistics
13	Tea Science	14	Zoology				

2. Two papers from the following as Ability Enhancement Courses (AEC):

I. Anyone from the following (two papers each) for 1st and 3rd Semesters:

Sl. No.	Sem.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
1	1	100	UENGAEM10001	Alternative English	2	50 (30+15+5)
	3	100	UENGAEM20002	Alternative English	2	50 (30+15+5)
2	1	100	UBNGAEM10001	MIL Bengali	2	50 (30+15+5)
	3	100	UBNGAEM20002	MIL Bengali	2	50 (30+15+5)
3	1	100	UHINAEM10001	MIL Hindi	2	50 (30+15+5)
	3	100	UHINAEM20002	MIL Hindi	2	50 (30+15+5)
4	1	100	UNEPAEM10001	MIL Nepali	2	50 (30+15+5)
	3	100	UNEPAEM20002	MIL Nepali	2	50 (30+15+5)
5	1	100	USANAEM10001	MIL Sanskrit	2	50 (30+15+5)
	3	100	USANAEM20002	MIL Sanskrit	2	50 (30+15+5)
6	1	100	UURDAEM10001	MIL Urdu	2	50 (30+15+5)
	3	100	UURDAEM20002	MIL Urdu	2	50 (30+15+5)

II. Another Language Core Course (LCC) English (Compulsory) (two papers) for 2nd and 4th Semesters:

Sl. No.	Sem.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
1	2	100	UENGAEL10001	English Compulsory	2	50 (30+15+5)
2	4	100	UENGAEL20002	English Compulsory	2	50 (30+15+5)

3. Three papers in the following as Skill Enhancement Courses (SEC):

Sem.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
1	100	UMATSEC11001	Logic, Integers, and Boolean Algebra	4	75 (60+15+5)
2	100	UMATSEC11002	Graph Theory	4	75 (60+15+5)
3	100	UMATSEC11003	Not yet assign	4	75 (60+15+5)

4. Two papers in the following as Value-Added Courses (VAC):**I. Any one from the following for Semester 1:**

Sem.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
1	100	UINDVAC1202A	Understanding India (UI)	4	75 (60+15+5)
1	100	UDIMVAC1202B	Digital Marketing (DM)	4	75 (60+15+5)

II. Another VAC Compulsory paper for Semester 2:

Sem.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
2	100	UENVVAC11001	Environmental Education (EE)	4	75 (60+15+5)

5. Vocational Courses (Optional):

In case of Certificate Level (2nd Sem.)/ Diploma Level (4th Sem.) exit, a student has to choose one paper from the following:

SL. No.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
1	100	UCRTVOC00001	Beauty and Wellness	4	75 (60+15+5)
2	100	UCRTVOC00002	GST Filing	4	75 (60+15+5)
3	100	UCRTVOC00003	Hospitality Management	4	75 (60+15+5)
4	100	UCRTVOC00004	NSS	4	75 (60+15+5)
5	100	UCRTVOC00005	Office Administration	4	75 (60+15+5)
6	100	UCRTVOC00006	Soft Skill and Personality Development	4	75 (60+15+5)

6. Three papers in the following as Multidisciplinary Courses (MDC):

Each one chosen from Pool-A, B, and C excluding courses belonging to the group of the Major and/or Minor subjects chosen and excluding those courses already undergone at the Higher Secondary Level (12th) class)

Sem.	Paper Levels	Paper Code	Paper Description	Credit	Full Marks
1	100	UPOAMDC 11001-11021	MDC-POOL A	3	75 (60+15+5)
2	100	UPOAMDC 12022-12042	MDC-POOL B	3	75 (60+15+5)
4	200	UPOAMDC 24043-24063	MDC-POOL C	3	75 (60+15+5)

Dr. Paltu Sarkar (Chairperson)
UG Board of Studies in Mathematics
University of North Bengal

Detailed Course Structure for 3/4 Year Undergraduate Program

MDC - POOL A FOR SEMESTER I ONLY

SL	SEM	PAPER	PAPER CODE	PAPER LEVELS	PAPER DESCRIPTION	CREDIT	PAPER TYPE	FULL MARKS	MARKS IN THEO	MARKS IN PRC	MARKS IN CE	MARKS IN ATT
1	1	MDC	UPOAMDC11001	100	Cultural Anthropology	3		75			10	5
2	1	MDC	UPOAMDC11002	100	Performing Arts	3		75			10	5
3	1	MDC	UPOAMDC11003	100	Introduction to Basic Bioinformatics	3		75			10	5
4	1	MDC	UPOAMDC11004	100	Chemistry in Action	3		75			10	5
5	1	MDC	UPOAMDC11005	100	Accounting and Finance	3		75			10	5
6	1	MDC	UPOAMDC11006	100	Microfinance and Financial Inclusion	3		75			10	5
7	1	MDC	UPOAMDC11007	100	Fundamentals of Data Science	3		75			10	5
8	1	MDC	UPOAMDC11008	100	Introduction to African Literature	3		75			10	5
9	1	MDC	UPOAMDC11009	100	Fundamentals of Remote Sensing	3		75			10	5
10	1	MDC	UPOAMDC11010	100	History of North Bengal	3		75			10	5
11	1	MDC	UPOAMDC11011	100	Management of Libraries and Information Centres	3		75			10	5
12	1	MDC	UPOAMDC11012	100	Community Journalism	3		75			10	5
13	1	MDC	UPOAMDC11013	100	Sports Management	3		75			10	5

14	1	MDC	UPOAMDC11014	100	Behavioural Science	3		75			10	5
15	1	MDC	UPOAMDC11015	100	Statistical Survey	3		75			10	5
16	1	MDC	UPOAMDC11016	100	Human Rights	3		75			10	5
17	1	MDC	UPOAMDC11017	100	Tibetan Language and Culture	3		75			10	5
18	1	MDC	UPOAMDC11018	100	Gender Studies	3		75			10	5
19	1	MDC	UPOAMDC11019	100	Great Indian Educators	3		75			10	5
20	1	MDC	UPOAMDC11020	100	Distance Education	3		75			10	5
21	1	MDC	UPOAMDC11021	100	Studies of Sexualities	3		75			10	5

Detailed Course Structure for 3/4 Year Undergraduate Program

MDC- POOL B FOR SEMESTER II ONLY

SL	SEM	PAPER	PAPER CODE	PAPER LEVELS	PAPER DESCRIPTION	CREDIT	PAPER TYPE	FULL MARKS	MARKS IN THEO	MARKS IN PRC	MARKS IN CE	MARKS IN ATT
22	2	MDC	UPOBMDC12022	100	Local Language and Folk Culture	3		75			10	5
23	2	MDC	UPOBMDC12023	100	Understanding Shakespeare and Tagore	3		75			10	5
24	2	MDC	UPOBMDC12024	100	Strategic and Area Studies	3		75			10	5
25	2	MDC	UPOBMDC12025	100	Introduction to Polymers	3		75			10	5
26	2	MDC	UPOBMDC12026	100	Conservation Biology	3		75			10	5
27	2	MDC	UPOBMDC12027	100	Human Resources Management	3		75			10	5
28	2	MDC	UPOBMDC12028	100	Web Technology	3		75			10	5
29	2	MDC	UPOBMDC12029	100	Software Development	3		75			10	5
30	2	MDC	UPOBMDC12030	100	Sustainable Development	3		75			10	5
31	2	MDC	UPOBMDC12031	100	Graphic Novels	3		75			10	5

32	2	MDC	UPOBMDC12032	100	Disaster Management	3		75				10	5
33	2	MDC	UPOBMDC12033	100	Media Science	3		75				10	5
34	2	MDC	UPOBMDC12034	100	Introduction to Linear Programming	3		75				10	5
35	2	MDC	UPOBMDC12035	100	Introduction to Astronomy	3		75				10	5
36	2	MDC	UPOBMDC12036	100	Ergonomics and Sports Medicine	3		75				10	5
37	2	MDC	UPOBMDC12037	100	International Relations	3		75				10	5
38	2	MDC	UPOBMDC12038	100	Sociology of Development	3		75				10	5
39	2	MDC	UPOBMDC12039	100	Tourism and Travel Management	3		75				10	5
40	2	MDC	UPOBMDC12040	100	Education of Children with Special Needs	3		75				10	5
41	2	MDC	UPOBMDC12041	100	Mental Health and Hygiene	3		75				10	5
42	2	MDC	UPOBMDC12042	100	Literature of Eastern Himalayas	3		75				10	5

Detailed Course Structure for 3/4 Year Undergraduate Program

MDC- POOL C FOR SEMESTER IV ONLY

SL	SEM	PAPER	PAPER CODE	PAPER LEVELS	PAPER DESCRIPTION	CRED IT	PAPER TYPE	FULL MARKS	MARKS IN THEO	MARKS IN PRC	MARKS IN CE	MARKS IN ATT
43	4	MDC	UPOCMDC24043	200	Pharmacognosy and Medicinal Plants	3		75			10	5
44	4	MDC	UPOCMDC24044	200	Basic Programming	3		75			10	5
45	4	MDC	UPOCMDC24045	200	Bio Entrepreneurship	3		75			10	5
46	4	MDC	UPOCMDC24046	200	Business Regulations	3		75			10	5
47	4	MDC	UPOCMDC24047	200	Cognitive Science	3		75			10	5
48	4	MDC	UPOCMDC24048	200	Constitutional Law	3		75			10	5
49	4	MDC	UPOCMDC24049	200	E-commerce	3		75			10	5
50	4	MDC	UPOCMDC24050	200	Environmental Microbiology	3		75			10	5
51	4	MDC	UPOCMDC24051	200	Global Environment and Health	3		75			10	5
52	4	MDC	UPOCMDC24052	200	Green Chemistry	3		75			10	5

53	4	MDC	UPOCMDC24053	200	Guidance and Counseling	3	75			10	5
54	4	MDC	UPOCMDC24054	200	ICT Fundamentals	3	75			10	5
55	4	MDC	UPOCMDC24055	200	Introduction to Cosmic Ray Physics	3	75			10	5
56	4	MDC	UPOCMDC24056	200	Mathematical Economics	3	75			10	5
57	4	MDC	UPOCMDC24057	200	Nutrition and Diet	3	75			10	5
58	4	MDC	UPOCMDC24058	200	Political Economy and Development	3	75			10	5
59	4	MDC	UPOCMDC24059	200	Postcolonial Literature	3	75			10	5
60	4	MDC	UPOCMDC24060	200	Public Administration	3	75			10	5
61	4	MDC	UPOCMDC24061	200	Rural Studies	3	75			10	5
62	4	MDC	UPOCMDC24062	200	Social Work	3	75			10	5
63	4	MDC	UPOCMDC24063	200	Development Studies of Indian Economy	3	75			10	5

