

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:

- 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)*.

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).

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.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 |

