UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section

NOTIFICATION
(26/Nov./Adp/52)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Competent Bodies, is pleased to authorize the adoption of the Syllabi and Courses of Studies of **Five Year Integrated UG-PG Programme in Mathematical Science** of **Semester III** as per NEP-2020 **(as given in the Annexure)** for the examinations to be held in the years mentioned below:

Semester	**For the examinations to be held in the year**
Semester-III	December 2026, 2027 and 2028

The Syllabi of the courses is available on the University website: www.jammuuniversity.ac.in.

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/26/6951-65
Dated: 11/11/2026

Copy for information and necessary action to:
1. Dean, Faculty of Mathematical Science
2. Convener, Board of Studies in **Mathematics, Computer Science & IT and Statistics**
3. Sr. P.A.to the Controller of Examinations
4. All members of the Board of Studies
5. Programmer, Computer Section, Examination Wing
6. Guard File

Assistant Registrar (Academic)

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Statistical Inference in Machine Learning Paradigm

Course Code: UIMJSTT301
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

Mode: Lectures + Practical Lab + Fieldwork

Course Objective

This course aims to build a rigorous foundation in statistical inference while aligning concepts with machine learning workflows. Students will learn estimation, hypothesis testing, and Bayesian inference to help them in understanding, performance evaluation, and decision-making. The course will develop critical thinking, ethical reasoning, and collaborative analysis by utilising real-world datasets. By combining theoretical depth with hands-on applications, it will prepare learners for predictive intelligence across AI and ML domains.

Learning Outcomes:

- Understand key principles of statistical inference and their role in data-driven modelling
- Apply estimation techniques and test hypotheses for structured data analysis
- Incorporate Bayesian methods for classification, decision modelling, and learning from data
- Perform error analysis and uncertainty quantification in ML pipelines
- Engage in creative, interdisciplinary projects that emphasise problem solving with inference tools

Unit I: Foundations of Statistical Inference

Sampling distributions: t and Chi square data-generating mechanisms,

Properties of estimators: unbiasedness, efficiency, consistency, sufficiency

Rao-Blackwel Theorem, Cramer Rao Inequality (without proof), Concept of Maximum Likelihood Estimation (MLE).

Experiential learning Activities:

Python Lab: Estimate population parameters using simulated and real-world data

Case Study: Wildfire risk estimation using confidence intervals and MLE

Unit II: Hypothesis Testing and Decision Theory

Hypothesis formulation, Type I & II errors, and significance testing, Concept of p-value, Confidence intervals and interpretation in ML.

Parametric tests (t,F and Z), one-way Anova method, Assumptions of Anova, and non-parametric tests (Mann Whitney U test, Wilcoxon Signed Rank test and Kruskal Wallis test), power analysis

Activities:

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

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Semester: IIIrd

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Experiential learning Activities: Hypothesis testing applied to biodiversity or behavioural datasets

Unit III: Bayesian Inference in ML

Recap of Bayes' Theorem and belief updating, Proper and improper Priors, Conjugate prior, posterior, and likelihood functions, Loss functions, Bayes risk,

Statistical decision theory principles for ML model selection Bayesian estimation and credible intervals.

Activities:

Experiential learning Activities: Bayesian inference in wildlife migration patterns

Panel Discussion: "Bayesian vs Frequentist Perspectives in Intelligent Systems"

Unit IV: Inference-Driven ML Algorithms

Bootstrap resampling and cross-validation,

Applications in classification and unsupervised learning.

Experiential learning Activities:

Capstone Project: Develop an inference-driven ML model using real domain data (climate, health, or sustainability)

Creative and Skill-Based Enhancements

Simulation Labs: Use Python libraries like PyMC3, scikit-learn, and TensorFlow Probability

Interactive Dashboards: Explore effects of estimators and priors on outcomes using Plotly/Streamlit

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

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Course Code: UIMJSTT301
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

Evaluation Scheme

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Mid-Semester Test	50 %	2 hour	50
End-Semester Test	100 %	3 hours	70
Continuous Assessment/Seminar/Quiz etc.	100%		30
Total			150

- The Mid-Semester Examination will carry a weightage of 50 marks and will be based on Unit-1 and Unit-2. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 10 compulsory multiple-choice questions, each question carrying 1 mark. Section B will consist of two descriptive questions from each unit, out of which the candidate has to attempt one question from each unit, each question will carry 15 marks. Section C will be based on a case study worth 10 marks.
- The End-Semester Examination will carry a weightage of 70 marks. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 10 compulsory multiple-choice questions based on Unit-3 and Unit-4, each question carrying 1. Section B will consist of One compulsory descriptive question based on Unit-1 and Unit 2, and two descriptive questions from Unit 3 and Unit-4, out of which the candidate has to attempt one question from each unit, each question will carry 15 marks. Section C will be based on a case study worth 15 marks.
- The remaining 20% weightage will be based on Continuous Practical Assessment / Assignment/Tutorial/ Group Discussion/ Presentation/ Field Work/ Quiz/Project/ Survey as may be specified in the course.

Suggested Textbooks

Casella, G., and R. L. Berger. *Statistical Inference*. 2nd ed. Pacific Grove, CA: Duxbury Press, 2002.

Lehmann, E. L., and G. Casella. *Theory of Point Estimation*. 2nd ed. New York: Springer, 1998.

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Statistical Inference in Machine Learning Paradigm

Course Code: UIMJSTT301
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

Lehmann, E. L., and J. P. Romano. *Testing Statistical Hypotheses*. 3rd ed. New York: Springer, 2005.

DeGroot, M. H., and M. J. Schervish. *Probability and Statistics*. 4th ed. Boston: Addison-Wesley, 2012.

Robert, C. P. *The Bayesian Choice: From Decision-Theoretic Foundations to Computational Implementation*. 2nd ed. New York: Springer, 2007.

Gelman, A., J. B. Carlin, H. S. Stern, D. B. Dunson, A. Vehtari, and D. B. Rubin. *Bayesian Data Analysis*. 3rd ed. Boca Raton, FL: CRC Press, 2013.

Wasserman, L. *All of Statistics: A Concise Course in Statistical Inference*. New York: Springer, 2004.

Efron, B., and R. J. Tibshirani. *An Introduction to the Bootstrap*. New York: Chapman & Hall/CRC, 1994.

Murphy, K. P. *Machine Learning: A Probabilistic Perspective*. Cambridge, MA: MIT Press, 2012.

Bishop, C. M. *Pattern Recognition and Machine Learning*. New York: Springer, 2006.

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Linear Algebra for AI

Course Code: UIMJMA302
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

Mode: Lectures + Practical Lab

Course Objectives :

By the end of the course, students will be able to:

1. Understand fundamental concepts of linear algebra including vectors, matrices, linear systems, and transformations.
2. Apply linear algebra techniques to solve real-world problems in data science and AI such as image compression, recommendation systems, and regression.
3. Interpret geometrical and data-driven meanings of matrix operations like projection, rotation, and dimensionality reduction.
4. Gain proficiency in using computational tools (e.g., Python, spreadsheets) to implement linear algebra operations and visualize results.
5. Collaborate on creative and applied projects connecting algebraic reasoning to real-world data applications.

Unit 1: Vectors, and the Geometry of Data

- Scalars, vectors, and coordinate systems. Points in two and three dimensions. Row and column vectors. Vector addition, subtraction, and scalar multiplication. Magnitude of a vector, unit vectors, and normalisation. Distance between two points. Dot product and vector projection. Angle between vectors, orthogonality, and cosine similarity. Linear combination and span (conceptual only). Application: Data as points and vectors, document similarity in NLP.
- **Basic MATLAB Activities:** Overview of MATLAB environment. Creating vectors. Basic arithmetic and plotting.

Unit 2: Matrices, Linear Transformations, and Data Encoding

- Matrix as a data table. Order of a matrix. Types of matrices: row, column, square, zero, diagonal, scalar, identity, triangular, symmetric. Matrix operations: addition, subtraction, scalar multiplication, multiplication. Matrix-vector product as a transformation. Identity matrix, transpose, inverse. Determinants of order two and three. Singular and non-singular matrices. Elementary row operations, row echelon form, and rank. Standard transformation matrices: scaling, reflection, rotation, shear, and projection. Composition of transformations. Applications: Image transformations, image compression, one-hot encoding, encoding systems in AI.
- **Experiential Learning Activities:** Use a pixelated image matrix to apply transformations (e.g., flip, rotate).

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Linear Algebra for AI

Course Code: UIMJMA302
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

- **Basic MATLAB Activities:** Matrix creation and indexing. Matrix addition, subtraction, multiplication. Transpose, determinant, and inverse.

Unit 3: Systems of Equations and Linear Models in AI

- Linear equations in two and three variables. Systems of linear equations: graphical and algebraic methods. Matrix form Ax = b and the augmented matrix. Gaussian elimination. Gauss-Jordan elimination and reduced row echelon form. Matrix inverse method. Cramer's rule for orders two and three. Consistent and inconsistent systems. Unique, infinite, and no solution. Homogeneous systems and the trivial solution. Consistency in terms of rank. Applications: Predictive modeling using linear equations, resource allocation, network and traffic flow, balancing chemical equations.
- **Experiential Learning Activities:** Solve and visualize real-world systems (e.g., diet/nutrition optimizer).
- **Basic MATLAB Activities:** Solving systems using row reduction (rref), the matrix inverse method, and MATLAB's \ operator. Interpreting solutions (unique, infinite, none).

Unit 4: Eigenvalues, PCA, and Dimensionality Reduction

- Cayley-Hamilton theorem and its applications to the inverse and higher powers of a matrix. Concept of eigenvalues and eigenvectors. Characteristic equation. Eigenvalues of diagonal and triangular matrices. Trace and determinant in terms of eigenvalues. Matrix diagonalization (conceptual only). Mean, variance, and standardisation of data. Covariance and the covariance matrix. Curse of dimensionality and the need for dimensionality reduction. Principal Component Analysis (PCA). Principal components, explained variance, and choice of number of components. Singular Value Decomposition (conceptual only). Applications: Face recognition, visualization of high-dimensional data, image compression.
- **Experiential Learning Activities:** Conduct PCA on a simple dataset (e.g., Iris) and visualize results in 2D.
- **Basic MATLAB Activities:** MATLAB functions: eig, diag, inv.

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Linear Algebra for AI

Course Code: UIMJMA302
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

Evaluation Scheme

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Mid-Semester Test	50 %	2 hour	50
End-Semester Test	100 %	3 hours	70
Continuous Assessment/Seminar/ Quiz etc.	100%		30
Total			**150**

- The Mid-Semester Examination will carry a weightage of 50 marks and will be based on Unit-1 and Unit-2. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 10 compulsory multiple-choice questions, each question carrying 1 mark. Section B will consist of two descriptive questions from each unit, out of which the candidate has to attempt one question from each unit, each question will carry 15 marks. Section C will be based on a case study worth 10 marks.
- The End-Semester Examination will carry a weightage of 70 marks. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 10 compulsory multiple-choice questions based on Unit-3 and Unit-4, each question carrying 1. Section B will consist of One compulsory descriptive question based on Unit-1 and Unit 2, and two descriptive questions from Unit 3 and Unit-4, out of which the candidate has to attempt one question from each unit, each question will carry 15 marks. Section C will be based on a case study worth 15 marks.
- The remaining 20% weightage will be based on Continuous Practical Assessment / Assignment/Tutorial/ Group Discussion/ Presentation/ Field Work/ Quiz/Project/ Survey as may be specified in the course.

Reference Books

1. Strang, G. (2019). *Linear Algebra and Learning from Data*. Wellesley-Cambridge Press.
2. Savov, I. (2017). *No Bullshit Guide to Linear Algebra*. Mini reference Co.

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Course Title: Linear Algebra for AI

Course Code: UIMJMA302
Semester: IIIrd

Credits: 4+2
Total Marks: 150
Mid-Term :50
Assessments/Projects : 30
End-Term : 70

3. Golub, Gene H., and Loan Charles F. Van (2013). *Matrix Computations*. Johns Hopkins University Press.

Suggested Additional Readings

4. Strang, G. (2016). *Introduction to Linear Algebra* (5th ed.). Wellesley-Cambridge Press.
5. Lay, D. C., Lay, S. R., and McDonald, J. J. (2016). *Linear Algebra and Its Applications* (5th ed.). Pearson.
6. Deisenroth, M. P., Faisal, A. A., and Ong, C. S. (2020). *Mathematics for Machine Learning*. Cambridge University Press.

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Understanding Object Oriented Programming using Core Java

Course Code: UIMICST303

Credits: 3+1

Semester: IIIrd

Total Marks: 100

Mid-Term :30

Assessments/Projects : 20

End-Term : 50

Mode: Lectures + Practical Lab + Fieldwork

Prerequisites: Basic knowledge of computers; no prior programming experience required

Expected Learning Outcomes

By the end of this course, learners will be able to:

- Understand and implement OOP concepts using Java
- Design, code, test, and debug Core Java applications
- Handle errors effectively using Java's exception mechanism
- Use Java collections for structured data handling
- Create file-based Java applications with modular code

Unit I: Introduction to Java and Programming Fundamentals

Objective: Understand the basics of Java programming and how to set up a development environment.

introduction to programming concepts and paradigms, history and features of Java, setting up Java: JDK, JRE, and IDEs (Eclipse/IntelliJ/BlueJ), writing first Java program: HelloWorld, Java syntax, data types, variables, constants, operators: arithmetic, relational, logical, assignment, control statements: if, if-else, switch-case, loops: for, while, do-while, arrays: 1D and intro to 2D arrays, input/output using Scanner, System.out

Skill Focus: Java syntax, control flow, basic data handling

Assignments/Hands-on: Simple calculator, pattern printing, array sorting program

Unit II: Core Object-Oriented Programming Concepts

Objective: Understand and implement core OOP principles: classes, objects, and methods.

Introduction to OOP: need and benefits, class and object structure in Java, creating and using classes and objects, this keyword and constructors (default & parameterized), method overloading and static methods, access specifiers: private, public, protected, default, encapsulation: getters, setters, data hiding, packages and importing classes, practical examples: student, employee, product class, code review and debugging techniques

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Understanding Object Oriented Programming using Core Java

Course Code: UIMICST303 **Credits:** 3+1

Semester: IIIrd **Total Marks:** 100

Mid-Term :30

Assessments/Projects : 20

End-Term : 50

Skill Focus: Class design, encapsulation, code modularity

Experiential learning Activities: Implement basic class-based programs with encapsulated data

Unit III: Inheritance and Polymorphism in Java

Objective: Learn reusability and flexibility using inheritance and polymorphism.

Concept of inheritance: need and benefits, extends keyword, types of inheritance (single, multilevel, hierarchical), constructors in inheritance, super () keyword, method overriding and runtime polymorphism, final keyword and its applications, dynamic method dispatch, abstract classes and methods, interfaces: definition and implementation, difference between abstract classes and interfaces, case study: shape hierarchy, bank account system

Skill Focus: Reusability, abstraction, polymorphic behaviour

Experiential learning Activities: Implement polymorphic class hierarchies with abstract/interface usage

Unit IV: Exception Handling, Arrays, and Collections

Objective: Equip learners to write robust Java programs using exception handling and collection frameworks.

types of errors: compile-time vs runtime, exception handling basics: try, catch, finally, multiple catch blocks, throw and throws, custom exception classes, revisiting arrays and array of objects, introduction to Java collections framework, using ArrayList, LinkedList, HashSet, iterating collections using for-each and iterators, HashMap and basic map operations, mini project: student gradebook using ArrayList & Map

Skill Focus: Error handling, data structures, safe coding practices

Experiential learning Activities: Create programs with robust error handling and data storage using collections

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Understanding Object Oriented Programming using Core Java

Course Code: UIMICST303

Credits: 3+1

Semester: IIIrd

Total Marks: 100

Mid-Term :30

Assessments/Projects : 20

End-Term : 50

Suggested Tools

- IDEs: IntelliJ IDEA, Eclipse, BlueJ, NetBeans
- JDK: OpenJDK or Oracle JDK
- Documentation: https://docs.oracle.com/javase
- Git (optional for version control practice)

Evaluation Scheme:

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
Mid-Semester Test	50 %	1.5 hour	30
End-Semester Test	100 %	2.5 hours	40
Project	100%		30
Total			100

- The Mid-Semester Examination will carry a weightage of 30 marks and will be based on Unit-1 and Unit-2. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 10 compulsory multiple-choice questions, each question carrying 1 mark. Section B will consist of two descriptive questions from each unit, out of which the candidate has to attempt one question from each unit, each question will carry 7.5 marks. Section C will be based on a case study worth 5 marks.
- The End-Semester Examination will carry a weightage of 40 marks. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 10 compulsory multiple-choice questions based on Unit-3 and Unit-4, each question carrying 1 mark. Section B will consist of two descriptive questions from Unit 3 and Unit-4, out of which the candidate has to attempt one question from each unit, each question will carry 10 marks. Section C will be based on a case study worth 10 marks.
- The remaining 30% weightage will be based on Project based on the course.

Suggested References

1. Schildt, H. (2018). *Java: The Complete Reference* (11th ed.). McGraw-Hill Education.
2. Balagurusamy, E. (2019). *Programming with Java: A Primer* (6th ed.). McGraw-Hill Education India.

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Course Title: Understanding Object Oriented Programming using Core Java

Course Code: UIMICST303 **Credits:** 3+1

Semester: IIIrd **Total Marks:** 100

Mid-Term :30

Assessments/Projects : 20

End-Term : 50

3. Jamwal S. S. (2018). Java 9. Shroff Publishers and Distributors Pvt. Ltd.
4. Kanetkar, Y. (2018). *Let Us Java*. BPB Publications.
5. Horstmann, C. S. (2019). *Core Java Volume I – Fundamentals* (11th ed.). Pearson Education.
6. Rajiv Chopra. (2012). *Object-Oriented Programming with C++ and Java*. S. Chand Publishing.

Recommended Online Resources

Interactive Learning Platforms

- **W3Schools Java Tutorial**
  Simple, interactive lessons for absolute beginners.
- **GeeksforGeeks Java Programming**
  Rich in examples, exercises, and OOP explanations; widely followed by Indian students.
- **Java Programming – freeCodeCamp (YouTube)**
  A full beginner tutorial with practical Java coding demos.
- **Oracle Java Documentation**
  Official documentation for all core Java components.
- **JavaPoint**
  Popular among Indian learners for clear explanations and topic-wise navigation.

Practice Platforms

- **Replit – Java Compiler**
  Write and run Java code online without setting up an IDE.
- **Coding Ninjas Java Course (Paid/Scholarships Available)**
  Industry-relevant Java + DSA programs for Indian learners.
- **HackerRank Java Track**
  Problem-solving and challenge-based practice on Java fundamentals and OOP.

IDE Tutorials

- **BlueJ Tutorial** – Beginner IDE suitable for first-time programmers.
- **Eclipse Java Tutorial** – For learners using more robust development environments.

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Operations Research for Decision Making

Course Code: UIMDFMT304
Semester: IIIrd

Credits: 3
Total Marks: 75
Mid-Term :20
Assessments/Projects : 15
End-Term : 40

Mode: Lectures + Practical Lab + Fieldwork

Course Objective

This course aims to build a rigorous foundation in statistical inference while aligning concepts with machine learning workflows. Students will learn estimation, hypothesis testing, and Bayesian inference to help them in understanding, performance evaluation, and decision-making. The course will develop critical thinking, ethical reasoning, and collaborative analysis by utilising real-world datasets. By combining theoretical depth with hands-on applications, it will prepare learners for predictive intelligence across AI and ML domains.

Learning Outcomes:

- Understand key principles of statistical inference and their role in data-driven modelling
- Apply estimation techniques and test hypotheses for structured data analysis
- Incorporate Bayesian methods for classification, decision modelling, and learning from data
- Perform error analysis and uncertainty quantification in Machine Learning
- Engage in creative, interdisciplinary projects that emphasise problem solving with inference tools

Unit I: Introduction to LPP

Mathematical Formulation for LPP, Solution, Feasible Solution, Basic Solution, Basic Feasible Solution, Convex set, Slack and Surplus Variables, Artificial variables, Standard form of LPP, Graphical methods for finding the solutions of LPP Activity: Solve real-world optimization problems (e.g., diet problem, workforce scheduling) using graphical methods. Simplex Algorithm and Big M method for solving LPP.

Group activity: students model a practical problem into LPP form and present their formulation.

Unit II: Transportation and Network Models

Transportation problem, Method for formulation of Transportation Problem as LPP, Methods for finding Initial Basic Feasible Solutions (Northwest Corner, Least Cost, Vogel's Approximation)

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Operations Research for Decision Making

Course Code: UIMDFMT304
Semester: IIIrd

Credits: 3
Total Marks: 75
Mid-Term :20
Assessments/Projects : 15
End-Term : 40

Network Models: Shortest path problem, Minimum spanning tree, Maximum flow problem, Project scheduling with PERT/CPM

Lab exercise: Implement shortest path algorithms (Dijkstra, Bellman-Ford) in R/Python.

Group project: Simulate a PERT/CPM chart for a real project (e.g., event planning).

Unit III: Operations Research in Machine Learning

Dynamic Programming: resource allocation problems, Applied examples (inventory control, shortest path, knapsack problem)
Operations Research in Machine Learning:
Optimization in ML (gradient descent, convex optimization),
OR concepts in regression, clustering, and scheduling algorithms.

Capstone Project: Students select a real-world problem (logistics, healthcare scheduling, machine learning optimization) and solve it using OR techniques.

Seminar Presentation: Each group presents one advanced OR application (e.g., OR in AI, supply chain, or public policy).

Evaluation Scheme:

	Syllabus to be covered in the examination	**Time allotted for the examination**	**%Weightage (Marks)**
Mid-Semester Test	50 %	1.5 hours	20
End-Semester Test	100 %	3 hours	40
Continuous Assessment/Seminar/Quiz etc.	100%		15
Total			75

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

- The Mid-Semester Examination will carry a weightage of 20 marks and will be based on Unit-1 and Unit-2. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 05 compulsory multiple-choice questions, each question carrying 1 mark. Section B will consist of two descriptive questions from each unit, out of which the candidate has to attempt one question from each unit, each question will carry 5 marks. Section C will be based on a case study worth 5 marks.

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course Title: Operations Research for Decision Making

Course Code: UIMDFMT304
Semester: IIIrd

Credits: 3
Total Marks: 75
Mid-Term :20
Assessments/Projects : 15
End-Term : 40

- The End-Semester Examination will carry a weightage of 40 marks. The question paper will be divided into three sections viz., A, B, and C. Section A will consist of 05 compulsory multiple-choice questions based on Unit-3 and Unit-4, each question carrying 1. Section B will consist of One compulsory descriptive question based on Unit-1 and Unit 2, and two descriptive questions from Unit 3 and Unit-4, out of which the candidate has to attempt one question from each unit, each question will carry 10 marks. Section C will be based on a case study worth 05 marks.
- The remaining 15 marks weightage will be based on Continuous Practical Assessment / Assignment/Tutorial/ Group Discussion/ Presentation/ Field Work/ Quiz/Project/ Survey as may be specified in the course.

Suggested Book Readings:

- Hillier, F. S., and G. J. Lieberman. *Introduction to Operations Research*. 10th ed. New York: McGraw-Hill, 2020.
- Taha, H. A. *Operations Research: An Introduction*. 10th ed. Pearson, 2017.
- Winston, W. L. *Operations Research: Applications and Algorithms*. 4th ed. Belmont, CA: Thomson Brooks/Cole, 2004.
- Bazaraa, M. S., J. J. Jarvis, and H. D. Sherali. *Linear Programming and Network Flows*. 4th ed. Wiley, 2010.
- Bertsekas, D. P. *Dynamic Programming and Optimal Control*. Vol. 1. 4th ed. Athena Scientific, 2017.
- Myerson, R. B. *Game Theory: Analysis of Conflict*. Harvard University Press, 1991.
- Boyd, S., and L. Vandenberghe. *Convex Optimization*. Cambridge University Press, 2004.

Syllabus for Five Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

पाठ्यक्रम का शीर्षक: संचार हेतु हिंदी भाषा

पाठ्यक्रम कोड: UIAEFMT305

क्रेडिट (अंक): 3

सत्र: तीसरा

कुल अंक: 75

मध्य-सेमेस्टर परीक्षा : 20

सतत मूल्यांकन/संगोष्ठी/प्रश्नोत्तरी :15

सेमेस्टर-अंत परीक्षा : 40

शिक्षण पद्धति: व्याख्यान + प्रायोगिक प्रयोगशाला + क्षेत्रकार्य

पाठ्यक्रम के उद्देश्य (Course Objectives):

- शैक्षणिक एवं व्यावसायिक संदर्भों में हिंदी में प्रभावी संप्रेषण कौशल का विकास करना
- गणित, सांख्यिकी एवं कंप्यूटर विज्ञान जैसे तकनीकी और विश्लेषणात्मक विषयों के विद्यार्थियों को अपने विचार हिंदी में स्पष्ट रूप से व्यक्त करने में सक्षम बनाना
- प्रस्तुतियों, प्रतिवेदनों तथा सहयोगात्मक परियोजनाओं में हिंदी के उपयोग को एकीकृत करना
- साक्षात्कार, संगोष्ठियों तथा कार्यस्थल पर मौखिक एवं लिखित संप्रेषण के लिए आत्मविश्वास विकसित करना

इकाई -1. हिंदी संप्रेषण की आधारभूत संकल्पनाएँ (Foundations of Hindi Communication)

प्रयोजनमूलक हिंदी:

1. हिंदी ध्वनियाँ और मजेदार उच्चारण खेल

स्वर एवं व्यंजन का उच्चारण , महाप्राण–अल्पप्राण (क–ख, ग–घ) , मूर्धन्य–दन्त्य (ट–त, ड–द), श, ष, स का अंतर , गणितीय शब्दों का सही उच्चारण, हिंदी में पहेलियाँ और गणितीय क्विज़, हिंदी में संक्षिप्त टिप्पणियाँ, व्याकरणिक भूलें और निराकरण, हिंदी अंक, संख्या आधारित पहेलियाँ, तार्किक प्रश्न, शब्द-खेल, शुद्ध-अशुद्ध शब्द.

उदाहरण: ऐसा कौन-सा अंक है जो उल्टा करने पर भी वैसा ही दिखता है?

- **गतिविधि:**

"गलत उच्चारण की पहचान, सूदको, क्रॉस वर्ड, शब्द-अन्ताक्षरी, शब्द खोज (वर्ड सर्च), भाषा डिबगिंग (Debugging), Tongue Twisters (जुबानी कसरत), **उदाहरण:** खड़क सिंह के खड़खड़ाने से.../चंदू के चाचा ने... , **समाचार वाचन:** विज्ञान समाचार , ISRO, AI, गणित दिवस, नई तकनीक

इकाई–II : शैक्षणिक एवं तकनीकी संदर्भों के लिए अनुप्रयुक्त हिंदी (Applied Hindi for Academic & Technical Contexts)

प्रस्तुतीकरण हेतु हिंदी: भाषण या प्रस्तुति की संरचना, तकनीकी शब्दों का हिंदी में प्रयोग, कार्यालयी हिंदी, प्रतिवेदन लेखन, पत्र लेखन, शीर्षक लेखन, प्रेस विज्ञप्ति, Google translate बनाम मानव अनुवाद, हिंदी की पारिभाषिक शब्दावली (गणित, सांख्यिकी, संगणक विज्ञान के विशेष सन्दर्भ में), हिंदी में जीवन-वृत्त (CV) की प्रविष्टियाँ, कार्यालीन अभिव्यक्तियाँ, तैयार करना।, हिंदी टाइपिंग, हिंदी कुंजीपटल, हिंदी के विभिन्न फोंट्स, हिंदी यूनिकोड, गूगल इंडिक टूल, हिंदी फ्लायर का निर्माण, Emoji से वाक्य निर्माण, डाटा से कहानी (Storytelling with data), चित्र से शब्द.

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पाठ्यक्रम का शीर्षक: संचार हेतु हिंदी भाषा (Hindi Language for Communication)

पाठ्यक्रम कोड: UIAEFMT305

क्रेडिट (अंक): 3

सत्र: तीसरा

कुल अंक: 75

मध्य-सेमेस्टर परीक्षा : 20

सतत मूल्यांकन/संगोष्ठी/प्रश्नोत्तरी :15

सेमेस्टर-अंत परीक्षा : 40

गतिविधि:

समूह गतिविधि: गणित, सांख्यिकी अथवा कंप्यूटर विज्ञान के किसी विषय का हिंदी में सार (Abstract) तैयार करना, विभिन्न विषयों में पत्र लेखनव शीर्षक लेखन, जीवन वृत्त तैयार करना, कार्यालयी हिंदी Escape room, Kahoot/ Quiz, भाषा hackathon

इकाई–III : हिंदी में व्यावसायिक एवं सृजनात्मक संप्रेषण (Professional & Creative Communication in Hindi)

सृजनात्मक अभिव्यक्ति: तकनीक विषयक ब्लॉग, लेख, किसी घटना, दृश्य अथवा स्थल का वर्णन अथवा लघु कहानी लिखना, सार्वजनिक भाषण: हिंदी में संक्षिप्त भाषण या प्रस्तुति देना।

गतिविधि:

हिंदी में मॉक इंटरव्यू (Mock Interview), स्वरचित कहानी या कविता प्रस्तुति व लेखन, हिंदी लेखन/फिल्म/पुस्तक की सहपाठी समीक्षा (Peer Review) करना।

मूल्यांकन योजना (Evaluation Scheme) :

परीक्षा	पाठ्यक्रम का कवरेज	परीक्षा अवधि	अंक/भारांक (%)
मध्य-सेमेस्टर परीक्षा	50%	1.5 घंटे	20
सेमेस्टर-अंत परीक्षा	100%	3 घंटे	40
सतत मूल्यांकन/संगोष्ठी/प्रश्नोत्तरी आदि	100%	—	15
कुल	—	—	**75**

विद्यार्थियों का मूल्यांकन पाठ्यक्रम के संचालन के दौरान निरंतर निम्न प्रकार से किया जाएगा:

• **मध्य-सेमेस्टर परीक्षा (20 अंक):** यह परीक्षा इकाई–I एवं इकाई–II पर आधारित होगी। प्रश्न-पत्र तीन खंडों—A, B तथा C—में विभाजित होगा।

- **खंड A:** 5 अनिवार्य बहुविकल्पीय प्रश्न, प्रत्येक 1 अंक का।
- **खंड B:** प्रत्येक इकाई से दो वर्णनात्मक प्रश्न दिए जाएंगे, जिनमें से प्रत्येक इकाई से एक प्रश्न करना होगा। प्रत्येक प्रश्न 5 अंक का होगा।
- **खंड C:** 5 अंकों का एक अध्ययन-प्रकरण (Case Study) होगा।

• **सेमेस्टर-अंत परीक्षा (40 अंक):** प्रश्न-पत्र तीन खंडों—A, B तथा C—में विभाजित होगा।

- **खंड A:** इकाई–III एवं इकाई–IV पर आधारित 5 अनिवार्य बहुविकल्पीय प्रश्न, प्रत्येक 1 अंक का।

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पाठ्यक्रम का शीर्षक: संचार हेतु हिंदी भाषा(Hindi Language for Communication)

पाठ्यक्रम कोड: UIAEFMT305

क्रेडिट (अंक): 3

सत्र: तीसरा

कुल अंक: 75

मध्य-सेमेस्टर परीक्षा : 20

सतत मूल्यांकन/संगोष्ठी/प्रश्नोत्तरी :15

सेमेस्टर-अंत परीक्षा : 40

- **खंड B:** इकाई–I एवं इकाई–II से एक अनिवार्य वर्णनात्मक प्रश्न तथा इकाई–III एवं इकाई–IV से दो-दो प्रश्न दिए जाएंगे, जिनमें से प्रत्येक इकाई से एक प्रश्न करना होगा। प्रत्येक प्रश्न 10 अंक का होगा।
- **खंड C:** 5 अंकों का एक अध्ययन-प्रकरण (Case Study) होगा।

• शेष **15 अंक** सतत व्यावहारिक मूल्यांकन/असाइनमेंट/ट्यूटोरियल/समूह चर्चा/प्रस्तुतीकरण आदि के आधार पर निर्धारित किए जाएंगे।

Syllabus for Five-Year UG-PG Integrated Programme in Mathematical Sciences as per National Education Policy (NEP) 2020 for Semester-III examinations to be held in Dec-2026,2027 and 2028

Course No: UIVAFMT 306 **Title:** Internship/Survey/Industrial training
Credit Hours :02 **Maximum Marks:** 50

Course Outcomes:
It shall be a short-term summer internship/Project of 30 days duration at the end of Semester 2nd during the summer vacations. Students will go for a job/professional training in a suitable organization or hands-on training or activity-based course at university level in order to gain work experience.

All students will undergo internships/ Apprenticeships/project in a firm, industry, or organization or labs with faculty or researchers in their field or other HEIs/research institutions during the summer break. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Community engagement and service: The curricular component of 'community engagement and service' seeks to expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems. This will be part of summer term activity.

Field-based learning/minor project: The filed-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems.

SCHEME OF EXAMINATION

The internship shall be under a teacher of Faculty of Mathematical Sciences who will be designated as Internship Supervisor. After completion of summer internship/Project/Training students will have to produce a report related to the work carried out duly signed by the internship supervisor and Dean of the Faculty of Sciences.

The Board of Examiners consisting of Dean, Faculty of Mathematical Sciences, three members of Board of studies of FMS, and internship supervisor shall evaluate/assess performance of the students.

The work will be assessed on the following components:

Contents of the Report	Domain Knowledge	Seminar Presentation	Total
20	20	10	50

Note: The minimum passing criteria for the summer internship are 40%.