Name of the Department: Mathematical Sciences

Programme: B.Sc. (Hons.) Mathematics

Paper UC-BSHM-101-19 Calculus-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic concepts of Differential and Integral Calculus.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO2: Visualize all concepts geometrically.	√	√	√	√	√	Appplying	Yes	Mid semester tests, End Term Exams
CO 3: Sketch curves of the functions intuitively with the help of Differential Calculus.	√	√	√	√	√	Evaulation	Yes	Mid semester tests, End Term Exams
CO 4: Apply the knowledge of Differential and Integral Calculus.		√	√	√		Applying	Yes	Mid semester tests, End Term Exams
CO 5: Understand the fundamental relation between differential and Integral Calculus.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-102-19 Co-ordinate Geometry

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the different types of plane figures.	√	√	√	√	√	Evaulation	Yes	Mid semester tests, End Term Exams
CO2: Visualize two-dimensional shapes geometrically.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO3: Apply the knowledge of geometry of two dimensions in advance courses in mathematics.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO4: Explain the Cartesian and Polar coordinate systems to study two dimensional shapes.	√	√	√	√	√	Evaulation	Yes	Mid semester tests, End Term Exams
CO5: Study further the geometry of three dimensions.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-103-19 Programming Lab-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the basic concepts of programming.	√	√	√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 2: Apply the knowledge of programming in different Matrix Operations.	√	√	√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 3: Use programming in plotting and visualization of graphs of algebraic and transcedental functions.	√	√	√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Obtain Surface of revolution of curves.	√	√	√	√	√	Evaulation	Yes	Internal Viva-voce, External Viva-voce
CO 5: Study further the tracing of conics.	√	√	√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce

Paper UC-BSHP-112-19 Electricity and Magnetism

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand and describe the different concepts of electromagnetism					√	Understanding	Yes	Mid semester tests, End Term Exams
CO2: To obtain the electric and magnetic fields for simple configurations under static conditions.					√	Applying	Yes	Mid semester tests, End Term Exams
CO3: To analyse time varying electric and magnetic fields.					√	Evaulation	Yes	Mid semester tests, End Term Exams

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CO4: To understand Maxwell's equation in different forms and different media.		√	Understanding	Yes	Mid semester tests, End Term Exams
CO5: Have a solid foundation in fundamentals required to solve problems and also to pursue higher studies.		√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHP-113-19 Physics Lab-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Able to verify the theoretical concepts/laws learnt in theory courses.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO 2: Trained in carrying out precise measurements and handling sensitive equipment.					√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 3: Understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors".					√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 4: Learn to draw conclusions from data and develop skills in experimental design.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO 5: Document a technical report which communicates scientific information in a clear and concise manner.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce

Paper UGCA-1902 Fundamentals of Computer and IT

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understanding the concept of input and output devices of Computers			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Learn the functional units and classify types of computers, how they process information and how individual computers interact with other computing systems and devices.			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Understand an operating system and its working, and solve common problems related to operating systems			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Learn basic word processing, Spreadsheet and Presentation Graphics Software skills.			√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Study to use the Internet safely, legally, and responsibly			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UGCA- 1906 Fundamentals of Computer and IT Laboratory

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Familiarizing with Open Office (Word processing, Spreadsheets and Presentation).			√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 2: To acquire knowledge on editor, spread sheet and presentation software.			√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 3: The students will be able to perform documentation and accounting operations.			√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Students can learn how to perform presentation skills.			√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce

Paper BBA-GE101-18 Managerial Economics I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO

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Course Outcome		PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic concepts of managerial economics and apply the economic way of thinking to individual decisions and business decisions.						√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Measure price elasticity of demand, understand the determinants of elasticity and apply the concepts of price, cross and income elasticity of demand.						√	Apply	Yes	Mid semester tests, End Term Exams
CO 3: Understand and estimate production function and Law of Diminishing Marginal Utility.						√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand and explain four basic market models of perfect competition, monopoly, monopolistic competition, and oligopoly, and how price and quantity are determined in each model.						√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the different costs of production and how they affect short and long run decisions.						√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHL-105-19 Communicative English -I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Acquire basic proficiency in reading &listening, writing and speaking skills					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Be able to understand spoken and written English language, particularly the language of their chosen technical field.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Be able to converse fluently.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Be able to produce on their own clear and coherent texts.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 5: Become proficient in professional communication, such as, interviews, group discussions, office environments, important reading skills as well as writing skills and thereby will have better job prospects.					√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHL-106A-19 ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ (Punjabi Compulsory)-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Translate and transfer/broadcast the western scientific knowledge in the local language.					√	Applying	Yes	Mid semester tests, End Term Exams
CO2: Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.					√	Applying	Yes	Mid semester tests, End Term Exams
CO3: Understand the society through Punjabi language, literature and culture					√	Understanding	Yes	Mid semester tests, End Term Exams
CO4: Learning science and in developing science literacy.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO5: Improve the internal communication.					√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHL-106B-19 ਮੁਢਲੀ ਪੰਜਾਬੀ (Mudhli Punjabi)-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Translate and transfer/broadcast the western scientific knowledge in the local language.					√	Applying	Yes	Mid semester tests, End Term Exams

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CO2: Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.					√	Applying	Yes	Mid semester tests, End Term Exams
CO3: Understand the society through Punjabi language, literature and culture					√	Understanding	Yes	Mid semester tests, End Term Exams
CO4: Learning science and in developing science literacy.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO5: Improve the internal communication.					√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-201-19 Calculus-II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the techniques to sketch a curve using the concepts of differential calculus.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Visualize all concepts of differential calculus geometrically	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Understand the concept of integration.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand the fundamental relation between differential and integral Calculus.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Apply the knowledge of integral calculus in finding length of arc, area under curves, volume and area of surface swept by curve during revolution.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-202-19 Solid Geometry

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Use the idea of three-dimensional Cartesian coordinate system, shift of origin and rotation of axes.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO2: Demonstrate knowledge and understanding of three dimensional shapes and their properties.	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO3: Visualize the three dimensional shapes, for example sphere, cylinder and cone etc.	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO4: Utilize the knowledge of geometry of three dimensions in other branches of mathematics, for example calculus and analysis.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-203-19 Computer Algebra System: MATLAB

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the basic concepts of programming	√	√	√	√	√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO 2: Visualize functions in 2-D and 3-D	√	√	√	√	√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO 3: Make their own computer programs for solving problems of their interest	√	√	√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Use symbolic tools of MATLAB for solving problems arising in various fields of applications	√	√	√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce

Paper UC-BSHP-124-19 Waves and Vibrations

HOD (Mathematical Sci.)

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Identify and illustrate physical concepts and terminology used in optics and other related wave phenomena					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 2: Analyze and understand the phenomenon of interference, and diffraction and their applications					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Get thorough knowledge of the polarization of light and its changes upon reflection and transmission and will learn to analyze the polarization in optical systems.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand the simple harmonic motion and its application.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Describe the different types of lasers, its principle, properties of laser beam.					√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-BSHP-125-19 Physics Lab-II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Able to understand the theoretical concepts learned in the theory course.					√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 2: Trained in carrying out precise measurements and handling equipment.					√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 3: Learn to draw conclusions from data and develop skills in experimental design.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO 4: Able to understand the principles of error analysis and develop skills in experimental design.					√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 5: Able to document a technical report which communicates scientific information in a clear and concise manner.					√	Applying	Yes	Internal Viva-voce, External Viva-voce

Paper UGCA-1909 Object Oriented Programming using C++

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: To learn programming from real world examples.			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: To understand Object oriented approach for finding Solutions to various problems with the help of C++ language.			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: To create computer based solutions to various real-world problems using C++			√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: To learn various concepts of object oriented approach towards problem solving			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BHCL-113-19 Introduction to Organic Chemistry

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the fundamental concepts of organic chemistry i.e structure, bonding and various effects in organic compounds.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: To learn the stereochemistry viz. optical isomerism, stereoisomerism and conformational isomerism of organic compounds					√	Understanding	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 3: To study the various known reactive intermediate in organic synthesis					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: To learn the fundamental and advanced concepts of reaction mechanisms along with the study of reaction mechanisms in various types of substitution addition and elimination reactions.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: To predict the relationships between organic chemical structures and their reactivity					√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-BHCP-

119-19 Introduction to Organic Chemistry
Lab

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: To check the purity of organic compounds by determining the melting or boiling points					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO2: To develop preparative skills for purification of organic compounds by crystallization method.					√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO3: To determine the element or functional groups present in organic compound by organic qualitative analysis.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO4: To present their work with practical skills and the awareness of health and safety procedures.					√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO5: To apply related experiments for their research work.					√	Applying	Yes	Internal Viva-voce, External Viva-voce

Paper BBA-GE 201-

18 Managerial Economics II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the concept of national income and its measurement using different approaches.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO2: Describe the underlying theories of demand and supply of money in an economy.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO3: Make use of employment and national income statistics students will be able to describe and analyze the economy in quantitative terms.					√	Applying	Yes	Mid semester tests, End Term Exams
Co4: Interpret macroeconomic issues like money, inflation and unemployment.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO5: Identify the phases of the business cycle and the problems caused by cyclical fluctuations in the market economy					√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-BHHL-

115-19 Communicative English -II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Acquire basic proficiency in reading &listening, writing and speaking skills					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Be able to understand spoken and written English language, particularly the language of their chosen technical field.					√	Understanding	Yes	Mid semester tests, End Term Exams

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| | | | | | | V | Understanding | Yes | Mid semester tests, End Term Exams |

CO 3: Be able to converse fluently.									
CO 4: Be able to produce on their own clear and coherent texts.						V	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Become proficient in professional communication, such as, interviews, group discussions, office environments, important reading skills as well as writing skills and thereby will have better job prospects.						V	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BHHL-116A PUNJABI COMPULSORY-II (ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-II)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Translate and transfer/broadcast the western scientific knowledge in the local language.					V	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.					V	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Understand the society through Punjabi language, literature and culture.					V	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Learning science and in developing science literacy.					V	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Improve the internal communication.					V	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BHHL-116B MUDHLI PUNJABI-II (ਮੁਢਲੀ ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-II)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Translate and transfer/broadcast the western scientific knowledge in the local language.					V	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Translate and transfer the indigenous/traditional scientific knowledge available in local knowledge into English and other global languages.					V	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Understand the society through Punjabi language, literature and culture.					V	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Learning science and in developing science literacy.					V	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Improve the internal communication.					V	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-301-19 Calculus-III

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the functions of several variables and their behavior	V	V			V	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Find the partial derivatives, understand its geometrical meaning and understand their relation with total derivative	V	V			V	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Find the maxima and minima of function of several variables and their expansion	V	V			V	Evaluation	Yes	Mid semester tests, End Term Exams

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	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 4: Understand the integrals of the functions of several variables and their geometrical interpretation	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Applications of the calculus of several variables in the real world.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-302-19 Algebra-I

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Use the De Moivre's theorem for solving problems concerning powers of complex numbers and complex roots of polynomials etc.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Use matrices in solving system of equations.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Demonstrate linear independence and dependence of a set of vectors.	√	√			√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Find inverse of a matrix using Gauss-Jordan method.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Demonstrate the nature of solutions of polynomial equations.	√	√			√	Evaluation	Yes	Mid semester tests, End Term Exams
CO6: Use Cardano's method, Ferrari method and Descarte's method for finding solutions of equations.						Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-303-19 Real Analysis-I

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Learn the basic concepts of Real line and its properties.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand about bounded, unbounded and limit suprema and infima.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Use of Monotone Convergence theorem for the calculation of square roots.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Be acquainted with knowledge of convergent and divergent sequences.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Apply the learnt tests in establishing convergence, divergence, absolute convergence and conditional convergence of infinite series.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHP-214-19 Elements of Modern Physics

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Gained a deep understanding on the motivations that have led in the past century to the relativistic and quantum revolution in physics					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Demonstrate ability to apply wave-particle duality and uncertainty principle to solve physics problems.					√	Evaluation	Yes	Mid semester tests, End Term Exams

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HOD(Mathematical Su.)

Course Outcome						Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 3: Demonstrate ability to solve quantum mechanical eigenvalue equations for various operators and obtain expectation values of the corresponding observables.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Demonstrate ability to solve 1-D quantum problems including the quantum particle in a box, a well, the simple harmonic oscillator, and the transmission and reflection of waves.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 5: solve problems involving the quantization of mass, charge, light, and energy including Avogadro's number, black-body radiation, photoelectric effect, and other related issues.					√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHP-215-19 Physics Lab-III

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Able to understand the theoretical concepts learned in the theory course.					√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO2: Trained in carrying out precise measurements and handling equipment.					√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO3: Learn to draw conclusions from data and develop skills in experimental design.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO4: Able to understand the principles of error analysis and develop skills in experimental design.					√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO5: Able to document a technical report which communicates scientific information in a clear and concise manner.					√	Applying	Yes	Internal Viva-voce, External Viva-voce

Paper UGCA1914 Programming in Python

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Familiar with Python environment, data types, operators used in Python.			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Compare and contrast Python with other programming languages.			√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Learn the use of control structures and numerous native data types with their methods.			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Design user defined functions, modules, and packages and exception handling methods.			√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Create and handle files in Python and learn Object Oriented Programming Concepts.			√	√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UGCA1917 Programming in Python Laboratory

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Solve simple to advanced problems using Python language.			√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce

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CO		PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 2: Develop logic of various programming problems using numerous data types and control structures of Python.									
CO 3: Implement different data structures.		√	√	√			Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Implement modules and functions.		√	√	√			Applying	Yes	Internal Viva-voce, External Viva-voce
CO 5: Design and implement the concept of object oriented programming structures.		√	√	√			Applying	Yes	Internal Viva-voce, External Viva-voce
		√	√	√			Evaluation	Yes	Internal Viva-voce, External Viva-voce

Paper UC-BHCL-204-19 PHYSICAL CHEMISTRY

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic principles and theories pertaining to different states of matter					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Solve various problems related to pH					√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Define the various laws pertaining to gaseous state and solutions.					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Familiarise with the different colligative properties of solutions and the concept of abnormal molecular mass					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the basic structure and symmetry elements in solids					√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BHCL-
208-19 Chemistry Lab-III

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic procedures for carrying out a physical chemistry practical like preparation and standardisation of solutions, handling the equipments and measuring with precision.					√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO2: Correlate the theoretical and practical aspects and know about the limits of the experimental error.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO3: Determine the various physical parameters for the various problems under study.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO4: Verify various laws studied in the theory part.					√	Evaluation	Yes	Internal Viva-voce, External Viva-voce

Paper BBA 301-18 Organizational Behaviour

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: To explain the basics of Orgnaizational behavlour and various challenges for OB					√	Understanding	Yes	Mid semester tests, End Term Exams
CO2: To illustrate the foundations of Individual Behaviour and various factors influencing individual behaviour viz. learning, personality, perception, attitude and motivation.					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO3: To examine the dynamics of group development and group properties.					√	Evaluation	Yes	Mid semester tests, End Term Exams

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CO4 To understand various dimensions of organisational culture								
CO5. To analyse the process of conflict management and approaches to stress management					✓	Understanding	Yes	Mid semester tests, End Term Exams
					✓	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-401-19 Vector Calculus

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1 Learn the basic concepts of Vector algebra, Dot product, Cross product.	✓	✓	✓	✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2 Learn about operations on vectors, such as, vector triple product, scalar triple product.	✓	✓	✓	✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 3 Understand the Differentiation of Vector valued functions, Scalar valued functions, gradient, Divergence and curl.	✓	✓	✓	✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4 Be acquainted with Line, Surface and Volume integrals of vector (or scalar) valued functions. And, Gauss, Divergence and Stokes theorem, Tensors.	✓	✓	✓	✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5 Apply the learnt techniques in solving various problems related to vectors.	✓	✓	✓	✓	✓	Applying	Yes	Mid semester tests, End Term Exams
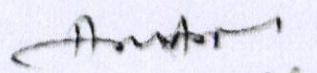
Paper UC-BSHM-402-19 Ordinary Differential Equations

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1 Understand the basic definitions to know about ordinary differential equations, its various types and their solutions	✓	✓			✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2 Visualize the geometrical meaning of first order differential equation.	✓	✓			✓	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3 Understand the fundamental concepts about existence and uniqueness of solution of initial value problem	✓	✓			✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4 Understand the applications of differential equations in different type of phenomenon.	✓	✓			✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5 Apply power series method to obtain series solutions of differential equations	✓	✓			✓	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-403-19 Linear Algebra

Course Outcome

	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1 Deal with the notions of vector spaces and linear transformations.	✓	✓			✓	Applying	Yes	Mid semester tests, End Term Exams
CO 2 Demonstrate matrix representation of linear transformation.	✓	✓			✓	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3 Deal with the eigenvalue and eigenvector problem arising in different fields of applications, for instance, in solution of system of linear differential equations and stability of numerical methods etc.	✓	✓			✓	Evaluation	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 4: Diagonalize a given matrix using the eigenvalues and eigenvectors of the corresponding matrix.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Demonstrate similarity of matrices and use of a method to check similarity of two matrices.	√	√			√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-BSNM-404-19 Probability and Statistics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the measures of central tendency, the concepts like skewness and standard deviation of the data.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Correlate bivariate and multivariate data.	√	√			√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Fit the curve by collecting random data and understand regression lines.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Understand the mathematical definition of probability, conditional probability and its applications.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the theoretical concepts like random variable, probability distribution, generating functions and their usage.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams

Paper EVS-101A Environmental Studies

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the fundamental concepts about Environment and its components.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Know about various types of natural resources, their functions, uses, exploitation and the problems arise due to these along with suitable case studies.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Gain knowledge about working of various ecosystems, their features and functions and energy flow through them.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Know about biodiversity, its various forms, importance and important areas	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSM-501-19 Real Analysis-II:
Metric Spaces and Reimann Integration

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic concepts of Real Analysis.	√				√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Visualize abstract mathematical concepts	√					Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Understand basic theorems related to real analysis	√					Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand the logical concepts and apply the knowledge to derive the basic results	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the behavior of Reimann integrable functions		√			√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSM-502-19 Algbera-II

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Deal with different algebraic structures occurring in abstract algebra.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 2: Analyze algebraic structure Group and its properties.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Analyze algebraic structure Ring and its properties.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Apply the knowledge of abstract mathematics in studying advanced pure mathematics.	√				√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Apply the methods of proofs in proving theoretical results in other branches, for example, in science and engineering.	√				√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSM-S03-19 Numerical Methods

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Find approximate numerical solutions of nonlinear equations and system of linear algebraic equations.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Develop and use interpolating polynomials when explicit form of the function of interest is not known or complicated to deal with.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Deal with differentiation and definite integral problems approximately when it is difficult to get exact evaluation of these.	√	√			√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Apply the numerical methods for solving ordinary differential equations when it is difficult to deal with them analytically.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Apply the understanding of computational techniques in dealing with real world problems occurring in science and engineering.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSM-S04-19 Partial Differential Equation (PDE)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Solve linear partial differential equations of both first and second order.	√				√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Classify the Partial differential equations.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Apply problem-solving using concepts and techniques from PDE's and Fourier analysis applied to diverse situations in physics, engineering and in other mathematical contexts.	√				√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Demonstrate accurate and efficient use of Fourier analysis techniques and their applications in the theory of PDE's.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 5: Solve real problems by identifying them appropriately from the perspective of partial derivative equation.	√				√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-601-19 Number Theory

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand well ordering principle, Archimedean Property, Binomial theorem, Triangular number	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Describe basic properties of GCD and LCM and having the ability to compute them.	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Decide the primality of a given number and be able to understand the concept of infinite primes.	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Apply Chinese remainder theorem.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Understand the utility of Divisibility tests.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSM-602-19 Complex Analysis

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand Complex functions, its continuity and differentiability.	√				√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Describe basic properties of complex integration and having the ability to compute such integrals.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Decide when and where a given function is analytic and be able to find its series development.	√				√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Apply residue theorem to compute the several kinds of real integrals.	√				√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Understand the concept of conformal transformation and bilinear transformation.	√				√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSM-603-19 Mechanics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the system of different forces and its effect on the physical body.		√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand the various concepts of statics and dynamics.		√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Understand the various mathematical laws of mechanics dealing with the motion of the particle and the static equilibrium.	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Apply the knowledge of Mechanics in solving real life problems related to mechanics.		√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Visualize the real life mechanical problems related to science and engineering and frame the mathematical problems along with suggested solutions.	√	√			√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-604-19 Discrete Mathematics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand sets, relations, and functions.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 2: Describe basic properties of graph theory.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Decide when and where a given function is one-one, onto.	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Apply logics for inferences.	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Understand the applicability of basic counting principles in daily life problems.	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-BSHM-605-19 Integral Equations and Integral Transforms

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the significance of Integral equations	√	√			√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Solve integral equations and apply the knowledge to real world problems.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Apply Laplace transform for solving certain differential equations.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Apply Fourier transform for solving certain differential equations.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Apply understanding of applicable mathematics for solving problems occurring in science and engineering.	√	√			√	Applying	Yes	Mid semester tests, End Term Exams

HoD (Mathematical Sciences)

Name of the Department: Mathematical Sciences
Programme: M.Sc. Mathematics

Paper UC-MSM-101-18 Algebra-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of Algebra to attain a good mathematical maturity and enables to build mathematical thinking and skill.	✓	✓		✓	✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Utilize the class equation and Sylow theorems to solve different related problems.	✓	✓		✓			✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Identify and analyze different types of algebraic structures such as Solvable groups, Simple groups, Alternate groups to understand and use the fundamental results in Algebra.	✓	✓		✓	✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Design, analyze and implement the concepts of homomorphism and isomorphism between groups and rings for solving different types of problems, for example, Isomorphism theorems, quotient groups, conjugacy etc.	✓	✓		✓	✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Create, select and apply appropriate algebraic structures such as finitely generated abelian groups, ideals, Fields to explore the existing results.	✓	✓		✓			✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 6: Identify the challenging problems in modern mathematics and find their appropriate solutions.	✓	✓		✓			✓		✓	✓	Applying	Yes	Mid semester Viva, End Term Viva

Paper UC-MSM-102-18 Real Analysis-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of concepts of real analysis in order to study theoretical development of different mathematical techniques and their applications.	✓						✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand the nature of abstract mathematics and explore the concepts in further details.		✓					✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Identify challenging problems in real variable theory and find their appropriate solutions.				✓			✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Deal with axiomatic structure of metric spaces and generalize the concepts of sequences and series, and continuous functions in metric spaces.		✓					✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Use theory of Riemann-Stieltjes integral in solving definite integrals arising in different fields of science and engineering.	✓						✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 6: Extend their knowledge of real variable theory for further exploration of the subject for going into research.					✓		✓		✓	✓	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-103-18 Complex Analysis

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Know the fundamental concepts of complex analysis.	✓	✓			✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Evaluate complex integrals and apply Cauchy integral theorem and formula.	✓	✓		✓	✓		✓			✓	Evaluation	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 3: Evaluate limits and checking the continuity of complex function & apply the concept of analyticity and the Cauchy-Riemann equations	√	√			√	√		√		√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Solve the problems using complex analysis techniques applied to different situations in engineering and other mathematical contexts.	√	√	√	√	√		√		√	√	Application	Yes	Mid semester tests, End Term Exams
CO 5: Establish the capacity for mathematical reasoning through analysing, proving and explaining concepts from complex analysis	√	√	√	√	√		√		√	√	Application	Yes	Mid semester tests, End Term Exams
CO 6: Extend their knowledge to pursue research in this field.	√	√	√	√	√		√		√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-104-18 Ordinary Differential Equations and Special Functions

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	Po 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand ordinary differential equations of various types, their solutions, and fundamental concepts about their existence.	√		√	√	√		√		√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand the concept and applications of eigen value problems.	√		√	√	√		√		√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Understand differential equations of Strum Liouville type.	√		√	√	√		√		√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Apply various power series methods to obtain series solutions of differential equations.	√		√	√	√		√		√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 5: Discuss various kinds of special functions in detail, their properties and relations.	√		√	√	√		√		√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 6: Solve problems of ordinary differential equations arising in various fields.	√		√	√	√		√		√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-105-18 Mathematical Methods

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the theory and applications of integral transforms.	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Explain how integral transforms can be used to solve a variety of differential equations.	√		√	√	√				√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Solve integro-differential equations of Fredholm and Volterra type.	√		√	√	√				√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Understand the properties of various kinds of integral equations.	√	√		√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Develop their attitude towards problem solving.	√		√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-106-18 Introduction to Computer Algebra System (Lab)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	Po 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of mathematical software viz. MATLAB and MATHEMATICA to solve real world problems efficiently.	√					√			√	√	Applying	Yes	Mid semester Viva, End Term Viva
CO 2: Utilize the symbolic tools of these CAS for handling different mathematical problems for example, solution of equations, differentiation, integration etc.	√					√			√	√	Applying	Yes	Mid semester Viva, End Term Viva

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 3: Design and analyze their own computer codes of mathematical methods.	✓				✓			✓	✓		Evaluation	Yes	Mid semester Viva, End Term Viva
CO 4: Understand and modify existing codes in scientific computing based on the use of different loops and conditional structures.	–				✓			✓	✓		Understanding	Yes	Mid semester Viva, End Term Viva
CO 5: IUse these CAS with the understanding of limitations of the systems.	✓				✓			✓	✓		Evaluation	Yes	Mid semester Viva, End Term Viva
CO 6 Identify the challenging problems in mathematics and find their appropriate solutions accurately and efficiently using Computer Algebra System.				✓				✓	✓		Evaluation	Yes	Mid semester Viva, End Term Viva
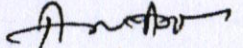
Paper UC-MSM-201-18 Algebra-II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of Algebra to attain a good mathematical maturity and enables to build mathematical thinking and reasoning.	✓	✓			✓		✓		✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Utilize the Polynomial rings, UFD, ED, PID to solve different related problems.	✓	✓			✓		✓		✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Identify and analyze different types of algebraic structures such as Algebraically closed fields, Splitting fields, Finite field extensions to understand and use the fundamental results in Algebra.	✓	✓		✓	✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Design, analyze and implement the concepts of Gauss Lemma, Einstein's Irreducibility criterion, separable extensions etc.	✓	✓	✓	✓	✓		✓		✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Create, select and apply appropriate algebraic structures such as Galois extensions, Automorphisms of groups and fixed fields, Fundamental theorem of Galois theory to understand and use the Fundamental theorem of Algebra.	✓	✓	✓	✓	✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 6: Identify the challenging problems in advanced Algebra to pursue further research.	✓	✓		✓	✓		✓		✓	✓	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-202-18 Real Analysis-II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	Po 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of concepts of functions of several variables and measure theory in order to study theoretical development of different mathematical concepts and their applications.	✓			✓	✓				✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Understand the nature of abstract mathematics and explore the concepts in further details		✓		✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Utilize the concepts of derivative, MVTS for vector-valued functions in applications different fields for example management, industry and economics etc.	✓			✓	✓				✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Recognize the need of concept of measure from a practical view point.		✓		✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand measure theory and integration from theoretical point of view and apply its tools in different fields of applications.		✓		✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 6: Extend their knowledge of Lebesgue theory of integration by selecting and applying its tools for further research in this and other related areas			√	√					√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-203-18 Mechanics-I

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the concept of functional and determine stationary paths of a functional to deduce the differential equation for stationary paths.		√		√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Use Euler-Lagrange equation to find stationary paths and its applications in some classical fundamental problems.	√		√	√					√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Define and understand basic mechanical concepts related to discrete and continuous mechanical systems.	√		√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: describe and understand the motion of a mechanical system using Lagrange-Hamilton formalism.	√	√		√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Connect concepts and mathematical rigor in order to enhance understanding.	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-204-18 Partial Differential Equations

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand partial differential equations of first order (linear and nonlinear), second and higher order.	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Apply various analytic methods for computing solutions of various PDEs.	√		√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Determine integral surfaces passing through a curve, characteristic curves of second order PDE and compatible systems.	√		√	√	√				√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Understand the formation and solution of some significant PDEs like wave equation, heat equation and	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Apply the knowledge of PDEs and their solutions in order to understand physical phenomena.	√		√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-205-18 Numerical Analysis

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Identity and analyze different types of errors encountered in numerical computing.				√					√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 2: Apply the knowledge of Numerical Mathematics to solve problems efficiently arising in science, engineering and economics etc.	√								√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Utilize the tools of the Numerical Mathematics in order to formulate the real-world problems from the view point of numerical mathematics.	√								√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Design, analyze and implement of numerical methods for solving different types of problems, viz. Initial and boundary value problems of ordinary differential equations etc.	√								√	√	Evaluation	Yes	Mid semester tests, End Term Exams

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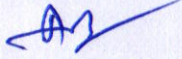
Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 5: Create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research.	√	√							√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 6: Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently.				√		√			√	√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-206-18 Numerical Analysis (Lab)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 1: Apply their knowledge of computer programming to develop and implement their own computer codes of numerical methods for solving different types of complex problems viz. nonlinear equations, system of linear equations, interpolation and extrapolation, numerical differentiation and integration, numerical initial and boundary value problems of ordinary differential equations etc.	√								√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Understand different implementation modes of a numerical method in order to solve a given problem efficiently.		√							√	√	Understanding	Yes	Mid semester Viva, End Term Viva
CO 3: Analyze and modify computer codes available in the scientific literature.	√	√							√	√	Applying	Yes	Mid semester Viva, End Term Viva
CO 4: Utilize the symbolic tools of Computer Algebra System (CAS) for example MATLAB, MATHEMATICA and MAPLE independently and in their computer codes for solving a given problem.	√								√	√	Evaluation	Yes	Mid semester Viva, End Term Viva
CO 5: Develop, select and apply numerical methods as a computer code with the understanding of their limitations so that they can be implemented in order to get acceptable results.	√		√						√	√	Evaluation	Yes	Mid semester Viva, End Term Viva
CO 6: Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently using computer codes.				√					√	√	Evaluation	Yes	Mid semester Viva, End Term Viva

Paper UC-MSM-301-18 Topology

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 1: Understand the concepts of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.	√	√			√	√			√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand the concepts of Bases and Subbases, create new topological spaces by using subspace.	√	√	√		√	√			√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Understand continuity, compactness, connectedness, homeomorphism and topological properties.	√	√			√	√			√	√	Understanding	Yes	Mid semester tests, End Term Exams

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CO 4: Understand how points of space are separated by open sets, Housdroff spaces and their importance.	√	√		√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand regular and normal spaces and some important theorems in these spaces.	√	√		√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-302-18 Number Theory and Cryptography

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of Number theory and Cryptography to attain a good mathematical maturity and enables to build mathematical thinking and skill.	√	√		√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Utilize the GCD, LCM, Fundamental Theorem of Arithmetic, Product of r consecutive integers, congruences, Chinese remainder theorem etc. to solve different related problems.	√	√		√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Apply different types of divisibility tests, Euler's theorem, Wilson theorem, Fermat's theorem, Mobius inversion formula to formulate and solve various related problems.	√	√	√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Design, analyze and implement the concepts of Diophantine equations for solving different types of problems. Understand and apply the concept of Power residue, order of a(mod m), Primitive root, Reduced residue system, Euler's solvability criterion, Lagrange's theorem for the number of incongruent solutions of a polynomial.	√	√		√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Create, select and apply appropriate number theoretic techniques such as Mersene primes, Fermats primes, greatest integer functions, indices, residue classes, Legendre symbols, Gauss Lemma, quadratic reciprocity law to use in real life problems.	√	√		√	√				√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 6: Identify the challenging problems in modern mathematics, such as, Cryptography and find their appropriate solutions.	√		√	√					√	√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-303-18 Mathematical Statistics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand and utilize the concept of probability.	√		√	√	√				√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Explain the concept of random variable and its applications.	√		√	√	√				√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Explore the different types of discrete and continuous distributions and their utilization.	√		√	√	√				√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Deal with formulation of hypotheses as per situations and their testing.	√		√	√	√				√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 5: Apply the knowledge of statistical techniques in various experimental and industrial requirements.	√		√	√	√				√	√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-304-18 Functional Analysis

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the fundamental concepts of functional analysis and their role in modern mathematics.	✓	✓		✓	✓				✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Utilize the concepts of functional analysis, for example continuous and bounded operators, normed spaces, Hilbert spaces and to study the behavior of different mathematical expressions arising in science and engineering.	✓	✓	✓	✓	✓				✓	✓	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Understand and apply fundamental theorems from the theory of normed and Banach spaces including the Hahn-Banach theorem, the open mapping theorem, the closed graph theorem and uniform boundedness theorem.	✓	✓	✓	✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand the nature of abstract mathematics and explore the concepts in further details.	✓	✓		✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Explain the concept of projection on Hilbert and Banach spaces.	✓	✓		✓	✓				✓	✓	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-305-18 Mechanics-II

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the concept of Tensor and their properties.	✓		✓	✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand the effect of co-ordinate transformations and visualize the tensor as a linear transformation.	✓		✓	✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Understand the conventions like summation convention and comma notations. Also, students shall learn the concepts of tensor calculus.	✓		✓	✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand continuum hypothesis, spatial an material co-ordinates and their applications.	✓		✓	✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the concepts of strain, stretch, rotation and shall be able to apply the knowledge in solving real world problems related to continuum mechanics.	✓		✓	✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-401-18 Differential Geometry

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic concepts and results related to space curves, tangents, normals and surfaces.	✓	✓		✓	✓				✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Explain the geometry of different types of curves and spaces.	✓	✓	✓	✓					✓	✓	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Explain the physical properties of different curves and spaces.	✓	✓	✓	✓	✓		✓		✓	✓	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Understand principal directions and curvatures, asymptotic lines and then apply their important theorems and results to study various properties of curves and surfaces.	✓	✓	✓	✓	✓		✓		✓	✓	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Utilize Geodesics, it's all related terms, properties and theorems.	✓	✓	✓	✓	✓		✓		✓	✓	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-501-18 Discrete Mathematics

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Construct mathematical arguments using logical connectives and quantifiers.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.	√	√	√	√	√						Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Validate the correctness of an argument using statement and predicate calculus.	√	√	√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Plearn how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relation.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the concepts Planarity including Euler	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 6: Discuss and understand the importance of the	√	√	√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-502-18 Coding Theory

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the concept of Maximum-Likelihood Decoding and Syndrome Decoding.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Analyze Double Error-Correcting B.C.H. code and Finite Fields Polynomials.	√	√	√	√	√				√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: Understand Cyclic Codes.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Study the concept of Bose-Chaudhuri-Hocquenghem (B.C.H.) Codes and Weight Distributions.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Learn about basic techniques of algebraic coding theory like matrix encoding, polynomial encoding, and decoding by coset leaders etc.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 6: Learn how algebraic coding theory is applicable in real world problems.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-503-18 Operations Research

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of basic optimization techniques in order to get best possible results from a set of several possible solution of different problems viz. linear programming problems, transportation problem, assignment problem and unconstrained and constrained problems etc.	√								√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Formulate an optimization problem from its physical consideration.				√					√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Select and implement an appropriate optimization technique keeping in mind its limitations in order to solve a particular optimization problem.	√	√							√	√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Understand theoretical foundation and implementation of similar type optimization techniques available in the scientific literature.		√							√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Continue to acquire knowledge and skills of optimization techniques that are appropriate to professional activities							√		√	√	Understanding	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 6: Extend their knowledge of basic optimization techniques to do interesting research work on these types of optimization techniques.				√					√	√	Understanding	Yes	Mid semester tests, End Term Exams

PaperUC-MSM-S04-18 Advanced Number Theory

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the different types of partitions & compositions.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Students will have a working knowledge of the various types of identities	√	√	√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Work with congruence's, solve congruence equations and systems of equations with one and more variables.	√	√	√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Be literate in the language and notation of number theory.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the concept of for n-colour partitions	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-505-18 Advanced Complex Analysis

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Equip with necessary knowledge and skills to enable them handle mathematical operations, analyses and problem solving involving complex numbers.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2:Understanding of topological and geometric properties of the complex plane	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Analyze how complex numbers provide a satisfying extension of the real numbers	√	√	√	√	√				√	√	Application	Yes	Mid semester tests, End Term Exams
CO 4: Learn techniques of complex analysis that make practical problems easy (e.g. graphical rotation and scaling as an example of complex multiplication);	√	√	√	√	√				√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Continue to develop proof techniques.	√	√	√	√	√				√	√	Application	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-506-18 Advanced Operations Research

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of advanced optimization techniques in order to get best possible results from a set of several possible solutions of a given problem.	√								√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Formulate an optimization problem from its physical considerations.			√						√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Select and implement an appropriate optimization technique keeping in mind its limitations in order to solve a particular optimization problem.	√	√							√	√	Application	Yes	Mid semester tests, End Term Exams
CO 4: Understand and analyze similar types of other optimization techniques available in the scientific literature.		√							√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Continue to acquire knowledge and skills of optimization techniques that are appropriate to professional activities.						√			√	√	Application	Yes	Mid semester tests, End Term Exams

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Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO 6: Extend their knowledge of advanced optimization techniques in order to do interesting research work on these and similar types of optimization techniques.				√				√	√		Application	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-S07-18 Advanced Fluid Mechanics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the concept of rotational and irrotational flow, stream functions, velocity potential, sink, source,	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Analyze simple fluid flow problems (flow between parallel plates, flow through pipe etc.) with Navier-Stoke's equation of motion.	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Understand the phenomenon of flow separation and boundary layer theory	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understand the concept of thermal conductivity.	√		√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Learn about the fundamental equations of the flow and energy	√		√	√	√				√	√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-S08-18 Advanced Solid Mechanics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the theory of elasticity including strain/displacement and Hooke's law relationships.	√		√	√	√					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Analyze solid mechanics problems using classical methods and energy methods.	√		√	√	√					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Solve for stresses and deflections of beams under unsymmetrical loading.	√		√	√	√					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Obtain stresses and deflections of beams on elastic foundations.	√		√	√	√					√	Application	Yes	Mid semester tests, End Term Exams
CO 5: Solve torsion problems in bars and thin walled members.	√		√	√	√					√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-S09-18 Theory of Linear Operators

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Have understanding of main topics of Banach Algebras and Spectral Theory.	√	√		√	√					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Terminology, notation and the basic results and concepts of Banach and Hilbert spaces.	√	√		√	√					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Understand the concept of spectrum and resolvent, adjoint operators, compact operators, self-adjoint and normal operators, Gelfand Representation, Riesz-Fredholm Theory.	√	√		√	√					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Relation of the subject with other branches of mathematics (Fourier analysis, complex functions, differential equations)	√	√	√	√	√					√	Application	Yes	Mid semester tests, End Term Exams
CO 5: Repare the students for reading the literature of a wide variety of subjects in which Hilbert space ideas are used.	√	√		√	√					√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-S10-18 Advanced Numerical Methods

HOD (mathematics Sci.)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of advanced numerical methods in order to solve different types of problems viz. linear systems, eigenvalues problems, ordinary and partial differential equation arising in various field of applications for example in science, engineering and economics etc.	√								√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Understand advantages and limitations of advanced numerical methods.		√							√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Select and implement an appropriate numerical method for solving a given problem keeping in mind nature of the problem.	√	√							√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Use theoretical basis of these methods in order to study their counterparts existing in the scientific literature.		√							√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently.				√					√	√	Application	Yes	Mid semester tests, End Term Exams
CO 6: Extend their knowledge to do research work on these methods and similar type of other methods.					√				√	√	Application	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-511-18 Topological Vector Spaces

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the general theory of topological vector spaces.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Learn the basic properties of topological vector spaces.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Define the structure of locally-convex topological vector spaces.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 4: Understanding and analyzing inductive and projective limits.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 5: Understand the structure of, Frechet spaces, Montel, Schwartz, and nuclear spaces.	√	√	√	√	√				√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-512-18 Fractional Calculus

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	Po 10	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the Riemann-Liouville fractional integral and evaluate fractional integrals of some common functions	√		√		√					√	Understanding	Yes	Mid semester tests, End Term Exams
CO 2: Define the Riemann-Liouville and Caputo fractional derivatives and find the fractional derivatives of some common functions	√		√		√					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 3: State sufficient conditions under which the fractional integrals and derivatives exist	√		√		√					√	Evaluation	Yes	Mid semester tests, End Term Exams
CO 4: Investigate some applications of the fractional calculus to the real world.	√		√	√	√					√	Application	Yes	Mid semester tests, End Term Exams
CO 5: Solve linear fractional differential equations using the Laplace transform and Fourier Transforms	√		√		√					√	Evaluation	Yes	Mid semester tests, End Term Exams

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HoD (Mathematical Sci.)

Name of the Department: Mathematical Sciences

Programme: Ph.D Mathematics

Paper MPHM-101 Research Methodology

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the basic concepts of LATEX packages and data statistics					√		√		Understanding	Yes	Mid semester tests, End Term Exams
CO2: Able to use research methods in research literature flow charts	√	√	√	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 3: Sketch graphs, draw flow charts, survey research related problems and infer data using multiple discriminant analysis	√	√	√	√	√	√	√	√	Evaulate	Yes	Mid semester tests, End Term Exams
CO 4: Apply the knowledge of Multivariate analysis and computational techniques in research problem analysis	√	√	√	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Understand the fundamental relation between motivation of research and Methods in research	√	√	√	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper MPHM-102 Methods in Applied Mathematics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the different types of Differential and Integral Equations	√	√	√	√	√		√		Evaulate	Yes	Mid semester tests, End Term Exams
CO2: Visualize wavelets and general construction of wavelets using computational techniques.	√	√	√	√	√		√		Applying	Yes	Mid semester tests, End Term Exams
CO3: Apply the knowledge of Gibbs Phenomena and Stormberg wavelet	√	√	√	√	√		√		Applying	Yes	Mid semester tests, End Term Exams
CO4: Explain the between wavelet transform and Fourier transform	√	√	√	√	√		√		Evaulation	Yes	Mid semester tests, End Term Exams
CO5: Study further the periodic wavelets, classical Fredolm theory and Complex Fourier integral	√	√	√	√	√		√		Understanding	Yes	Mid semester tests, End Term Exams

Paper MPHM-103 Continuum Mechanics

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Explain the basic concepts of mass, density, motion, spatial coordinates, stress, tensor, elasticity, shear velocity, bulk velocity etc.	√	√	√	√	√		√		Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 2: Apply the knowledge of stress analysis to homogenous isotropic bodies	√	√	√	√	√		√		Applying	Yes	Internal Viva-voce, External Viva-voce
CO 3: Use programming in plotting and visualization of graphs of action of surface forces on fluids	√	√	√	√	√	√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Obtain governing equations for a viscous fluid flow	√	√	√	√	√		√		Evaluation	Yes	Internal Viva-voce, External Viva-voce
CO 5: Study further the balance of energy, entropy inequality and Euler's equation of motion	√	√	√	√	√		√		Understanding	Yes	Internal Viva-voce, External Viva-voce

Paper MPHM-104 Advanced Analysis

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand and describe the different concepts of Schwartz space, tempered distributions and finite element methods	√	√	√	√		√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO2: To obtain the weak solutions of elliptic boundary value problems	√	√	√	√		√	√	√	Applying	Yes	Mid semester tests, End Term Exams

HOD mathematical Sciences)

...alyse operations with distributions and trace theory	√	√	√	√			√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams
To understand Galerkin method and maximum principles in eigen value problems	√	√	√	√			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO5: Have a solid foundation in fundamentals required to solve elliptic boundary value problems	√	√	√	√			√	√	√	Understanding	Yes	Mid semester tests, End Term Exams

Paper UC-MSM-504-18 Advanced Number theory

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Understand the different types of partitions & compositions	√	√	√	√		√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 2: Students will have a working knowledge of the various types of identities	√	√	√	√		√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 3: Able to work with congruence's, solve congruence equations and systems of equations with one and more variables.	√	√	√	√		√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Apply the language and notation of number theory in programming computer coding	√	√	√	√	√	√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 5: Use the concept of for n-colour partitions in Combinatorics	√	√	√	√		√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce

Paper UC-MSM-510 Advanced Numerical Methods

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Apply the knowledge of advanced numerical methods in order to solve different types of problems viz. linear systems, eigenvalues problems, ordinary and partial differential equation arising in various field of applications for example	√	√	√	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 2: Understand advantages and limitations of advanced numerical methods.	√	√	√	√	√	√	√	√	Understanding	Yes	Mid semester tests, End Term Exams
CO 3: Select and implement an appropriate numerical method for solving a given problem keeping in mind nature of the problem.	√	√	√	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 4: Use theoretical basis of these methods in order to study their counterparts existing in the scientific literature.	√	√	√	√	√	√	√	√	Applying	Yes	Mid semester tests, End Term Exams
CO 5: Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently.	√	√	√	√	√	√	√	√	Evaluation	Yes	Mid semester tests, End Term Exams

Paper Research and Publication Ethics (RPE)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	Skill	Focus on Employability / Entrepreneurship	Assessment Tools to Measure Attainment of CO
CO1: Familiarizing with moral philosophy of Research Ethics	√	√	√	√		√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 2: To acquire knowledge on definition, concept and problems that lead to unethical behaviour in research	√	√	√	√		√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 3: The students will understant predatory publishers and journals	√	√	√	√		√	√	√	Applying	Yes	Internal Viva-voce, External Viva-voce
CO 4: Students can learn how to search relevent journals and research papers using online resources	√	√	√	√	√	√	√	√	Understanding	Yes	Internal Viva-voce, External Viva-voce
CO 5: Identify the challenging problems in research integrity and intellectual honesty.	√	√	√	√		√	√	√	Evaluation	Yes	Internal Viva-voce, External Viva-voce

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