Deccan Education Society's

Fergusson College (Autonomous), Pune

Program Specific Outcomes (PSOs) and Course Outcomes (COs) 2019-20

Department of Mathematics

Programme: M. Sc. IMCA

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Understand basic facts about Mathematics -annotations, terminology, geometrical figures, graphical displays and its major subfields (Analysis, Algebra, Applied Mathematics and Statistics). (ii) Design and develop computer programs/computer-based systems in the areas related to algorithms, networking, web design, cloud computing, IoT and data analytics. (iii) Demonstrate unifying structures of Mathematics and the basic constructs of several programming languages and their application areas.
PSO2	**Personal and Professional Competence:** (i) Apply mathematical solutions in a variety of contexts related to science, technology, business and industry, and carry out hands-on activities on several programming technologies as well as academic projects. (ii) Analyse the data by selecting and using appropriate mathematical formulae or techniques/programming technology stack in order to draw the relevant conclusion. (iii) Execute the problem solving skills, equip with Mathematical modelling abilities and develop competent professionals who will be able to address challenges in the field of IT at global level.
PSO3	**Research Competence:** (i) Apply advanced knowledge on topics in pure Mathematics and impart analytical skills to develop initiatives and come up with innovative ideas for R&D in various fields. (ii) Integrate the knowledge of Computer Science and Mathematics to solve and authenticate real-time data from various fields.
PSO4	**Entrepreneurial and Social competence:** (i) Develop analytical skills required to get distinguishing employment opportunities in several fields including IT, Research and Development, teaching field and gain understanding about the ethical issues related to protection of intellectual property - copyrights, trademarks, and patents. (ii) Execute social competence including communication and effective

	interaction with others, listening, speaking, observational skills and presenting skills.

Course Outcomes (COs)		
F.Y. M.Sc. Semester I		
Title of the Course and Course Code	**Real Analysis (MTS4101)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Retrieve basic concepts in Metric Topology.	1
CO2	Interpret properties of continuous and differentiable functions.	2,3
CO3	State and implement Mean Value Theorems to real life problems and discuss its use.	1,3
CO4	Identify series expansions for general category of continuously differentiable functions for computational needs.	1,4
CO5	Evaluate Riemann Integration to generalise the theory of Integration over Euclidean Spaces.	5
CO6	Formulate the Fundamental Theorem of Integral Calculus, support the theory with examples and create counter examples wherever needed.	5,6
Title of the Course and Course Code	**Applied Linear Algebra (MTS4102)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe key concepts associated with Vector spaces.	1
CO2	Illustrate various mathematical properties of inner products and solve examples to justify the properties.	2,3,5
CO3	Apply the concept of orthogonality to find an orthogonal basis using the Gram Schmidt process.	3
CO4	Design and analyze the concept of Linear Transformations to solve real life problems.	3,4,6
CO5	Compute Eigenvalues and Eigenvectors for a given matrix and identify its role in Matrix decompositions.	1,2,3,4
CO6	Formulate the concept of matrix decompositions to discuss problems in Engineering and Data Science.	2, 6
Title of the Course and	**Discrete Mathematics I (MTS4103)**	**Number of Credits : 04**

Course Code		
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Articulate basic concepts of Logic and formulate it mathematically.	2, 6
CO2	Describe the propositional equivalences, quantifiers, predicates and formulate different types of proofs.	1, 6
CO3	Apply basic graph theory and compare different types of graphs and operations on graphs.	2,3,4,5
CO4	Articulate and apply algorithms of fusion, matching algorithms. Formulate Matrix representation of graphs.	2,3,6
CO5	Demonstrate shortest path algorithms and evaluate shortest paths for various graphs.	3,5
CO6	Explain and apply minimum weighted spanning tree algorithms, graph colouring algorithms.	2,3,4
Title of the Course and Course Code	**Software Engineering (MTS4104)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall facts about software engineering.	1
CO2	Articulate the key concepts, characteristics, objectives and applications of software engineering.	2
CO3	Discriminate different life cycle models based on various factors by analyzing their strengths and weaknesses.	4,5
CO4	Apply the concepts of software requirements in the software requirement engineering process and build the foundation for requirement analysis.	3,6
CO5	Apply various designs and implement design techniques.	3
CO6	Analyze the structures through different tools such as data flow diagrams, structure charts, decision tables and decision trees.	4
Title of the Course and Course Code	**Experiential Training Course on C Programming (MTS4105)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the basic concepts of the C programming language.	1
CO2	Discuss basic concepts of computers, algorithms and algorithmic thinking.	2
CO3	Apply stack for implementation of function calls and parameter passing mechanisms.	3

CO4	Analyze and compare usage of arrays, strings, structures and files.	2,4,5
CO5	Determine the solution for a given problem by distinguishing various memory allocation methods.	5
CO6	Write C programs to validate the specifications.	6
	F.Y. M.Sc. Semester II	
Title of the Course and Course Code	**Advanced Calculus (MTS4201)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe basic concepts related to sequences and series of functions and apply it to solve problems.	1,3
CO2	Discuss various properties related to sequence and series of functions and illustrate it with suitable examples.	2,3
CO3	Explain various properties of elementary functions to solve problems in science and engineering applications.	2,3,4
CO4	Evaluate derivatives of scalar, vector valued functions to determine maxima, minima and saddle points.	5
CO5	Demonstrate the concept of Integral of a k-form considered over a boundary and generalise it to arbitrary spaces.	3
CO6	Develop the Stoke Theorem to structure the concept of Integration to be stated by a single formula.	6
Title of the Course and Course Code	**Abstract Algebra (MTS4202)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Articulate basic concepts of Group theory with focus on axiomatic theory. Explain the fundamental concepts of abstract algebra such as groups and rings and their role in modern Mathematics and applied contexts.	2,4
CO2	Demonstrate capacity for mathematical reasoning through analyzing, proving, and explaining concepts from abstract algebra.	3
CO3	Discuss key concepts associated with graphs and compare different types of groups and rings.	2,4,5
CO4	Demonstrate theorems based on group theory, ring theory and articulate problem-solving techniques based on them.	2,3
CO5	Explain the notion of rings, ideals. Describe and construct the structure of finite fields.	1,2,4,6
CO6	State and use Sylow's theorems to describe the structure of certain finite groups.	1,3

Title of the Course and Course Code	**Discrete Mathematics II (MTS4203)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	State and articulate counting principles.	1, 2
CO2	Explain and formulate recurrence relations	2, 4,6
CO3	Determine fundamental notions of Lattice theory and properties of Lattices.	5
CO4	Develop an ability to solve individually and creatively advanced problems connected with its applications to Mathematics.	3,6
CO5	Apply and convince the basics of Boolean axioms.	3
CO6	Explain fundamental operations on Boolean expressions.	2,4
Title of the Course and Course Code	**Probability and Statistics (MTS4204)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	State basic concepts related to Probability Theory and solve examples.	1
CO2	Discuss various properties related to mean and variance.	2
CO3	Apply the concept of discrete and continuous distributions to a given model or a given data.	3
CO4	Interpret Inference based tests to various problems to determine the statistical significance of null hypothesis.	2,3,5
CO5	Analyze the concept of Correlation and Regression for a given data.	4
CO6	Create a Regression Model on a given random dataset to determine the statistical significance of various models and verify the assumptions.	5,6
Title of the Course and Course Code	**Experiential Training Course on C++ (MTS4205)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the features of Object-Oriented Programming using C++.	1

CO2	Explain containment and inheritance to promote code reuse in C++.	2,4
CO3	Analyze the strengths of C++ programming.	4
CO4	Implement file handling operations using C++ programming.	3
CO5	Test and validate C++ applications using exception handling mechanisms.	5
CO6	Write object-oriented applications using C++.	6
Title of the Course and Course Code	**Experiential Training Course on DBMS (MTS4205)**	**Number of Credits : 04**
CO1	Describe major components of DBMS.	1
CO2	Analyze a problem and identify the computing requirements appropriate to its solution.	1,4
CO3	Implement appropriate database for computer-based systems according to the user requirements.	3
CO4	Apply syntax and write SQL commands to perform various RDBMS operations.	3,6
CO5	Discuss the purpose of query processing determine the optimized solution.	2,5
CO6	Design data requirements of an application with the help of conceptual modelling tools.	6
	S.Y. M.Sc. Semester III	
Title of the Course and Course Code	**Digital Image Processing (MTS5301)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	State basic concepts related to mathematics behind digital image processing.	1
CO2	Differentiate between spatial transforms and intensity transforms.	2,4
CO3	Apply different techniques employed for the enhancement of images. Demonstrate and execute morphological image processing on various image formats.	3
CO4	Explain the need for image compression and apply various techniques of image enhancement and compression.	2,3,4
CO5	Discuss different feature extraction and segmentation techniques and compare the techniques used in feature extraction in images.	2,4,5
CO6	State different causes for image degradation and reconstruct the images using various reconstruction models.	1, 6
Title of the Course and Course Code	**Statistical Inference (MTS5302)**	**Number of Credits : 04**

On completion of the course, the students will be able to:		Bloom's Cognitive level
CO1	Define key concepts of statistical inference.	1
CO2	Analyze the process of Estimation and Testing of Hypothesis.	4
CO3	Illustrate and implement the process of Hypothesis testing for practical applications.	2,3
CO4	Identify the key concepts in estimation of parameter estimation.	1,4
CO5	Apply, infer and justify hypothesis testing techniques to solve various problems on data.	2,3,5
CO6	Generate a model on a random dataset and interpret the inference. Compare different techniques that lead to the best performance among the choices.	2,3,4,5,6
Title of the Course and Course Code	**Complex Analysis (MTS5303)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define key concepts of Complex analysis.	1
CO2	Explain definitions, properties, examples of Analytic functions and harmonic functions. State, explain and apply Cauchy-Riemann equations.	1,2,3,4
CO3	Explain elementary functions and solve problems based on logarithmic, exponential functions.	2, 3, 4
CO4	Implement accurate and efficient use of complex integration.	3
CO5	Develop problem-solving techniques using complex analysis and apply them to diverse situations in physics, engineering and other mathematical contexts.	3,6
CO6	Evaluate and apply residues and poles in various complex integrations.	3,5
Title of the Course and Course Code	**Financial Mathematics (MTS5304)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Identify basic terms in Finance and Mathematical Statistics.	1,4
CO2	Interpret the concept of Present value and Interest rates to solve various real-life problems.	2,3
CO3	Apply the options Pricing techniques to determine best output in a given situation.	3,5
CO4	Analyze the option Pricing Model in a discrete and continuous time case to determine the best outcome.	4,5

CO5	Evaluate complex options with dividends on a security and identify the returns.	1,4,5
CO6	Design a scenario for pricing option pricing using utility and calculate the returns in the case.	3,6
Title of the Course and Course Code	**Coding Theory (MTS5305)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe knowledge of basic concepts and principles related to finite fields.	1
CO2	Explain error detection, coding and decoding techniques.	2,4
CO3	Discuss the basic principles and theory of linear codes to compute encoding and decoding of linear code.	2,3
CO4	Explain and implement cyclic codes and compute encoding and decoding using cyclic codes.	2,3,4
CO5	Specify special types of cyclic codes.	6
CO6	Evaluate hamming distance, distance of a code, binary hamming codes and linear codes.	5
Title of the Course and Course Code	**Operating Systems (MTS5306)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Identify the different types of an operating system and their responsibilities.	1,4
CO2	Explain issues in different file systems and describe various access methods. Differentiate process, threads.	2,4
CO3	Solve problems on CPU scheduling, disk scheduling, memory management.	3
CO4	Determine the concurrency conditions, critical section problems.	5
CO5	Write C programs on various concepts of Operating systems.	6
CO6	Discuss the basics of the Linux system and perform administrative tasks.	2,6
Title of the Course and Course Code	**Computer Networks (MTS5307)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive**

		level
CO1	Describe components of a data communication system and explain basics of computer network technology.	1,2,4
CO2	Illustrate the layers of the OSI, TCP/IP models and discuss the function(s) of each layer.	2,3
CO3	Classify and compare different protocols of different layers.	2,3,4,5
CO4	Solve various problems by applying the various error detection, correction techniques and implement various methods to achieve network layer addressing.	3
CO5	Compare various routing algorithms.	2,4,5
CO6	Build the view towards current trends such as virtualization and quantum computing.	6
Title of the Course and Course Code	**Experiential Training Course on Data Structures using C (MTS5308)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Write C programs to implement Operating Systems algorithms using data structures.	6
CO2	Compute the time complexity of various data structures algorithms.	2,3
CO3	Identify, illustrate fundamental data structures and summarize their uses, strengths, and weaknesses.	1, 2,3,4
CO4	Explain the memory representations of several data structures.	2,4
CO5	Determine appropriate data structures as per the specified problem definitions.	5
CO6	Design and implement various data structure algorithms.	3,6
	S.Y. M.Sc. Semester IV	
Title of the Course and Course Code	**Design and Analysis of Algorithms (MTS5401)**	**Number of Credits : 04**
CO1	Describe basic concepts of algorithm designs.	1
CO2	Solve the problems based on Polynomial time and Non-Polynomial time approaches.	3
CO3	Illustrate the concept of recurrences, hash tables to run complex functions.	2,3
CO4	Analyze the concept of dynamic programming, greedy and graph theoretic algorithms.	4
CO5	Evaluate and compare performance analysis of various algorithm designs.	2,4, 5
CO6	Develop algorithms based on design techniques and identify	1,4,6

	the Asymptotic notations.	
Title of the Course and Course Code	**Cryptography (MTS5402)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe key notions and principles related to basic Cryptography.	1
CO2	Explain the notion of classical cryptography.	2,4
CO3	Discuss the basic principles, theory of public key cryptography, key exchange algorithm for developing new cryptographic algorithms.	2,6
CO4	Implement basic symmetric key algorithms and public key algorithms using programming language.	3
CO5	Apply different cryptographic algorithms to obtain security and to encrypt, decrypt data. State and apply different types of attacks on data.	1,3
CO6	Compute and integrate basic algorithms on elliptic curves and explain the use of it in cryptography.	2,3,4,6
Title of the Course and Course Code	**Applied Geometry for Computer Graphics using CAD (MTS5403)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Demonstrate knowledge of basic concepts and principles related to transformations in plane.	3
CO2	Explain basic 2D and 3D transformations.	2,4
CO3	Outline the basic principles and theory of homogeneous coordinates and transformations in plane and space.	1,2,3
CO4	Implement standard 2D and 3D transformation algorithms to create different projections and transformations.	3,6
CO5	State and apply different types of projections on an object and demonstrate viewing pipeline.	1, 3
CO6	Demonstrate different types of curves and compute and evaluate points on standard curves, Bezier curve and on B-Spline.	2,3,5
Title of the Course and Course Code	**Dynamical Systems (MTS5404)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	State basic concepts with dynamical systems and solve basic	1,3

	examples.	
CO2	Interpret physical problems with differential equations using initial conditions for Mathematical analysis.	2,3
CO3	Analyze and solve dynamical systems using the standard methods available for planar systems.	3,4
CO4	Evaluate key concepts related to limit cycles and visualise bifurcation diagrams for a given dynamical system.	5
CO5	Determine the Geometry of dynamical systems and implement codes to visualise a dynamical system and identify its features.	1,3,4,5
CO6	Formulate a dynamical system for a given physical problem and identify the key aspects related to it.	1,4,6
Title of the Course and Course Code	**Machine Learning (MTS5405)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List basic concepts in Machine Learning related to Regression and Classification.	1
CO2	Discuss and summarize numerical techniques required for Machine Learning.	2
CO3	Analyze the mathematical and statistical aspects of algorithms based on Regression, Clustering and Decision trees.	4
CO4	Compute, review the performance, evaluations and verify assumptions for several algorithms.	2,3,5
CO5	Determine models suitable for a given data.	5
CO6	Generate models on random data, verify assumptions and evaluate performance metrics to determine the best algorithm.	5,6
Title of the Course and Course Code	**Theoretical Computer Science (MTS5406)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Identify and apply mathematical foundations, algorithmic principles and computer science theory to the modelling and design of computer-based systems.	1,3,4,6
CO2	Discuss key notions of theoretical computer science.	2
CO3	Demonstrate knowledge of formal computation and its relationship to languages.	3
CO4	Compare different computing languages and classify their respective types.	2,3,4,5
CO5	Identify and describe formal reasoning about languages.	1,4

CO6	Develop efficient and effective algorithmic solutions for different real-world problems.	6
Title of the Course and Course Code	**UNIX Internals (MTS5407)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the history of the UNIX operating system and retrieve the general overview about system structure.	1
CO2	Interpolate the basic architecture of the UNIX operating system, Kernel data structures and system administration.	2
CO3	Articulate and compare different concepts of buffer cache.	2,4,5
CO4	Illustrate internal representation and interpret the applications of various file systems.	2,3
CO5	Specify the structure of a process, process creation and signal processing.	6
CO6	Determine different system level algorithms applicable to different types of UNIX subsystems.	5
Title of the Course and Course Code	**Experiential Training Course on Java Programming (MTS5408)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Implement object-oriented design with Java.	3
CO2	Discuss the concepts of OOPs and Java 8 features.	2
CO3	Identify Java language components and their working in applications.	1,4
CO4	Analyze Java APIs for program development. Implement file handling operations in Java.	3,4
CO5	Test and validate Java applications using exception handling mechanism.	5
CO6	Determine different system level algorithms applicable to different types of UNIX subsystems.	5
Title of the Course and Course Code	**Experiential Training Course on Python Programming (MTS5409)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe various constructs of python programming.	1
CO2	Use an IDE to write, compile, run, and test python programs.	3,5,6

CO3	Illustrate file handling operations in Python.	2,3
CO4	Write interactive applications using Database, GUI and multithreading.	6
CO5	Explain Object-oriented programming concepts in python.	2,4
CO6	Test and validate Python applications using exception handling mechanisms.	5
Title of the Course and Course Code	**Experiential Training Course on Web UI & UX (MTS5410)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Demonstrate AJAX calls, use of a debugger and a DOM inspector.	3
CO2	Illustrate the use of jQuery as a light-weight JavaScript library.	2,3
CO3	Analyze the importance of user experience in designing of the websites.	4
CO4	State the design process for single-page applications using ReactJS.	1
CO5	Write web pages using various web technologies.	6
CO6	Test and validate web applications using JavaScript.	5