आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

SCHOOL OF SCIENCES
DEPARTMENT OF MATHEMATICS

Bachelor of Science (Honors Mathematics)

THREE YEAR PROGRAMME

[W. E. F. ACADEMIC SESSION: 2020 - 21]

IFTM UNIVERSITY
N.H.-24, Lodhipur Rajput, Delhi Road, Moradabad, Uttar Pradesh-244001
www.iftmuniversity.ac.in

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SCHOOL OF SCIENCES
DEPARTMENT OF PHYSICS

Study & Evaluation Scheme of
Bachelor of Science (Physics)
[Session 2020-21]

Programme:	***Bachelor of Science (Hons.) Mathematics***
Course Level:	***UG Degree***
Duration:	***Three Year (Six Semester) Full Time***
Medium of Instruction:	***English***
Minimum Required Attendance:	***75%***
Maximum Credits:	***94***

Programme Outcomes (POs):
Students completing this programme will be able to:

- Create a hypothesis and appreciate how it relates to broader theories.
- Evaluate hypotheses, theories, methods and evidence within their proper contexts.
- Solve complex problems by critical understanding, analysis and synthesis.
- Demonstrate engagement with current research and developments in the subject.
- Critically interpret data, write reports and apply the basics of rules of evidence.
- Select, interpret and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and the internet.
- Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.
- Provide a systematic understanding of the concepts and theories of mathematics and there application in the real world – to an advanced level, and enhance career prospects in a huge array of fields.
- Communicate effectively by oral, written, computing and graphical means.
- Recognize the need to engage in lifelong learning through continuing education and research

B. Sc. - I Year Mathematics (Hons.), Semester-I

Effective from Session 2020-21

S. No.	Course Code	Course Titles		EVALUATION SCHEME					Course Total (Marks)	Credits
				Internal Exam				External Exam		
			L	T	P	CT	AS+ AT	Total		
1	BMAT(H)-101	Matrices and Trigonometry	3	1	0	20	10	30	70	100	4
2	BMAT(H)-102	Calculus	3	1	0	20	10	30	70	100	4
3	BPHY(H)-101	Mechanics	3	1	0	20	10	30	70	100	4
4	BPHY(H)-102	Thermal Physics	3	1	0	20	10	30	70	100	4
5	BCHE(H)-101	Inorganic Chemistry	3	1	0	20	10	30	70	100	4
6	BCHE(H)-102	Organic Chemistry	3	1	0	20	10	30	70	100	4
7.	BPHY(H)-151	Physics Lab-1	0	0	4	-	-	30	70	100	2
8.	BCHE(H)-151	Chemistry Lab -1	0	0	4	-	-	30	70	100	2
	TOTAL		18	6	4	-	-	-	-	800	28

B. Sc. - I Year Mathematics (Hons.), Semester-II

Effective from Session 2020-21

S. No.	Course Code	Course Titles		EVALUATION SCHEME					Course Total (Marks)	Credits
				Internal Exam				External Exam		
			L	T	P	CT	AS+ AT	Total		
1.	BMAT(H)-201	Vector Calculus and Co-ordinate geometry	3	1	0	20	10	30	70	100	4
2.	BMAT(H)-202	Differential equations and Integral Transforms	3	1	0	20	10	30	70	100	4
3.	BPHY(H)-201	Waves & Oscillations	3	1	0	20	10	30	70	100	4
4.	BPHY(H)-202	Optics	3	1	0	20	10	30	70	100	4
5.	BCHE(H)-201	Physical Chemistry	3	1	0	20	10	30	70	100	4
6.	BCHE(H)-202	Basic of Analytical Chemistry	3	1	0	20	10	30	70	100	4
7.	BPHY(H)-251	Physics lab-2	0	0	4	--	--	30	70	100	2
8.	BCHE(H)-251	Chemistry lab-2	0	0	4	-	-	30	70	100	2
9.	AECC* Audit course	Environmental Science	3	0	0	20	10	30	70	100	3*
	TOTAL		18	6	4	-	-	-	-	800	28

B. Sc. - II Year Mathematics (Hons.), Semester-III

Effective from Session 2020-21

S. No.	Course Code	Course Titles		EVALUATION SCHEME						Course Total (Marks)	Credits
				Internal Exam					External Exam		
			L	T	P	CT	AS+ AT	Total			
1.	BMAT(H)-301	Mechanics	3	1	0	20	10	30	70	100	4
2.	BMAT(H)-302	Numerical Methods	3	1	0	20	10	30	70	100	4
3.	BPHY(H)-301	Electricity and Magnetism	3	1	0	20	10	30	70	100	4
4.	BPHY(H)-302	Circuit fundamental and Basic Electronics	3	1	0	20	10	30	70	100	4
5.	BCHE(H)-301	Inorganic Chemistry	3	1	0	20	10	30	70	100	4
6.	BCHE(H)-302	Organic chemistry	3	1	0	20	10	30	70	100	4
7.	BPHY(H)-351	Physics Lab -3	0	0	4	-	-	30	70	100	2
8.	BCHE(H)-351	Chemistry Lab -3	0	0	4	-	-	30	70	100	2
9.	UDM* Audit course	Disaster Management	3	0	0	20	10	30	70	100	03*
	TOTAL		18	6	8	-	-	-	-	800	28

B. Sc. - II Year Mathematics (Hons.), Semester-IV

Effective from Session 2020-21

S. No.	Course Code	Course Titles		EVALUATION SCHEME						Course Total (Marks)	Credits
				Internal Exam					External Exam		
			L	T	P	CT	AS+ AT	Total			
1.	BMAT(H)-401	Discrete Structures	3	1	0	20	10	30	70	100	4
2.	BMAT(H)-402	Real Analysis	3	1	0	20	10	30	70	100	4
3.	BPHY(H)-401	Atomic and Laser Physics	3	1	0	20	10	30	70	100	4
4.	BPHY(H)-402	Classical and Statistical Mechanics	3	1	0	20	10	30	70	100	4
5.	BCHE(H)-401	Physical Chemistry	3	1	0	20	10	30	70	100	4
6.	BCHE(H)-402	Environmental Chemistry	3	1	0	20	10	30	70	100	4
7.	BPHY(H)-451	Physics Lab- 4	0	0	4	-	-	30	70	100	2
8.	BCHE(H)-451	Chemistry Lab-4	0	0	4	-	-	30	70	100	2
	TOTAL		18	6	8	-	-	-	-	800	28

B. Sc. - III Year Mathematics (Hons.), Semester-V

Effective from Session 2020-21

S. No.	Course Code	Course Titles	Periods			EVALUATION SCHEME				Credits	Course Total (Marks)
						Internal Exam			External Exam		
			L	T	P	CT	AS+AT	Total			
1.	BMAT(H)-501	Linear Algebra	4	0	0	20	05+05	30	70	04	100
2.	BMAT(H)-502	Linear Programming	4	0	0	20	05+05	30	70	04	100
3.	BMAT(H)-503	Advanced Real Analysis	4	0	0	20	05+05	30	70	04	100
4.	BMAT(H)-504	Abstract Algebra I	4	0	0	20	05+05	30	70	04	100
5.	BMAT(H)-505	Theory of Probability	4	0	0	20	05+05	30	70	04	100
6.	BCS(H)-506	Computer Fundamentals and Programming in C	4	0	0	20	05+05	30	70	04	100
7.	BMAT(H)-507	Mathematical Methods	4	0	0	20	05+05	30	70	04	100
8.	BCS(H)-556	Practicals for Programming in C	0	0	4	---	----	30	70	02	100
									TOTAL	30	800

B. Sc. - III Year Mathematics (Hons.), Semester-VI

Effective from Session 2020-21

S. No.	Course Code	Course Titles	Periods			EVALUATION SCHEME				Credits	Course Total (Marks)
						Internal Exam			External Exam		
			L	T	P	CT	AS+AT	Total			
1.	BMAT(H)-601	Complex Analysis	4	0	0	20	05+05	30	70	04	100
2.	BMAT(H)-602	Difference Equations	4	0	0	20	05+05	30	70	04	100
3.	BMAT(H)-603	Multivariable Calculus	4	0	0	20	05+05	30	70	04	100
4.	BMAT(H)-604	Abstract Algebra II	4	0	0	20	05+05	30	70	04	100
5.	BMAT(H)-605	Introduction to Number Theory	4	0	0	20	05+05	30	70	04	100
6.	BMAT(H)-606	Partial Differential Equation and Calculus of Variation	4	0	0	20	05+05	30	70	04	100
7.	BMAT(H)-607	Metric Space	4	0	0	20	05+05	30	70	04	100
8.	BMAT(H)-608	Project and Viva voce	0	0	4	20	05+05	30	70	04	100
									TOTAL	32	800

IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICSPROGRAMME
B. Sc. (Hons.), I- YEAR, (I- Semester)

BMAT (H)-101: MATRICES AND TRIGONOMETRY

Objective: -The main aims of this course is to introduce the basic tools of matrices to solve the systems of linear equations, eigenvalues and corresponding eigenvectors for a square matrix and to compute the values of the six trigonometric functions and their transformations, use the basic trigonometric identities to solve trigonometric equations.

MATRICES

UNIT-1 **(10 Sessions)**
Special types of matrices, Elementary transformations, Inverse of a matrix by elementary transformations.

UNIT-2 **(10 Sessions)**
Rank of matrix, Echelon form and Normal forms, Solution of simultaneous linear equations.

UNIT-3 **(12 Sessions)**
Characteristic Equation, Eigen values and Eigen vector of a matrix, Cayley-Hamilton Theorem with proof, Eigen values and Eigen vectors of symmetric, Skew symmetric, Hermition,Skew-Hermition, Unitary and Orthogonal matrices, Diagonalisation of matrix.

TRIGONOMETRY

UNIT-4 **(10 Sessions)**
Complex number, Function of complex variable, Trigonometric, Exponential ,Logarithmic functions, Inverse trigonometric, Hyperbolic functions and Separations into real and imaginary parts.

UNIT-5 **(08 Sessions)**
Expansions and Summation of series.

Course Outcomes:
Students completing this course will be able to:

- Solve a system of linear equations by row-reducing its augmented form.
- Perform the matrix operations of addition, multiplication and transposition and express a system of simultaneous linear equations in matrix form
- Determine whether or not a given matrix is invertible and if it is, find its inverse.
- Solve the problems of Complex number, Function of complex variable, Trigonometric, Exponential, Logarithmic functions.

Suggested Readings:

1. S. C. GUPTA: Introduction to matrices, Sultan Chand & Sons Publication Delhi.
2. N. Saran & J.K. Goyal: Introduction to matrices, Pragati Prakashan, Meerut.
3. P. Duraipandian: Trigonometry, Sultan Chand & Sons Publication
4. R. S. Chandel, S.K. Singh &GauriSankar: A Text book of Algebra &Trigonometry, Ram Prasad & Sons.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), I- YEAR, (I- Semester)

BMAT (H)-102: CALCULUS

Objective: -The main aims of this course is to equip the student with necessary analytic and technical skills to handle problems of mathematical nature as well as practical problems. More precisely, main target of this course is to explore the different tools for higher order derivatives, to plot the various curves and to solve the problems associated with differentiation and integration of vector functions. This course is primarily concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications to create mathematical models in order to arrive into an optimal solution.

DIFFERENTIAL CALCULUS

UNIT-1 **(12 Sessions)**
Successive Differentiation, n^{th} differential coefficient of algebraic, Exponential, Trigonometric function, Inverse function, Logarithmic function, Leibnitz's theorem (with proof), Finding $(y_n)_0$.

UNIT-2 **(10 Sessions)**
Expansions of functions by Maclaurin and Taylor's theorems, Curvature, Asymptotes, Curve tracing.

UNIT-3 **(10 Sessions)**
Partial differentiation, Euler's theorem, Change of variables, Jacobians, Maxima and minima of two variables.

INTEGRAL CALCULUS

UNIT-4 **(08 Sessions)**
Reduction Formulae, Beta and Gamma functions, Dirichelet's theorem, Definite integrals.

UNIT-5 **(10 Sessions)**
Multiple integrals, Length of the curves, Area of the curves, Volume and surface of solids by revolution of the curves.

Course Outcomes:
Students completing this course will be able to:

- Understand continuity and differentiability in terms of limits.
- Describe asymptotic behavior in terms of limits involving infinity.
- Use derivatives to explore the behavior of a given function, locating and classifying its extrema, and graphing the function.

Suggested Readings:

1. Gorakh Prasad : Integral calculus, Pothisala Publication.
2. Shanti Narayan : Integral calculus, S. Chand Publication.
3. Gorakh Prasad : Differential calculus, Pothisala Publication.
4. Shanti Narayan : Differential calculus, S. Chand Publication.

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), I- YEAR, (II- Semester)

BMAT (H)-201: VECTOR CALCULUS AND CO-ORDINATE GEOMETRY

Objective: -The main aims ofthis course are to introduce and develop the methods of vector analysis and to familiarize the students with concept and applications co-ordinate geometry of three dimensions. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Mathematics.

VECTOR CALCULUS

UNIT-1 **(12 Sessions)**
Vector Differentiation and Integration, Gradient, Divergence and Curl and their properties.

UNIT-2 **(10 Sessions)**
Line integrals, Surface integral, Volume integral, Theorems of Gauss, Green and Stoke'sandtheirproblems.

GEOMETRY

UNIT-3 **(10 Sessions)**
General equation of second degree, Tracing of conics, System of conics, Confocal conics, Polar equation of conic and its properties.

UNIT-4 **(10 Sessions)**
3-Dimensional system of co-ordinates, Direction cosines and direction ratios, Projection, Plane, Straight line,

UNIT-5 **(08 Sessions)**
Sphere, Cone and Cylinder and central conicoid.

Course Outcomes:
Students completing this course will be able to:

- Calculate and interpret derivatives in up to three dimensions
- Integrate functions of several variables over curves and surfaces
- Use Green's theorem and the Divergence theorem to compute integrals Identify and sketch curves
- Use three dimensional geometry using vectors
- Understand mathematical models to relate mathematics with daily life problems.

Suggested Readings:

1. B. S .Grewal: Engineering Mathematics, Khanna Publishers.
2. S. S. Gangwar, Hari Krishan&K.M.Agarwal: Vector Analysis & Analytical Geometry Published by Ram Prashad& Sons, Agra,
3. Pundir& Gupta M. C: Geometry & Vectors,Published by PragtiPrakashan, Meerut.
4. M.A. Pathan: Vector Analysis, Published by PragtiPrakashan, Meerut.
5. Mittal & Mittal: Three dimension Co-ordinate geometry Published by PragtiPrakashan, Meerut.

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), I- YEAR, (II- Semester)

BMAT(H)-202: DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS

Objective: -The main aims of this course are to recognize differential equations that can be solved by each of the three methods – direct integration, separation of variables and integrating factor method – and use the appropriate method to solve them. To describe Laplace Transforms, the ideas of Fourier and indicate their applications in the fields such as application of PDE, theory of wave equations, differential equations and many others.

DFFERENTIAL EQUATIONS

UNIT-1 **(10 Sessions)**
Formation of First order and first degree,Solutions of homogeneous differential equations, linear differential equations and exact differential equations, Linear differential equations with constant coefficients, Homogeneous linear differential equations.

UNIT-2 **(12 Sessions)**
Differential equations of the first order but not of the first degree, Clairaut's equations and singular solutions, Simultaneous linear differential equations with constant coefficients, Linear differential equations of the second order (including the method of variation of parameters) with variable coefficient.

UNIT-3 **(10 Sessions)**
Formation of partial differential equations, Partial differential equations of the first order, Lagrange's equations, Linear partial differential equations with constant coefficients.

INTEGRAL TRANSFORMS

UNIT-4 **(10 Sessions)**
The concept of transform, Laplace transforms(L.T.), Linearity property of transforms, Shifting theorem, Laplace transform of derivatives & integrals, Dirac's Deltafunction, Unit step function, Laplace transform of periodic function.

UNIT-5 **(08 Sessions)**
Inverse Laplace transform, Convolution theorem, Solution of differential equations by Laplace transform.

Course Outcomes:
Students completing this course will be able to:

- Think logically and mathematically in any field of engineering.
- Gain an experience in the implementation of Mathematical concepts which are applied in various field of sciences and Engineering.
- Recognize the different methods of finding Laplace transforms and Fourier transforms of different functions.
- Apply the knowledge of L.T, F.T, and Finite Fourier transforms in finding the solutions of differential equations
- Solve the initial value problems and boundary value problems.

Suggested Readings:

1. I. E. Kreyszig : Advanced Engineering Mathematics(9^{th} Edition), John Wiley and sons
2. A. R. Vasishtha: Differential equations, Krishna publication, Meerut.
3. K. P. Gupta & J. K. Goyal: Integral transforms.
4. R. Kumar and N. Kumar: Differential Equations & Integral Transform C.B.S.Publication, Delhi.

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), II- YEAR, (III- Semester)

BMAT (H)-301: MECHANICS

Objective: -The main aims of this course are helps the students to develop skills and knowledge of standard concepts in mechanics to become aware of their applications. Both the components of mechanics, namely, statics and dynamics are dealt with in this course and also study of various forces and components.

UNIT-1 **(12 Sessions)**
Velocity, Acceleration along radial and transverse directions, along tangential and normal directions.

UNIT-2 **(10 Sessions)**
Simple harmonic motion, Motion under laws of forces, Earth attraction, Elastic strings.

UNIT-3 **(08 Sessions)**
Motion in resisting medium, Constrained motion (circular and cycloidal only).

UNIT-4 **(10 Sessions)**
Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law.

UNIT-5 **(10 Sessions)**
An introduction to central conicoid, Common Catenary, Centre of gravity, Virtual work.

Course Outcomes:
Students completing this course will be able to:

- Solve for the resultants & moments of any force systems and determine equivalent force systems
- Determine the internal forces in plane trusses and beams
- Solve the mechanics problems associated with friction forces
- Obtain the centroid, first moment and second moment of an area
- Describe the motion of a particle in terms of its position, velocity and acceleration in different frames of reference and analyze the forces causing the motion of a particle
- Apply work, energy, impulse and momentum relationships for a particle in motion

Suggested Readings:

1. K. P. Gupta & J. K. Goyal: Statics. Krishna publication ,Meerut
2. A. R. Vasishtha& D. C. Agarwal: Dynamics of a particle. Krishna publication.
3. S. D. Sharma & P. P. Mittal : Dynamics of a particle. Krishna publication , Meerut

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), II- YEAR, (III- Semester)

BMAT (H)-302: NUMERICAL METHODS

Objective: -The main aims of this course are to introduce a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering. The goal is to provide a basic understanding of the derivation, analysis, and use of these numerical methods, along with a rudimentary understanding of finite precision arithmetic and the conditioning with stability of the various problems and methods. This will help to choose, develop and apply the appropriate numerical techniques for your problem, interpret the results, and assess accuracy

UNIT-1 **(10 Sessions)**
Approximation and errors in computations, Inherent errors, Rounding error, Truncation errors, absolute errors, Relative errors and percentage errors, Error in the approximation of a function and series, Propagation of error.

UNIT – 2 **(12 Sessions)**
Calculus of Finite Differences: Finite difference, Forward differences, Backward differences, Shift operator, Central difference operator, Averaging operator, Differential operator, Relationship between operators, Factorial notation, Missing terms technique and Separation of symbols.

UNIT - 3 **(08 Sessions)**
Interpolation with Equal Intervals:Introduction, Gregory- Newton's forward and Gregory- Newton's backward interpolation formulae
Central Differences: Central differences, Gauss's forward and Gauss's backward interpolation formulae.

UNIT - 4 **(10 Sessions)**
Interpolation with Unequal Intervals: Introduction, Divided differences, divided difference table, Newton's divided difference formula, Lagrange's interpolation formula.

UNIT - 5 **(10 Sessions)**
Numerical Differentiation:Introduction, Derivatives of Newton's forward and Newton's backward interpolation formulae.
Numerical Integration:Introduction, General quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule.

Course Outcomes:
Students completing this course will be able to:

- Apply various interpolation methods and finite difference concepts
- Apply numerical methods to find our solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations
- Work out numerical differentiation and integration whenever and wherever routine methods are not applicable

Suggested Readings:

1. V. Rajaraman: Computer Oriented Numerical Methods, PHI.
2. Gupta&Malik: Numerical Analysis",
3. B. S.Grewal: Numerical methods in Engineering and Science, Khanna Publishers, Delhi.
4. PradipNiyogi: Numerical Analysis and Algorithms, TMH.

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), II- YEAR, (IV- Semester)

BMAT (H)-401: DISCRETE STRUCTURES

Objective: -The main aims of this course are to prepare students to develop mathematical foundations to understand and create mathematical arguments require in learning many mathematics and computer sciences courses. To motivate students how to solve practical problems using discrete mathematics. Also, in this course basic concepts of Graph theory such as Trees, Eulerian Graphs, Vertex colorings.

UNIT – 1 **(12 Sessions)**

Relations: Sets, Product sets, Relations, Composition of relations, Types of relations, Equivalence Relation.
Functions: Function, Types of functions, Injective, Surjective, Bijective, Inverse function, Composition of functions, Recursively defined functions.

UNIT – 2 **(10 Sessions)**

Propositional Calculus: Propositions, Compound propositions, Basic logical operations, Tautologies and Contradictions, Logical equivalence, Algebra of propositions, Conditional and Biconditional statements, Normal forms, Arguments and Mathematical induction.

UNIT – 3 **(08 Sessions)**

Boolean Algebra: Definition, Laws of Boolean algebra, Duality, Logic gates, Boolean Expressions, Normal forms, *K*-maps for two, three and four variables.

UNIT – 4 **(10 Sessions)**

Combinatorics: Basic counting principles, Permutation, Combinations, Binomial coefficients, Inclusion-Exclusion principle, Discrete numeric function, Generating function, Recurrence relations.

UNIT – 5 **(10 Sessions)**

Graph Theory: Graph, Finite and Infinite graphs, Trivial graph, Degree of a vertex, Null graph, Subgraph, Connected and Disconnected graphs, Directed graph, Paths, Cycles, Regular graph, Planar graph, Euler's formula, Eulerian and Hamiltonian graphs.
Trees: Tree, Forest, Rooted tree, Properties of trees, Level, Height, Path length of tree.

Course Outcomes:
Students completing this course will be able to:

- Write an argument using logical notation and determine if the argument is or is not valid.
- Demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described.
- Understand the basic principles of sets and operations in sets.
- Apply counting principles to determine probabilities.
- Demonstrate an understanding of relations and functions and be able to determine their properties.
- Demonstrate different traversal methods for trees and graphs.

Suggested Readings:

1. J.P. Tremblay and R.P. Manohar: Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1989.

2. Seymour Lipschutz and Marc Lars Lipson: Discrete Mathematics, Tata McGraw-Hill Publishing company Limited, New Delhi.

3. N. Deo, "Graph Theory with application to Engineering and Computer Science," PHI.

4. Swapan Kumar Sarkar: A text book of discrete mathematics, S. Chand & Company Pvt. Ltd. New Delhi.

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), II- YEAR, (IV- Semester)

BMAT (H)-402: REAL ANALYSIS

Objective: - The main aims of this course real analysisare to provide students with the special knowledge which necessary for basic concepts in real analysis, it strives to enable students to learn basic concepts about functions of bounded variation grasp basic concepts about the uniform convergence of sequences and series of functions, total variation and learn about Riemann integrals.

UNIT-1 **(12 Sessions)**
Countability of Z and Q, Order properties of Q and its order incompleteness, Construction of R from Q using Dedekind cuts, Order completeness of R, The least upper bound property and equivalent conditions including the nested interval property, Uncountability of R Bounds, Bounded sets and their properties, Sup and inf of sets, Bolzano-Weierstrass theorem.

UNIT-2 **(10 Sessions)**
Sequences, Bounded sequences, Monotone sequences and their convergence, Limsup and liminf and convergence criterion using them, Subsequences, Cauchy sequences and their convergence criterion.

UNIT-3 **(08 Sessions)**
Interior points and limit points, Open, Closed, and Perfect sets.

UNIT-4 **(10 Sessions)**
Limits and continuity, Basic properties of continuous functions, Operations on sequences, Uniform continuity, Bounded functions, Intermediate Value Theorem, Discontinuities, Monotonic functions.

UNIT-5 **(10 Sessions)**
Infinite series and their convergence, Geometric series, The comparison test, Series of non-negative terms, The condensation test, Integral test, Ratio and root tests, Absolute and conditional convergence, Alternating series and Leibnitz's theorem.

Course Outcomes:
Students completing this course will be able to:

- Describe the basic differences between the rational and the real numbers.
- Understand and perform simple proofs
- Answer question concerning uniform convergence of concrete numerical sequences and series
- Give the definition of concepts related to metric spaces, such as continuity, compactness, completeness and connectedness
- Give the essence of the proof of Stone-Weierstrass theorem, the contraction theorem as well as the existence of convergent subsequences using equicontinuity.

Suggested Readings:

1. Malik & Arora: Mathematical Analysis, New Age Publication ,New Delhi
2. N.R. Gupta: Real Analysis, Pearson Education Ltd
3. Tom M. Apostol: Mathematical Analysis, Addison-Wesley Publishing Company
4. Walter Rudin: Principles of Mathematical Analysis, McGraw-Hill.
5. Richard R. Goldberg : Methods of Real Analysis, Oxford and IBH

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BMAT (H)-501:LINEAR ALGEBRA

Objective: - The main aims of this courseare to enables the students to understand the basic ideas of vector algebra, linear dependent and independent set, basis, the fundamental properties of eigenvalue, eigenvectors of a linear transformation various types of real quadratic forms and their applications to be familiar with the notion of inner product space and orthogonal vectors.

UNIT-1 **(10 Sessions)**
Theory of sets, Relations and functions, Binary composition, Vector spaces and their elementary properties.

UNIT-2 **(10 Sessions)**
Subspaces, Linear dependence and independence, Spanning set, Basis and dimension, Direct sum, Quotient space.

UNIT-3 **(10 Sessions)**
Linear transformations and their algebra, Range and null space, Rank and nullity, Rank-nulity theorem, Matrix representation of linear transformations, Change of basis.

UNIT-4 **(08 Sessions)**
Linear functions, Dual space, Bi-dual space, Natural isomorphism, Annihilators, Bilinear and quadratic forms.

UNIT-5 **(12 Sessions)**
Inner product spaces, Cauchy-Schwarz's inequality, Bessel's inequality and orthogonality, Hermitian, Unitary, Normal transformations and their diagonalizations.

Course Outcomes:
Students completing this course will be able to:

- Define basic terms and concepts of matrices, vectors and complex numbers
- Use of various forms of complex numbers to solve numerical problems
- Apply the matrix calculus in solving a system of linear algebraic equations
- Calculate the area of planar shapes (triangle, parallelogram) and the volume of parallelepiped using vector algebra

Suggested Readings:

1. A. R. Vashistha :Linear Algebra, , Krishna Publication, Meerut.
2. N. P. Balli :Linear Algebra, , Golden Book.
3. Hoffmann kunze :Linear Algebra, , PHI Learning Pvt.
4. David C. Lay :Linear Algebra and its applications, , Pearson India.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BMAT (H)-502: LINEAR PROGRAMMING

Objective: -The main aims of this courseare to help in solving problems in different environments that needs decisions to formulate linear programming. This module aims to introduce students to use quantitative methods and techniques effective for assignment and transportation problems, game theory, model formulation and applications that are used in solving business decision problems as well as various fields of science.

UNIT – 1 **(12 Sessions)**
Linear Programming Problems: Definition of Linear Programming(LP), Terminology and requirements of LP, Advantages of LP, Limitations of LP, Application areas of LP, General mathematical formulation of LPP, Graphical method for solving LPP, Simplex method, and Big-M method.

UNIT – 2 **(10 Sessions)**
Duality in Linear Programming: Definition, Formulation of dual problems, Advantages of duality, Characteristics of dual problem, Construction of the dual problem, Solution of the prime and dual problems and Dual simplex method.

UNIT – 3 **(10 Sessions)**
Transportation Problem: Definition, Transportation models, Linear programming formulation of transportation problem, Method for finding the initial solution by North -West corner method, least cost entry method, Row minima method, Column minima Method, Vogel's approximation method, unbalanced problem, Degeneracy problem, Test for optimality.

UNIT – 4 **(10 Sessions)**
Assignment Problems: Definition, Assignment models, Hungarian method of assignment problem (minimization case), Maximization case in assignment problem, unbalanced assignment problem and Restrictions on assignments.
Job Sequencing Problem: Definition, Notations, Terminology, Assumptions, Processing *n* jobs through two machines, processing n jobs through three machines, processing*n* jobs through *m* machines.

UNIT – 5 **(08 Sessions)**
Game Theory: Definition, Pay-off, Types of games, The maximin - minimax principle, Principles of dominance, Games without saddle points (Mixed strategies), Solution of games by Graphical method and Linear programming method.

Course Outcomes:
Students completing this course will be able to:

- Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method todemonstrate the solution process.
- Explain the relationship between a linear program and its dual, including strong duality
- Formulate specialized linear programming problems, namely transportation and assignment problems
- Demonstrate solution methods including graphs and linear programming to analyze and solve the Two-person, zero-sum games

Suggested Readings:

1. H. A. Taha: Operations Research an introduction, Macmillan.
2. J. K. Sharma: Operations Research Theory and Applications, Macmillan India Ltd.
3. V. K. Kapoor: Operations Research, Sultan Chand and Sons, New Delhi.
4. S. D. Sharma: Operations Research ,Kedar nath&Ramnath and Company.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BMAT (H)-503: ADVANCED REAL ANALYSIS

Objective : The main aims of this course are to understand open and closed sets, sequences and series, real number system and their properties, convergence and divergence criteria for sequence and series of functions Riemann integration of real valued functions. Fundamental theorem of calculus, mean value theorem of integral calculus.

UNIT-1 **(12 Sessions)**
Riemann integration, Inequalities of upper and lower sums, Riemann conditions ofintegrability, Riemann sum and definition of Riemann integral through Riemann sums, Properties of the Riemann integral, Intermediate Value theorem for integrals, Fundamental theorems of calculus.

UNIT-2 **(08 Sessions)**
Improper integrals and their types, Convergence and divergence of improper integrals.

UNIT-3 **(10 Sessions)**
Point-wise and uniform convergence of sequence of functions, Theorems on continuity, Derivability and integrability of the limit function of a sequence of functions.

UNIT-4 **(10 Sessions)**
Series of functions, Theorems on the continuity and derivability of the sum function of aseries of functions, Cauchy criterion for uniform convergence and Weierstrass M-Test.

UNIT-5 **(10 Sessions)**
Power series, Radius of convergence, Cauchy-Hadamard theorem, Differentiation and integration of power series, Abel's theorem, Weierstrass approximation theorem.

Course Outcomes:
Students completing this course will be able to:

- Understand and prove fundamental results and solve algebraic problems using appropriate techniques.
- Understand the basic properties of real number system that will used later in development of real analysis theory.
- Develop the logical thinking to proof the basic results of real analysis.
- Solve the problems of convergence and divergence of sequences and series.
- Develop an understanding of limits in abstract way and how they are used in sequences, series, differentiation and integration.
- Appreciate how abstract ideas in real analysis can be applied to practical problems.

Suggested Readings:

1. K.A. Ross, Elementary Analysis: The Theory of Calculus, Undergraduate Texts in
2. Mathematics, Springer (SIE), Indian reprint, 2004.
3. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis (3rd edition), John Wiley and Sons (Asia) Pvt. Ltd.., Singapore, 2002.
4. S. C. Malik, Savita Arora , Mathematical analysis (4th Edition) New Age International.
5. W. Rudin : Principles of Mathematical Analysis, McGraw Hill, 1983.
6. T. M. Apostol: Mathematical Analysis, New Delhi, Narosa, 2004.

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- onlinecourses.nptel.ac.in
- en.wikipedia.org

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BMAT (H)-504: ABSTRACTALGEBRA I

Objective: The main aims of this course are to introduce basic structures of algebra like groups, rings, fields and vector spaces which are the main pillars of modern mathematics. The course gives the student a good mathematical maturity and enables to build mathematical thinking and skills in the field of science.

UNIT-1 **(10 Sessions)**
Definition and examples of a group, Symmetries of a square, dihedral groups, Permutation groups and quaternion groups (illustration through matrices), Elementary properties of a group.

UNIT-2 **(12 Sessions)**
Subgroups and examples of subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups, Abelian group, Cyclic group, Properties of a cyclic group, Classification of subgroups of a cyclic group.

UNIT-3 **(10 Sessions)**
Cycle notation for permutations, Properties of permutations, Even and Odd permutations, Alternating group, Properties of cosets, Lagrange's theorem, External direct product of a finite number of groups.

UNIT-4 **(10 Sessions)**
Normal subgroups, Factor groups, Cauchy's theorem for finite abelian groups, Sylow's Theorem and its applications.

UNIT-5 **(08 Sessions)**
Group homomorphism, Properties of homomorphism, Group isomorphism, Properties of group isomorphism.

Course Outcomes:
Students completing this course will be able to:

- Explore the properties of groups, sub-groups, including symmetric groups, permutation groups, cyclic groups, normal sub-groups and quotient groups.
- Understand the concepts of homomorphism and isomorphism between groups.
- Apply class equation and Sylow theorems to solve different problems.
- Explore the properties of rings, sub-rings, ideals including integral domain, principle ideal domain, Euclidean ring and Euclidean domain.
- Understand the concepts of homomorphism and isomorphism between rings.

Suggested Readings:

1. Joseph A. Gallian: Contemporary Abstract Algebra (4th Edition), Narosa Publishing House,
2. New Delhi, 1999.(IX Edition 2010)
3. V.K khanna, S.K Bhambri: A Course in Abstract Algebra (3rd Edition), Vikas Publishing House Pvt. Ltd.,2009.
4. A. R. Vasishtha: Abstract Algebra, Krishna Publication, Meerut.
5. M. Artin: Algebra, Prentice Hall of India, 1991.
6. Darek F. Holt, Bettina Eick and Eamonaa. Obrien: Handbook of computational group theory, Chapman & Hall/CRC Press, 2005
7. J. B. Fraleigh : A first course in abstract algebra(7th Edition), Addison-Wesley Longman, 2002.

Website Sources:

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- onlinecourses.nptel.ac.in
- en.wikipedia.org

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BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BMAT (H)-505: THEORY OF PROBABILITY

Objective: The main aims of this course are to introduce the fundamentals of probability theory, random processes and illustrate these concepts with Science and engineering applications. It will present the basic principles of random variables and random processes needed in applications such as signal processing, digital communications, speech processing, data modeling and data analyzing.

UNIT-1 **(12 Sessions)**
Definition of probability , Sample space, Events and algebra of events, Probability axioms, Addition andmultiplication theorems of probability, Conditional probability, Independent events, Baye's theorem.

UNIT-2 **(08 Sessions)**
Random variables (discrete and continuous), Cumulative distribution function, Probability mass/densityfunctions.

UNIT-3 **(10 Sessions)**
Mathematical expectation, Moments, Moment generating function, Characteristic function, Uniform, Binomial, Poisson, Geometric, Negative binomial distribution, Normal distribution.

UNIT-4 **(10 Sessions)**
Joint cumulative distribution function and its properties, Joint probability density functions, Marginal and conditional distributions, Expectation of function of two random variables, Conditional expectations.

UNIT-5 **(10 Sessions)**
Meaning of correlation and regression, Coefficient of correlation, Rank correlation, Lines of regression. Properties of regression coefficients.

Course Outcomes:
Students completing this course will be able to:

- Demonstrate understanding ofBasic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
- Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.
- Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.
- Discrete time Markov chains and methods of finding the equilibrium probability distributions.
- Calculate probabilities of absorption and expected hitting times for discrete time Markov chains with absorbing states.
- Translate real-world problems into probability models.

Suggested Readings:

1. Arun kumar, Alka Chaudhary: Probability Theory, Krishna's Publication Media Pvt. Ltd.
2. Murray Spiegel, Larry Stephens: Statistics (4th Edition), McGraw Hill Professional.
3. Edwin Thompson Jaynes: Probability Theory, Cambridge university press
4. S. C. Gupta and V. K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BCS (H)-506: Computer Fundamentals and Programming in "C"

Objective: To provide complete knowledge of C language and to create programs in C.

UNIT-1 **(10 Sessions)**

Computer Fundamental: Introduction of Computer, Classification of Computers, Applications of Computers, Generations of Computers, Basic organization of a Computer, Software and its types, Hardware, Input Devices – Keyboard , Mouse , Scanner , Barcode Reader etc, Output Devices – Printer, Plotters etc.

UNIT-2 **(10 Sessions)**

Computer Memory, Memory Hierarchy, Registers, Cache Memory, Primary Memory, Secondary Memory. Operating System: Definition of Operating System, Function of Operating System, Types of Operating System.

UNIT-3 **(08 Sessions)**

Networks: Computer Networks, Types of Networks, Network Topology, Data Transmission Mode.

UNIT-4 **(12 Sessions)**

Programming Using C: Variables, Constants, Operators, Data types: Character types, Integer, short, float, long, Type Casting, functions, Conditional Program Execution : Applying if statement, if…else statement ,nested if else, Looping Statements(while, for, do…while), Nested loop, Use of Break, Continue and goto Statement, Applying Switch case Statement.

UNIT-5 **(10 Sessions)**

Arrays: Introduction of Arrays, Array notation and representation, Type of arrays, String, Debugging and testing of Programs.

Course Outcome

Students completing this course will be able to:

- Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming.
- Study computer memory, types of operating system
- Understand types of networks.
- Write, compile and debug programs in C language and use different data types for writing the programs.
- Learn Array notation and representation

References Books:

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals BPB Publications
2. V. Raja Raman, Fundamentals of Computers PHI Learning,
3. Yashavant P. Kanetkar, Let us C ,Infinity Science Press.

Website Sources:

- http://gpnanakpur.ac.in
- https://www.tutorialspoint.com
- http://www.tmv.edu.in
- https://www.tutorialspoint.com
- https://en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BMAT (H)-507: MATHEMATICAL METHODS

Objective: The main aims of this course are to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the applied mathematics and engineering programs. It also enable students to apply transforms and variation problem technique for solving differential equations and extremum problems.

UNIT-1 **(12 Sessions)**
Fourier series and transforms, Determination of Fourier coefficients, Fourier series, Even and Odd functions, Fourier series in an arbitrary interval, Half-range Fourier sine and cosine series.

UNIT-2 **(10 Sessions)**
Fourier integral theorem (without proof)– Fourier sine and cosine integrals, Fourier transforms, Fourier sine and cosine transforms and their properties, Inverse transforms, Finite Fourier transforms, Discrete Fouriertransforms.

UNIT-3 **(10 Sessions)**
Z-transforms: Introduction, Definition, Some standard Z-transforms, Initial and final value theorems, Z-transforms properties, Inverse Z-transforms, Convolution theorem, Solution of difference equations using Z-transforms.

UNIT-4 **(10 Sessions)**
Series Solution of ODE, Special function**,** Power series method, Legender's equation, Legender's polynomial, Generating function of Legender polynomial, Orthogonal property, Recurrence relations, Laplace transformation of first kind and second kind for $P_n(x)$ and its problems.

UNIT-5 **(08 Sessions)**
Bessel's equation and its solution, Generating function for Bessel's function, Recurrence relations, Bessel's function of first and second kind, Sine and cosine series for Bessel's function.

Course Outcomes:
Students completing this course will be able to:

- Understand the basics of Laplace Transformation to solve initial and boundary value problems.
- Learn Fourier transformation and Z transformation and their applications to relevant problems.
- Understand Hankel's Transformation to solve boundary value problem.
- Find solutions of linear integral equations of first and second type (Volterra and Fredhlom).
- Understand theory of calculus of variations to solve initial and boundary value problems.

Suggested Readings:

1. Erwin Kreyszig:Advanced Engineering Mathematics (Second edition), Michael Greenberg, John Wiley & Sons, (10th Edition).
2. I.N. Sneddon : The use of Integral Transforms, Tata Mc Graw Hill, Publishing Company Ltd, New Delhi,1974.
3. R.P. Kanwal: Linear integral equations theory and techniques, Academic Press, New York, 1971.
4. C.M. Bender and S.A. Orszag : Advanced mathematical methods for scientists and engineers, Mc Graw Hill, New York, 1978.
5. H.T. Davis: Introduction to nonlinear differential and integral equations, Dover Publications, 1962.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in

- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (V- Semester)

BCS (H)-556: Practical for Programming in C

Objective: This coursehelps to learn the fundamental programming concepts and methodologies that are essential to build C programs.

List of Experiments **(20 Sessions)**

1) Write a program in C to find the sum of two numbers.
2) Write a program in C to find the factorial of a number.
3) Write a program in C to print first ten natural numbers.
4) Write a program in C to calculate area of rectangle.
5) Write a program in C to check whether number is prime or not.
6) Write a program in C using arrays to find the largest and second largest number.
7) Write a program in C to calculate area of circle.
8) Write a program in C to read a string and write it in reverse order.
9) Write a program in C to concatenate two strings of different lengths.
10) Write a program in C to check that the input string is a palindrome

Course Outcomes:
Students completing this course will be able to:

- Identifysituations where computational methods and computers would be useful.
- Given a computational problem, identify and abstract the programming task involved.
- Write the program on a computer, edit, compile, debug, correct, recompile and run it.
- Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Suggested Readings:

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals BPB Publications
2. V. Raja Raman, Fundamentals of Computers PHI Learning,
3. Yashavant P. Kanetkar, Let us C ,Infinity Science Press.

Website Sources:

- https://www.lkouniv.ac.in
- https://legacy.essie.ufl.edu
- https://ncss-wpengine.netdna-ssl.com
- https://uomustansiriyah.edu.iq
- https://beginnersbook.com

Note: Latest editions of all the suggested readings must be used

IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (VI- Semester)

BMAT (H)-601: COMPLEX ANALYSIS

Objective: The main aims of this course are to introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions, complex integrals and a range of skills which will allow students to work effectively with the concepts of analysis and evaluation.

UNIT-1 **(12 Sessions)**
Functions of a complex variable, Analytic function, Necessary and sufficient conditions of analytic function, C-R equations (Cartesian and polar forms), Harmonic functions, Milne's thomson method, Orthogonal system.

UNIT-2 **(10 Sessions)**
Mapping by elementary function, Linear and bilinear transformation, fixed point, Cross ratio, Critical point.

UNIT-3 **(10 Sessions)**
Complex integration, Line integral, Cauchy fundamental theorem, Cauchy's integral formula, Cauchy's integral formula for higher derivatives, Liouville theorem, Taylor and Laurent series.

UNIT-4 **(08 Sessions)**
Singularities and zeros of an analytic function, Rouche's theorem, Fundamental theorem of algebra.

UNIT-5 **(10 Sessions)**
Cauchy residue theorem, Jordan lemma, Calculus of residues-integration round the unit circle, Roots lie in improper integral form, Poles lie on the real axis.

Course Outcomes:
Students completing this course will be able to:

- Becoming familiar with the concepts Complex numbers and their properties and operations with Complex number.
- Finding domain and range of complex functions and sketching their graphs.
- Evaluating limits and checking the continuity of complex function.
- Checking differentiability and Analyticity of functions.
- Evaluate Complex integrals and applying Cauchy integral.

Suggested Readings:

1. Ruel V. Churchill: Complex Variables and Applications, TMH Publication.
2. T.Path : Function of Complex Variable, PothisalaPvt.Ltd, Allahabad.
3. A. R. Vasistha: Complex Analysis, Krishna Prakashan Media (P) Ltd, Meerut.
4. Conway: Complex of one variable,Nrosa Publication.
5. Kasana : Complex variable, Theory and Application, PHI Publication.

Website Sources:

- www.pdfdrive.com

- www.dmi.gov.in
- www.yourarticlelibrary.com
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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (VI- Semester)

BMAT (H)-602:DIFFERENCE EQUATIONS

Objective: -The main aims of this course are to understand application of sequences and series of numbers and functions, partial difference equations, Discrete boundary value problem, Application with different engineering problem, Discrete mathematical models.

UNIT-1 **(10 Sessions)**
Introduction, Difference Calculus – The Difference Operator Summation, Generating functions a approximate summation.
Linear Difference Equations – First order equations, General results for linear equation. Equations with constant coefficients Applications, Equations with variable coefficients,nonlinear equations that can be linearized and the z-transform.

UNIT-2 **(10 Sessions)**
Stabilty Theory- Initial value problems for linear systems, Stability of linear systems, Stability of nonlinear systems, Chaotic behavior.
Asymptotic methods – Introduction, Asymptotic analysis of sums, Linear equations, Nonlinear equations.

UNIT-3 **(10 Sessions)**
The self-adjoint second order linear equation – Introduction Sturmian Theory, Greens functions, Disconjugacy, The Riccati Equations and Oscillation.
The Sturm-Liouville problem- Introduction, Finite Fourier Analysis, A non-homogeneous problem.

UNIT-4 **(08 Sessions)**
Discrete Calculus of variations- Introduction, Necessary conditions, Sufficient conditions and Disconjugacy.

UNIT-5 **(10 Sessions)**
Boundary Value Problems for Nonlinear equations- Introduction, The Lipschitz case, Existence of solutions, Boundary value Problems for differential Equations, Partial differential Equations, Discretization of Partial Differential Equations, Solution of partial differential equations.

Course Outcomes:
Students completing this course will be able to:

- Apply the theory to study the qualitative theory of solutions of difference equations and partial difference equations of higher order.
- Apply the theory to study the quantitative and qualitative study of solutions of different discrete models in Engineering.
- Difference between the qualitative and quantitative behavior of solutions of the difference equations and the corresponding differential equations.
- Apply the theory to study the solution in discrete boundary value problems.

Suggested Readings:

1. M. D. Rai Singhaniya : Differential equations, S. chand Publications.

2. Difference equations : Schaum'sOutlines, TMH.
3. Fulford Glenn R. : Modelling with Differential and Difference Equations, Cambridge University Press.
4. Youssef N. Raffoul : Qualitative Theory of Volterra Difference Equations, Springer International Publishing AG.
5. Hyun-Ku Rhee, Rutherford Aris, Neal R. Amundson : First-Order Partial Differential Equations, Vol. 1 (Dover Books on Mathematics) Kindle Edition.

Website Sources:

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BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons.), III- YEAR, (VI- Semester)

BMAT (H)-603: MULTIVARIABLE CALCULUS

Objective: The main aims of this course are to introduceMultivariable Calculus applies the techniques and theory of differentiation and integration to a thorough study of vectors in two and three dimensions, vector-valued functions, calculus of functions of more than one variable, partial derivatives, multiple integration, Green's Theorem, Stokes' Theorem, Divergence Theorem; includes motion in two and three dimensions, curves and surfaces.

UNIT-1 **(10 Sessions)**
Functions of several variables, Limit and continuity of functions of two variables, Partialdifferentiation, Total differentiability and differentiability, Sufficient condition fordifferentiability.

UNIT-2 **(10 Sessions)**
Chain rule for one and two independent parameters, Directional derivatives, the gradient, maximal and normal property of the gradient, Tangent planes.

UNIT-3 **(08 Sessions)**
Extrema of functions of two variables, Method of Lagrange multipliers, constrainedoptimization problems,Definition of vector field, Divergence and curl.

UNIT-4 **(12 Sessions)**
Double integration over rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integralover a parallelepiped and solid regions, Volume by triple integrals, Cylindrical and spherical coordinates, Change of variables in double integrals and triple integrals.

UNIT-5 **(10 Sessions)**
Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem forline integrals, Conservative vector fields, Independence of path, Green's theorem,Surface integrals, Stokes' theorem, Divergence theorem.

Course Outcomes:
Students completing this course will be able to:

- Effectively write mathematical solutions in a clear and concise manner.
- Locate and use information to solve calculus problems in several variables.
- Demonstrate ability to think critically effectively interpreting and using functions of several variables.
- Demonstrate ability to think critically by recognizing patterns and determining and using appropriate techniques for solving a variety of integration and differentiation problems.
- Work effectively with others to complete homework and class assignments.
- Demonstrate an intuitive and computational understanding for calculus applications by solving a variety of problems from physics, engineering and mathematics.
- Demonstrate the ability to differentiate and integrate vector-valued functions.

Suggested Readings:

1. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. James Stewart, Multivariate Calculus, Cengage Learning, (7th Edition).
3. Don Shimamoto, Swarthmore College, Multivariable Calculus, Don Shimamoto
4. Calculus: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability" by Tom M Apostol, John Wiley and Sons Ltd.
5. A Course in Multivariable Calculus and Analysis (Undergraduate Texts in Mathematics)" by Sudhir R Ghorpade and Balmohan V Limaye, Springer.

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IFTM UNIVERSITY, MORABDABAD
BACHELOR OF SCIENCE (HONS.)MATHEMATICS PROGRAMME
B. Sc. (Hons), III- YEAR, (VI- Semester)

BMAT (H)-604: ABSTRACT ALGEBRA II

Objective: The main aims of this course are to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups, rings, fields and some related structures. Abstract algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.

UNIT-1 **(12 Sessions)**
Definition and examples of rings, Properties of rings, Subrings, Integral domains and fields, Characteristic of a ring.

UNIT-2 **(10 Sessions)**
Ideals, Ideal generated by a subset of a ring, Factor rings, Operations on ideals, Prime and maximal ideals.

UNIT-3 **(08 Sessions)**
Ring homomorphism , Properties of ring homomorphism, Ring isomorphism, Field of quotients.

UNIT-4 **(10 Sessions)**
Polynomial rings over commutative rings, Division algorithm and consequences, Principal ideal domains, Factorization of polynomials, Reducibility tests, Irreducibility tests, Einstein criterion, unique factorization in Z[x]**.**

UNIT-5 **(10 Sessions)**
Divisibility in integral domains, Irreducible Polynomials, Primes, Unique factorization domains, Euclidean domains.

Course Outcomes :
Students completing this course will be able to:

- Effectively write abstract mathematical proofs in a clear and logical manner
- Locate and use theorems to solve problems in number theory and theory of polynomials over a field
- Demonstrate ability to think critically by interpreting theorems and relating results to problems in other mathematical disciplines
- Demonstrate ability to think critically by recognizing patterns and principles of algebra and relating them to the number system

- Work effectively with others to discuss homework problems put on the board. This will be assessed through class discussions.

Suggested Readings:

1. Joseph A. Gallian: Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010)
2. V.K khanna, S.K Bhambri: A Course in Abstract Algebra (3rd Edition), Vikas Publishing House Pvt. Limited, 2009.
3. C. Musili : Introduction to Rings and Modules, Narosa Publishing House, 1997.
4. Miles Reid: Under-graduate Commutative Algebra, Cambridge University Press, 1996.
5. M. Artin : Algebra, Prentice Hall of India, 1991.
6. N. Jacobson : Basic Algebra-I, HPC, 1984.
7. J. B. Fraleigh : A first couses in Algebra, 3rd edition, Narosa 1996.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

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BMAT (H)-605: INTRODUCTION TO NUMBER THEORY

Objective: The main aims of this course are to introduce students to some of the basic ideas of number theory, and to use this as a context in which to discuss the development of mathematics through examples, conjectures, theorems, proofs and applications. The module will introduce and illustrate different methods of proof in the context of elementary number theory, and will apply some basic techniques of number theory to cryptography.

UNIT-1 **(10 Sessions)**
Divisibility in Z, Fundamental theorem of arithmetic, Primes, Congruences, Fermat's theorem, Euler's theorem and Wilson's theorem.

UNIT-2 **(08 Sessions)**
Fermat's quotients and their elementary consequences, Solutions of congruence's, Chinese Remainder theorem, Euler's phi-function.

UNIT-3 **(10 Sessions)**
Power residues, Primitive roots and their existence, Quadratic residues, Legendre symbol, Gauss lemma about Legendre symbol, Quadratic reciprocity law.

UNIT-4 **(10 Sessions)**
Greatest integer function, Arithmetic functions, Multiplicative arithmetic functions, Mobius inversion formula, Convolution of arithmetic functions, Group properties of arithmetic functions.

UNIT-5 **(12 Sessions)**
Solution of Sum of two, four and five squares of integers, Difference of two squares, Perfect numbers, Polygonal numbers, Partition Generating Function, Uniqueness.

Course Outcomes:

Students completing this course will be able to:

- Find quotients and remainders from integer division

- Apply Euclid's algorithm and backwards substitution
- Understand the definitions of congruences, residue classes and least residues
- Add and subtract integers, modulo n, multiply integers and calculate powers, modulo n
- Determine multiplicative inverses, modulo n and use to solve linear congruences.

Suggested Readings:

1. I. Niven, H. Zuckerman and H. L. Montegomery: An Introduction to the Theory of Numbers (6th edition) John Wiley and sons, Inc., New York, 2003.
2. D. M. Burton: Elementary Number Theory, Universal Book Stall, New Delhi, (7^{th} Edition).
3. Burton David : Elementary Number Theory, McGraw Hill India
4. Titu Andreescu, Dorin Andrica, Birkhauser: Number Theory: Structures, Examples, and Problems, John Wiley & Sons.

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BMAT (H)-606: PARTIAL DIFFERENTIAL EQUATION AND CALCULUS OF VARIATION

Objective: The main aims of this course are to familiarize the students with the fundamental concepts of Partial Differential Equations (PDE) which will be used as background knowledge for the understanding of specialized courses in the field of science by solving homogeneous heat, wave, and Laplace's equations.Knowledge to solve a class of optimization problem in which the function(s) to be optimized under definite integral are restricted with constraint(s), Learn to establish the necessary conditions.

UNIT-1 **(12 Sessions)**
Formation of partial differential equations, Partial differential equations of the first order,Lagrange's equations, Charpit's method, Jacobi's method for solving a non- linear first order P.D.E in two variables.

UNIT-2 **(08 Sessions)**
PDEs of order two with variable coefficients, Monge's method.

UNIT-3 **(10 Sessions)**
Method of Separation of variables for Laplace, Heat and Wave Equations.

UNIT-4 **(10 Sessions)**
Calculus of variations: Variations of a functional, Euler- Lagrange's equations, Necessary and sufficient conditions for extrema.

UNIT-5 **(10 Sessions)**
Variational method with constraint condition, Isometric problem, Strum Liouville system and natural boundary conditions.

Course Outcomes:-
Students completing this course will be able to:
- Minimization problems for variational integrals, existence and regularity theory for minimizers and critical points, geometric measure theory

- Variational methods for partial differential equations, optimal mass transportation, linear and nonlinear eigenvalue problems
- Variational problems in differential and complex geometry
- Variational methods in global analysis and topology
- Variational methods in mathematical physics, nonlinear elasticity, asymptotic variational problems, homogenization, capillarity phenomena, free boundary problems and phase transitions
- Monge-Ampère equations and other fully nonlinear partial differential equations related to problems in differential geometry, complex geometry, and physics.

Suggested Readings:

1. M.D. Rai shinghania: Odinary and Partial Differential Equation, S. Chand Limited (Revised Edition).
2. A.S. Gupta : Calculus of Variation, PHI Learning Pvt. Ltd.
3. RimplePundir: Calculus of Variation, PragatiPrakashan.
4. I. M. Gelfand, S. V. Fomin: Calculus of Variations, Published by Courier Corporation
5. J. N. Sharma and K.Singh: Partial differential equations for engineers and scientists, 2nd Edition, New Delhi, Narosa Publication House, 2009.

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BMAT (H)-607: METRIC SPACE

Objective: The main aims of this courseareIntroduction of metric as a generalization of distance function and basic concepts in metric spaces. Also to explain the concept of sequence and complete metric space with their properties and discuss compactness, and sequential compact spaces and their properties along with continuity.

UNIT-1 **(12 Sessions)**

Metric spaces: Definition and examples, Sequences in metric spaces, Cauchy sequences, Complete metric spaces.

UNIT-2 **(10 Sessions)**

Open and closed balls, Neighborhood, Open set, Interior of a set, Limit point of a set, Closed set, Diameter of a set, Cantor's theorem, Subspaces, Dense sets, Separable spaces.

UNIT-3 **(10 Sessions)**

Continuous mappings, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Completeness, Contraction mappings, Banach fixed point theorem.

UNIT-4 **(08 Sessions)**

Connectedness, Connected subsets of**R,** Connectedness and continuous mappings.

UNIT-5 **(10 Sessions)**

Compactness, Compactness and boundedness, Continuous functions on compact spaces.

Course Outcomes:-

Students completing this course will be able to:

- Understand the Euclidean distance function on AB and appreciate its properties, and state and use the Triangle and Reverse Triangle Inequalities for the Euclidean distance function on AB
- Explain the definition of continuity for functions from AB to AD and determine whether a given function from AB to ADis continuous

- Explain the geometric meaning of each of the metric space properties (M1) – (M3) and be able to verify whether a given distance function is a metric
- Distinguish between open and closed balls in a metric space and be able to determine them for given metric spaces
- Define convergence for sequences in a metric space and determine whether a given sequence in a metric space converges
- State the definition of continuity of a function between two metric spaces.

Suggested Readings:

1. Satish Shirali&Harikishan L. Vasudeva, Metric Spaces, Springer Verlag London (2006) , First Indian Reprint 2009
2. J.N Sharma, Mathematical Analysis I(Metric Space), Krishna Publication.
3. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. PVT. LTD
4. S. C. Malik and Savita Arora, Mathematical Analysis, Second Edition, New Age International Pvt. Ltd., New Delhi

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BMAT (H) - 608: PROJECT & VIVA VOCE

Objective: -The main aims of this course are to understand applications various subjects to study in previous semesters for the interest of students.

(40 Sessions)

Course Outcomes:

After completing all courses, Students will be able to:

- Analyses hypotheses and conclusions of mathematical statements.
- Explain the concept and Classification of different courses.
- Demonstrate knowledge and understanding of fundamental concepts of writing skills.
- Give the essence of the proof of the different theorems studied in the previous courses.
- Work out to enhance the previous knowledge differentiation and integration whenever and wherever routine methods are not applicable.
- Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method, demonstrate the solution process by hand and solver.
- Demonstrate solution methods including graphs and programming to analyze and solve the mathematical problems.

Suggested Readings:

1. John B. Fraleigh: A First Course in Abstract Algebra, Pearson Education India..
2. I. N. Herstein:Topics in Algebra,2nd Edition , John Wiley & Sons. Copyright.
3. T. Apostol: Mathematical Analysis (5th edition), Addison-Wesley Pub.
4. R. G. Bartle and D. R. Sherbert : Introduction to Real Analysis (3rd edition), John Wiley &Sons, Inc.
5. D. M. Burton: Elementary Number Theory (4th edition) –Universal Book Stall, New Delhi, 2002.
6. Shepley.L.Ross : Differential Equations, Wiley India (Pvt.) Ltd.
7. James R. Munkres: *Topology*, 2nd Edition (Jan 7, 2000), Prentice Hall, ISBN-10:0131816292, ISBN-13: 978-0131816299.

8. Seymour Lipschutz and Marc Lars Lipson: Discrete Mathematics, Tata McGraw-Hill publishing company Limited, New Delhi.
9. S. Kumaresan: Linear Algebra,A Geometric Approach –, Prentice-Hall of India Pvt.
10. Erwin Kreyszig: Introduction to functional Analysis with Application, John wiley & Son Inc.,New York.
11. M. D. Rai Singhania: Fluid Dynamics, S. Chand Publication, New Delhi.
12. R. K. Jain, Iyenger: Numerical Analysis, New age publication, Delhi.
13. I.N. Sneddon: Elements of Partial Differential Equation, 3rd Edition. McGraw Hill BookCompany, 1998.
14. H. A. Taha: Operations Research an introduction, Macmillan.
15. V. K. Kapoor: Operations Research, Sultan Chand and Sons, New Delhi.

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