BMATCC(H)-101: MATRICES AND TRIGONOMETRY

Objective: -The main aim 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 for skill development

MATRICES

UNIT-1 (10 Sessions)
Special types of matrices, Elementary transformations, Inverse of a matrix by elementary transformations for skill development

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

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 for skill development

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 for skill development

UNIT-5 (08 Sessions)
Expansions and Summation of series for skill development

Course Outcomes:

CO1: Solve a system of linear equations by row-reducing its augmented form for skill development
CO2: Perform the matrix operations of addition, multiplication and transposition and express a system of simultaneous linear equations in matrix for skill development
CO3: Determine whether or not a given matrix is invertible and if it is, find its inverse for skill development
CO4: Solve the problems of Complex number, Function of complex variable, Trigonometric, Exponential, Logarithmic Functions for skill development
CO5: Solve the problems of expansions and summation of series mathematical model for skill development

Mapping Course Outcomes(COs) leading to the achievement of Programme Outcomes(POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	2	3	2	3
CO2	2	1	2	3	3	3	3	3	3	2
CO3	1	3	2	3	1	2	3	1	2	1
CO4	3	3	3	2	3	3	2	3	3	2
CO5	3	2	3	3	3	3	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

Suggested Readings:

1. S. C. GUPTA: Introduction to matrices, Sultan Chand & Sons Publication Delhi.
2. N. Saran & J.K. Goyal: Introduction to matrices, PragatiPrakashan, 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.

BMATCC(H)-102: CALCULUS

Objective: -The main aim 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 to provide employability & skills.

DIFFERENTIAL CALCULUS

UNIT-1 **(12 Sessions)**
Successive Differentiation, nth differential coefficient of algebraic, Exponential, Trigonometric function, Inverse function, Logarithmic function, Leibnitz's theorem (with proof), Finding $(y_n)_0$ for skill development

UNIT-2 **(10 Sessions)**
Partial differentiation, Euler's theorem, Change of variables, Jacobians, Maxima and minima of two variables for skill development

UNIT-3 **(10 Sessions)**
Expansions of functions by Maclaurin and Taylor's theorems, Curvature, Asymptotes, Curve tracing for skill development

INTEGRAL CALCULUS

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

UNIT-5 **(10 Sessions)**
Multiple integrals, Length of the curves, Area of the curves, Volume and surface of solids by revolution of the curves knowledge for better employability in industry.

Course Outcomes:

CO1: Understand continuity and differentiability in terms of limits for skill development

CO2: Describe asymptotic behavior in terms of limits involving infinity for skill development

CO3: Use derivatives to explore the behavior of a given function, locating and classifying its extrema, and graphing the function for skill development

CO4: Study the implementation of multiple integrals knowledge for better employability in industry.

CO5: Gain knowledge of fundamental concepts of Beta and Gamma Functions for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	3	1	3	3	3	3	3	3
CO2	3	3	1	3	3	1	3	3	1	3
CO3	3	1	3	3	1	3	1	1	3	3
CO4	3	3	1	3	3	1	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	1	1
CO4	3	2	2
CO5	3	2	1

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.

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.

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.

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

Objective: -The main aim of this course is 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 to provide employability & skills.

VECTOR CALCULUS

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

UNIT-2 **(10 Sessions)**
Line integrals, Surface integral, Volume integral, Theorems of Gauss, Green and Stoke's and their problems for understanding entrepreneurial skill,

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 for better skilling of entrepreneurship.

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

UNIT-5 **(08 Sessions)**
Sphere, Cone and Cylinder and central conicoid knowledge for better employability in industry.

Course Outcomes:

CO1: Calculate and interpret derivatives in up to three dimensions for skill development
CO2: Integrate functions of several variables over curves and surfaces for entrepreneurial skill
CO3: Use Green's theorem and the Divergence theorem to compute integrals Identify and sketch curves better skilling of entrepreneurship.
CO4: Use three dimensional geometry using vectors for skill development
CO5: Understand mathematical models to relate mathematics with daily life problems skill development and employability

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	2	3	3	3	1	3	3	3	2	3
CO4	1	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	1	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	1
CO5	3	1	1

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 Pragti Prakashan, Meerut.
4. M.A. Pathan: Vector Analysis, Published by Pragti Prakashan, Meerut.
5. Mittal & Mittal: Three dimension Co-ordinate geometry Published by Pragti Prakashan, Meerut.

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.

BMATCC(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 to provide employability & skills.

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 for skill development

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 for skill development

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 for skill development

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 Delta function, Unit step function, Laplace transform of periodic function for understanding entrepreneurial skill.

UNIT-5 (08 Sessions)
Inverse Laplace transform, Convolution theorem, Solution of differential equations by Laplace transform for skill development

Course Outcomes:

CO1: Think logically and mathematically in any field of engineering for skill development
CO2: Gain an experience in the implementation of Mathematical concepts which are applied in various field of sciences and Engineering for skill development
CO3: Recognize the different methods of finding Laplace transforms and Fourier transforms of different functions for skill development
CO4: Apply the knowledge of L.T, F.T, and Finite Fourier transforms in finding the solutions of differential equations for entrepreneurship.
CO5: Solve the initial value problems and boundary value problems for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	2
CO3	2	3	3	2	1	3	3	1	2	3
CO4	1	3	3	2	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	1	2

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	1	2
CO4	3	2	1
CO5	3	1	1

Suggested Readings:

1. I. E. Kreyszig : Advanced Engineering Mathematics(9th 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.

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.

BMATCC(H)-301: MECHANICS

Objective: -The main aim of this course is to help 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. Study of various forces and components help to provide employability & skills.

UNIT-1 (12 Sessions)
Velocity, Acceleration along radial and transverse directions, along tangential and normal directions for skill development

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

UNIT-3 (08 Sessions)
Motion in resisting medium, Constrained motion (circular and cycloidal only) knowledge for better employability in industry.

UNIT-4 (10 Sessions)
Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law for better skilling of entrepreneurship

UNIT-5 (10 Sessions)
Common Catenary, Centre of gravity, Virtual work for skill development

Course Outcomes:

CO1: 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 for skill development
CO2: To study about simple harmonic motion and elastic strings for skill development
CO3: Solve the mechanics problems associated with friction forces knowledge for better employability
CO4: Solve for the resultants & moments of any force systems and determine equivalent force systems and to determine the internal forces in plane trusses and beams for better entrepreneurship
CO5: Obtain the centroid, first moment and second moment of an area and apply work, energy, impulse and momentum relationships for a particle in motion for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	1	1	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	1	1	3
CO5	3	3	3	3	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	2	1
CO4	3	1	2
CO5	3	2	2

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

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.

BMATCC(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 to provide employability & skills.

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 for better skilling of entrepreneurship

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 for skill development.

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

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

UNIT - 5 (10 Sessions)
Numerical Differentiation: Introduction, Derivatives of Newton's forward and Newton's backward interpolation formulae to develop skill

Numerical Integration: Introduction, General quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule to provide employability & skills.

Course Outcomes:

CO1: Apply various interpolation methods and finite difference concepts for skill development
CO2: Apply numerical methods to find our solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations for skill development
CO3: Work out numerical differentiation and integration whenever and wherever routine methods are not applicable for skill development
CO4: Understand mathematical model divided differences table, Newton's divided and Lagrange's formula for skill development
CO5: Develop the ability to solve the numerical differentiation and numerical integration problems employability.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	1	1	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	1	1	3
CO5	3	3	3	3	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	2	1
CO4	3	1	2
CO5	3	2	2

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.

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.

BMATCC(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 to provide employability & skills.

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 for skill development.

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 for skill development.

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 for skill development.

UNIT – 4 (10 Sessions)
Combinatorics: Basic counting principles, Permutation, Combinations, Binomial coefficients, Inclusion-Exclusion principle, Discrete numeric function, Generating function, Recurrence relations to develop skill

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 to develop skill
Trees: Tree, Forest, Rooted tree, Properties of trees, Level, Height, Path length of tree for entrepreneurship & employability.

Course Outcomes:

CO1: Understand the basic principles of sets and operations in sets also demonstrate the properties of relations and functions for skill development

CO2: Write an argument using logical notation and determine if the argument is valid or not for skill development

CO3: Demonstrate the ability to write and evaluate a proof or outline the basic structure and give examples of each proof of techniques described skill development and employability**.**

CO4: Apply counting principles to determine probabilities for skill development

CO5: Demonstrate different traversal methods for trees and graphs for entrepreneurship.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	1	1	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	2	3	3	3	3
CO4	3	3	2	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	1	2
CO3	3	1	1
CO4	3	1	2
CO5	3	2	2

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. SeymourLipschutz 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.

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.

BMATCC(H)-402: REAL ANALYSIS

Objective: - The main aims of this course real analysis are 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 to provide employability & skills.

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 for skill development.

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 for skill development.

UNIT-3 (08 Sessions)

Interior points and limit points, Open, Closed, and Perfect sets for skill development.

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 for better skilling of entrepreneurship

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 for better skilling of entrepreneurship

Course Outcomes:

CO1: Describe the basic differences between the rational and the real numbers for skill development
CO2: Understand and perform simple proofs for skill development
CO3: Answer question concerning uniform convergence of concrete numerical sequences and series for skill development
CO4: Give the definition of concepts related to metric spaces, such as continuity, compactness, completeness and Connectedness for entrepreneurship.
CO5: Give the essence of the proof of Stone-Weierstrass theorem, the contraction theorem as well as the existence of convergent subsequences using equicontinuity for employability.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	2	1	2	3	3	3	2	3	1	2
CO3	1	3	2	1	1	2	3	1	3	2
CO4	3	3	3	2	3	3	2	3	3	2
CO5	1	2	3	3	3	3	3	3	1	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	1	1
CO4	3	2	1
CO5	3	1	2

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:

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- 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.

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

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

BMAT(H)-501: LINEAR ALGEBRA

Objective: - The main aims of this course are 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 to provide employability & skills.

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

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

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 understanding for entrepreneurial skill,

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

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

Course Outcomes:

CO1: Define basic terms and concepts of matrices, vectors and complex numbers for skill development
CO2: Use of various forms of complex numbers to solve numerical problems for skill development
CO3: Apply the matrix calculus in solving a system of linear algebraic equations for entrepreneurship.
CO4: Use matrix algebra and the related matrices to linear transformation skill development and employability.
CO5: Calculate the area of planar shapes (triangle, parallelogram) and the volume of parallelepiped using vector algebra for skill development.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	2	3	2	3
CO2	2	1	2	3	3	3	3	3	3	2
CO3	3	3	2	2	1	2	3	1	2	1
CO4	3	3	3	1	3	1	2	3	2	2
CO5	3	2	3	3	3	1	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	2	1

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

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

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.

BMAT(H)-502: LINEAR PROGRAMMING

Objective: -The main aims of this course are 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 **to** provide employability & skills.

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 understanding for entrepreneurial skill,

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 for skill development.

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 knowledge for better employability in industry

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 knowledge for better employability in industry

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

Course Outcomes:

CO1: Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method to demonstrate the solution process for entrepreneurship.
CO2: Explain the relationship between a linear program and its dual, including strong duality for skill development.
CO3: Formulate specialized linear programming problems as transportation problems for entrepreneurship
CO4: Formulate specialized linear programming problems as assignment problems for skill development and employability.
CO5: Demonstrate solution methods including graphs and linear programming to analyze and solve the Two-person, zero-Sum Games for skill development and employability.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	2	2	2	3
CO2	2	1	2	3	3	3	3	3	3	2
CO3	3	3	2	2	1	2	3	1	2	3
CO4	3	3	3	1	3	3	2	3	2	2
CO5	3	2	3	3	3	1	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	1
CO5	3	1	1

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, Kedarnath & Ramnath and Company.

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.

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 to provide employability & skills.

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

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

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

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

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

Course Outcomes:

CO1: Understand and prove fundamental results and solve algebraic problems using appropriate techniques for entrepreneurship.
CO2: Understand the basic properties of real number system that will used later in development of real analysis theory for skill development
CO3: Develop the logical thinking to proof the basic results of real analysis for skill development
CO4: Solve the problems of convergence and divergence of sequences and series skill development and employability**.**
CO5: Develop an understanding of limits in abstract way and how they are used in sequences, series, differentiation and integration. skill development and employability**.**
CO6: Appreciate how abstract ideas in real analysis can be applied to practical problems for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	2	3	2	3
CO2	2	1	2	3	3	3	3	3	3	2
CO3	3	3	2	2	1	2	3	1	2	1
CO4	2	3	1	1	3	1	2	3	2	2
CO5	3	2	3	3	3	2	3	3	3	3
CO6	3	3	3	2	2	3	2	3	2	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	1	2
CO4	3	2	1
CO5	3	1	1
CO6	3	2	2

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, SavitaArora , 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.

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.

BMAT(H)-504: ABSTRACT ALGEBRA 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 to provide employability & skills.

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 for skill development.

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 to develop skill

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 for better skilling

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

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

Course Outcomes:

CO1: Explore the properties of groups, sub-groups, including symmetric groups, permutation groups, cyclic groups, normal sub-groups and quotient groups for skill development

CO2: Understand the concepts of homomorphism and isomorphism between groups for skill development

CO3: Apply class equation and Sylow theorems to solve different problems to develop skill

CO4: Explore the properties of rings, sub-rings, ideals including integral domain, principle ideal domain, Euclidean ring and Euclidean domain for skill development and employability

CO5: Understand the concepts of homomorphism and isomorphism between rings for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	1	3	3	3
CO2	3	3	3	3	3	3	2	3	1	3
CO3	2	3	2	3	2	3	3	3	3	2
CO4	3	3	2	3	3	2	3	1	2	3
CO5	3	3	3	2	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	1	1

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:

- 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.

BMAT(H)-505: THEORY OF PROBABILITY

Objective: The main aim of this course is 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 to provide employability & skills.

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

UNIT-2 (08 Sessions)
Random variables (discrete and continuous), Cumulative distribution function, Probability mass/density functions for skill development.

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

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 to develop skill

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

Course Outcomes:

CO1: Demonstrate understanding of Basic 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 for skill development.
CO2: Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions for skill development.
CO3: Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables for skill development and employability.
CO4: Discrete time Markov chains and methods of finding the equilibrium probability distributions for skill development
CO5: Calculate probabilities of absorption and expected hitting times for discrete time Markov chains with absorbing states for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	1	1	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	3	3	3	3	3
CO4	2	2	2	1	3	1	3	3	2	3
CO5	3	3	3	3	3	2	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	2
CO2	3	2	2
CO3	3	1	1
CO4	3	2	2
CO5	3	2	1

Suggested Readings:

1. Arunkumar, 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

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

BACHELOR OF SCIENCE (MATHEMATICS) HONS. 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 provide employability & skills.

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. for better skilling of entrepreneurship.

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 for better skilling of entrepreneurship.

UNIT-3   **(08 Sessions)**

Networks: Computer Networks, Types of Networks, Network Topology, Data Transmission Mode for better employability in industry.

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 knowledge for better employability in industry.

UNIT-5   **(10 Sessions)**
Arrays: Introduction of Arrays, Array notation and representation, Type of arrays, String, Debugging and testing of Programs knowledge for better employability in industry.

Course Outcome

CO1: Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming skill development and employability
CO2: Study computer memory, types of operating system for entrepreneurship.
CO3: Understand types of networks for entrepreneurship.
CO4: Write, compile and debug programs in C language and use different data types for writing the programs for skill development and employability
CO5: Learn Array notation and representation for skill development and employability

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	3	1	3	3
CO2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	2	2	3	1	3	2
CO4	3	3	2	1	3	3	3	1	2	3
CO5	3	3	3	3	2	3	3	3	1	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	3	2
CO4	3	2	3
CO5	3	3	2

Suggested Readings:

1. Pradeep K. Sinha, PritiSinha, 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.

Suggested Readings:

1. Pradeep K. Sinha, PritiSinha, 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:

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

Objective: This course helps to learn the fundamental programming concepts and methodologies that are essential to build C programs to provide employability & skills.

List of Experiments   **(20 Sessions)**

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

Course Outcomes:

CO1: Identify situations where computational methods and computers would be useful skill development and employability**.**

CO2: Given a computational problem, identify and abstract the programming task involved for skill development and employability.

CO3: Write the program on a computer, edit, compile, debug, correct, recompile and run it for skill development and employability

CO4: 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 for entrepreneurship

CO5: To gain knowledge of basic of programming language C for entrepreneurship

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	1	1	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	1	1	3
CO5	3	3	3	3	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3
CO5	3	3	3

Suggested Readings:

1. Pradeep K. Sinha, PritiSinha, 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

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 to provide employability & skills.

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 for skill development

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 Fourier transforms for skill development

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 knowledge for better employability in industry.

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

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 for skill development

Course Outcomes:

CO1: Understand the basics of Laplace Transformation to solve initial and boundary value problems for skill development

CO2: Learn Fourier transformation and Z transformation and their applications to relevant problems skill development and employability

CO3: Understand Hankel's Transformation to solve boundary value problem skill development and employability

CO4: Find solutions of linear integral equations of first and second type (Volterra and Fredhlom) employability.

CO5: Understand theory of calculus of variations to solve initial and boundary value problems skill development and employability

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	1	1	3	3
CO2	3	2	3	3	3	3	3	3	3	2
CO3	2	3	3	2	2	3	3	3	3	3
CO4	3	3	1	3	3	3	2	1	1	2
CO5	3	3	3	3	3	3	3	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	1	2
CO4	3	2	1
CO5	3	1	1

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 McGraw 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, McGraw 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.

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 to provide employability & skills.

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 for skill development.

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

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 to develop skill

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

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 understanding for entrepreneurial skill,

Course Outcomes:

CO1: Becoming familiar with the concepts Complex numbers and their properties and operations with Complex number skill development and employability.
CO2: Finding domain and range of complex functions and sketching their graphs skill development and employability.
CO3: Evaluating limits and checking the continuity of complex function skill development and employability.
CO4: Checking differentiability and Analyticity of functions for skill development
CO5: Evaluate Complex integrals and applying Cauchy integral for entrepreneurship

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	2	3	3	3
CO2	3	3	2	3	3	3	3	1	3	3
CO3	3	1	3	3	2	1	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	1
CO5	3	3	3	3	3	3	1	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	1	1

Suggested Readings:

1. Ruel V. Churchill: Complex Variables and Applications, TMH Publication.
2. T. Path: Function of Complex Variable, Pothisala Pvt.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
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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

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 to provide employability & skills.

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 for skill development.

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

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

UNIT-4   **(08 Sessions)**
Discrete Calculus of variations- Introduction, Necessary conditions, Sufficient conditions and Disconjugacy for skill development and entrepreneurship

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 for skill development.

Course Outcomes:

CO1: Apply the theory to study the qualitative theory of solutions of difference equations and partial difference equations of higher order for skill development.
CO2: Apply the theory to study the quantitative and qualitative study of solutions of different discrete models in Engineering for skill development.
CO3: Difference between the qualitative and quantitative behavior of solutions of the difference equations and the corresponding differential equations skill development and entrepreneurship
CO4: Apply the theory to study the solution in discrete boundary value problems skill development and entrepreneurship
CO5: Apply difference equations to find solution of boundary value problems for Nonlinear equations for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	1	3	3	3	2	3	3	3	3	3
CO4	3	2	2	1	3	3	3	2	2	3
CO5	3	3	1	3	3	3	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	1

Suggested Readings:

1. M. D. RaiSinghaniya : 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.

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.

BMAT(H)-603: MULTIVARIABLE CALCULUS

Objective: The main aims of this course are to introduce Multivariable 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 to provide employability & skills.

UNIT-1   **(10 Sessions)**
Functions of several variables, Limit and continuity of functions of two variables, Partial differentiation, Total differentiability and differentiability, Sufficient condition for differentiability for skill development.

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 for skill development and entrepreneurship.

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

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

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

Course Outcomes:

CO1: Effectively write mathematical solutions in a clear and concise manner for skill development.
CO2: Apply the theory to calculate the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solids for skill development.
CO3: Solve problems involving maxima and minima, line integral and surface integral, and vector calculus for skill development.
CO4: Demonstrate ability to think critically by recognizing patterns and determining and using appropriate techniques for solving a variety of integration and differentiation problems for skill development.
CO5: Demonstrate an intuitive and computational understanding for calculus applications by solving a variety of problems from physics, engineering and mathematics for skill development.
CO6: Demonstrate the ability to differentiate and integrate vector-valued functions for entrepreneurship

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	3	3
CO2	3	2	3	3	3	3	3	3	3	1
CO3	1	3	3	3	2	2	3	3	1	3
CO4	3	2	2	1	3	3	3	2	2	3
CO5	2	3	1	3	3	3	3	3	3	2
CO6	3	3	3	2	3	2	1	3	3	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	1	1
CO6	3	2	1

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.

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.

Objective: The main aim of this course is 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 to provide employability & skills

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

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

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

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] for skill development.

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

Course Outcomes:

CO1: Understanding the basic concepts of rings for skill development.
CO2: Analyze the concepts of Ideas for skill development.
CO3: Mapping among rings and their properties for skill development.
CO4: Provide information regarding Polynomial rings for skill development.
CO5: Effectively write abstract mathematical proofs in a clear and logical manner for skill development.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	3	3
CO2	3	2	3	3	3	3	3	3	3	1
CO3	1	3	3	3	2	2	3	3	1	3
CO4	3	2	2	1	3	3	3	2	2	3
CO5	2	3	1	3	3	3	3	3	3	2

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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

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 to provide employability & skills.

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

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

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

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

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 for skill development.

Course Outcomes:

CO1: Find quotients and remainders from integer division for skill development.

CO2: Apply Euclid's algorithm and backwards substitution for skill development.
CO3: Understand the definitions of congruences, residue classes and least residues for entrepreneurship.

CO4: Add and subtract integers, modulo n, multiply integers and calculate powers for skill development

CO5: Determine multiplicative inverses, modulo n and use to solve linear congruences for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	3	3	3	1
CO2	3	3	3	3	3	3	3	3	3	1
CO3	1	3	3	3	3	2	3	2	1	3
CO4	3	2	2	1	2	3	3	2	2	3
CO5	2	3	1	3	3	3	3	3	3	2

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	2
CO3	3	1	2
CO4	3	2	1
CO5	3	1	1

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, (7th 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.

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

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 to provide employability & skills.

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 for skill development.

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

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

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

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

Course Outcomes:-

CO1: Minimization problems for variational integrals, existence and regularity theory for minimizers and critical points, geometric measure theory for skill development
CO2: Variational methods for partial differential equations, optimal mass transportation, linear and nonlinear eigenvalue problems skill development and employability**.**
CO3: Variational problems in differential and complex geometry for skill development
CO4: Variational methods in global analysis and topology for entrepreneurship.
CO5: Variational methods in mathematical physics, nonlinear elasticity, asymptotic for entrepreneurship.
CO6: variational problems, homogenization, capillarity phenomena, free boundary problems and phase transitions for entrepreneurship.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	2	3
CO2	3	2	2	3	3	3	3	3	3	1
CO3	1	3	3	3	2	2	3	1	3	3
CO4	3	2	2	1	3	3	2	2	2	3
CO5	3	3	1	3	3	3	3	3	3	2
CO6	3	3	3	2	3	3	1	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	2
CO5	3	1	2
CO6	3	2	2

Suggested Readings:

1. M.D. Raishinghania: Ordinary and Partial Differential Equation, S. Chand Limited (Revised Edition).

2. A.S. Gupta : Calculus of Variation, PHI Learning Pvt. Ltd.
3. Rimple Pundir: Calculus of Variation, Pragati Prakashan.
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.

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.

BMAT(H)-607: METRIC SPACE

Objective: The main aims of this course are introduction 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 to provide employability & skills.

UNIT-1 **(12 Sessions)**
Metric spaces: Definition and examples, Sequences in metric spaces, Cauchy sequences, Complete metric spaces for skill development

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 for skill development

UNIT-3 **(10 Sessions)**
Continuous mappings, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mappings, Banach fixed point theorem for better skilling of entrepreneurship

UNIT-4 **(08 Sessions)**
Connectedness, Connected subsets of **R,** Connectedness and continuous mappings for better skilling of entrepreneurship

UNIT-5 **(10 Sessions)**
Compactness, Compactness and boundedness, Continuous functions on compact spaces for better skilling of entrepreneurship

Course Outcomes:-

CO1: 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 geometric meaning of each of the metric space properties (M1) – (M3) and be able to verify whether a given distance function is a metric for skill development
CO2: Distinguish between open and closed balls in a metric space and be able to determine them for given metric spaces for skill development
CO3: Explain the definition of continuity for functions from AB to AD and determine whether a given function from AB to ADis continuous. Also understand the concept of uniform continuity and convergence for sequences in a metric space skill development and employability.
CO4: To analyze the concepts of connectedness for entrepreneurship.
CO5: To analyze the concepts of compactness for entrepreneurship.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	3	3
CO2	3	2	3	3	3	3	3	3	3	1
CO3	1	3	3	3	2	2	3	3	1	3
CO4	3	2	2	1	3	3	3	2	2	3
CO5	2	3	1	3	3	3	3	3	3	2

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	2	1
CO4	3	1	2
CO5	3	1	2

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

Website Sources:

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- 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.

BMATCC (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 to provide employability & skills

Course Outcomes:

CO1: Analyses hypotheses and conclusions of mathematical statements skill development and employability
CO2: Explain the concept and Classification of different courses skill development and employability
CO3: Demonstrate knowledge and understanding of fundamental concepts of writing skills skill development and employability
CO4: Give the essence of the proof of the different theorems studied in the previous courses
CO5: Work out to enhance the previous knowledge differentiation and integration whenever and wherever routine methods are not applicable kill development and entrepreneurship.
CO6: 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 skill development and employability**.**
CO7: Demonstrate solution methods including graphs and programming to analyze and solve the mathematical problems skill development and employability.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	3	3
CO2	3	2	3	3	3	3	3	3	3	1
CO3	1	3	3	3	2	2	3	3	1	3
CO4	3	2	2	1	3	3	3	2	2	3
CO5	2	3	1	3	3	3	3	3	3	2
CO6	3	3	3	2	3	3	1	3	3	3
CO7	3	2	3	3	3	3	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	1	2
CO4	3	2	1
CO5	3	1	2
CO6	3	2	1
CO7	3	2	1

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
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. RaiSinghania: 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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