GURUKULA KANGRI (DEEMED TO BE UNIVERSITY)

Department of Mathematics & Statistics

Syllabus for B.Sc. NEP 1.0

Subject: Mathematics

(Effective from Session 2025-26)
(The revised syllabus of Sem. VII &VIII will also be implemented for the students admitted in session 2022-23 onwards)

Contents of Courses for B.Sc. with Mathematics as Major Subject & B.Sc.(Hons) Mathematics

S. N	Subject Code	Course Type	Subject Title	Period			Evaluation Scheme				Subject Total
							Sessional			ESE	
				L	T	P	Credit	CT	TA		
B. Sc. I Year											
Semester – I											
1	BMA-C111	DSC	Calculus	5	2	-	6	20	10	70	100
									Total credit		**6**
Semester – II											
1	BMA-C211	DSC	Algebra	5	2	-	6	20	10	70	100
									Total credit		**6**
Exit Option with Certificate											
B. Sc. II Year											
Semester – III											
1	BMA-C311	DSC	Differential Equations	5	2	-	6	20	10	70	100
2	BMA-S311	SEC	Analytical Geometry	3	2	-	4	20	10	70	100
									Total credit		**10**
Semester – IV											
1	BMA-C411	DSC	Real Analysis	5	2	-	6	20	10	70	100
	BMA-S411	SEC	Vector Calculus and Mechanics	3	2	-	4	20	10	70	100
									Total credit		**10**
Exit Option with Diploma											

B. Sc. III Year											
Semester – V											
1	BMA-C511	DSC	Numerical Analysis	5	2	-	6	20	10	70	100
Any one of the following:											
2	BMA-S511	SEC1	Linear Programming	3	2	-	4	20	10	70	100
	BMA-S512	SEC2	Programming in C	2	-	4	4	20	10	70	100
										Total credit	**10**
Semester – VI											
1	BMA-C611	DSC	Linear Algebra	5	2	-	6	20	10	70	100
Any one of the following:											
2	BMA-S611	SEC1	Mathematical Modeling	3	2	-	4	20	10	70	100
	BMA-S612	SEC2	Laplace and Fourier Transform	3	2	-	4	20	10	70	100
										Total credit	**10**
Exit Option with B.Sc. Degree											
B. Sc. IV Year											
Semester – VII											
1	BMA-C711	DSC	Abstract Algebra	5	2	-	6	20	10	70	100
2	BMA-C712	DSC	Mathematical Statistics	5	2	-	6	20	10	70	100
3	BMA-C713	DSC	Advanced Real Analysis	5	2	-	6	20	10	70	100
4	BMA-C714	…….	Industrial Training/Research Project/Dissertation	-	-	-	6	20	-	80	100
										Total credit	**24**
Semester – VIII											
1	BMA-C811	DSC	Complex Analysis	5	2	-	6	20	10	70	100
2	BMA-C812	DSC	Topology	5	2	-	6	20	10	70	100
3	BMA-C813	DSC	Advanced Differential Equations	5	2	-	6	20	10	70	100
4	BMA-C814	…….	Industrial Training/Research Project/Dissertation	-	-	-	6	20	-	80	100
SEC/VoC											
1	BMA-S811	…..	Optimization Techniques	2	1	-	2	20	10	70	100
										Total credit	**24/26**
Award of B.Sc.(Hons.) Degree in Mathematics											

Programme Outcome/ Programme Specific Outcome

Programme Outcome:

PO1: Inculcate foundation knowledge in the students to understand basics of mathematics including applied aspect for the same.

PO2: Evolve in-depth knowledge of various branches of pure and applied mathematics.

PO3: Enhance the ability to develop solution-oriented approach towards various real world problems.

PO4: Develop scientific and mathematical temper.

PO5: Use programming skills to solve mathematical problems enhancing online literacy.

Programme Specific Outcome:

PSO1: Student would be able to formulate and develop mathematical arguments in a logical manner.

PSO2: Student would have adequate exposure to many aspects of mathematical sciences.

PSO3: Students would be able to apply their skills and knowledge in various fields of studies including, science, engineering, commerce and management etc.

B.Sc. I(MATHEMATICS)

Detailed Syllabus

For

CERTIFICATE COURSE

IN

MATHEMATICS

Programme: Certificate Class: B.Sc.	Year: First	Semester: I

Subject: Mathematics

Course Code: BMA-C111 | **Course Title: Calculus**

Course Outcome	By the end of this course, students will be able to CO1: Understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well. CO2: Understand successive differentiation, maxima and minima, asymptotes and curve tracing in polar, cartesian as well as parametric curves. CO3: Understand the Beta and Gamma functions, double and triple integrals with applications.

Unit No.	Course Content	Hours
I	Successive differentiation, nth differential coefficients of a function, Leibnitz theorem, Expansion of functions: Maclaurin's and Taylor's theorems.	12
II	Partial differentiation: Partial derivatives of first and higher orders, Total differential coefficient, First and second order differential coefficient of an implicit function, Homogenous functions, Euler's theorem on homogenous function. Maxima and minima upto two independent variables.	12
III	Asymptotes: Parallel asymptotes, Asymptotes of an algebraic curve, Asymptotes of non-algebraic curve, Asymptotes of polar curves, Position and nature of double point, Curve tracing for Cartesian form of the curves, Curve tracing for polar form of the curves.	12
IV	Beta function, Gamma function and their properties, Relation between beta and gamma functions, Duplication formula. Rectification (Lengths of curves), Quadrature (Area of curves), Volumes and Surfaces of solids of revolution.	12
V	Double integration, Evaluation of double integral, Change of order of integration, Application of the double integrals, Triple integration, Change to spherical co-ordinates, Application of triple integrals.	12

Suggested Readings:

1. R. G. Bartle & D. R. Sherbert: Introduction to Real Analysis, John Wiley & Sons.
2. S. Balachandra Rao & C. K. Shantha: Differential Calculus, New Age Publication.
3. H. Anton, I. Birens and S. Davis: Calculus, John Wiley and Sons, Inc., 2002.
4. G. B. Thomas and R. L. Finney: Calculus, Pearson Education, 2007.
5. Shanti Narayan & Dr. P. K. Mittal: Integral Calculus, S. Chand.
6. Schaum's Outline of Calculus -Frank Ayresand Elliott Mendelson, 5th ed. USA McGraw Hill.
7. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
8. Gorakh Prasad: Differential Calculus, Pothishala Publication.
9. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers.
10. Suggested online platform: NPTEL/SWAYAM/MOOCs

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1	2	3	3	3
CO2	3	3	3	3	1	2	3	3	3
CO3	3	3	3	3	1	2	3	3	3

Note: 1-Low, 2-Medium, 3-High

Programme: Certificate Class: B.Sc.	Year: I	Semester: II

Subject: Mathematics	
Course Code: BMA-C211	**Course Title: Algebra**

Course Outcome	By the end of this course, students will be able to **CO1:** Understand theory of equations. **CO2:** Understand basic concepts of Groups, Rings, Fields and their properties. **CO3:** Build Foundation for higher course in algebra.

Unit No.	Course Content	Hours
I	Algebraic Solution of cubic and bi-quadratic equations, Descarte's rule of signs, Relation between the roots and coefficients of equations.	12
II	Binary operations, Relation, Equivalence relations and partitions, Congruence modulo n, Definition of a group with examples and simple properties, Abelian group, Finite and infinite group, Order of a finite group, General properties of groups, Composition table for finite groups, Order of an element of a group.	12
III	Complexes and subgroups of a group, Theorems on subgroups, Cosets, Coset decomposition, Lagrange's theorem, Cyclic groups.	12
IV	Permutations, Cyclic Permutations, Even and odd permutations, Group of Permutations, Alternating group.	12
V	Rings, Elementary properties of Rings, Rings with or without zero divisors, Integral domains and fields, Division ring or skew fields, Subrings, Subfields.	12

Suggested Readings:

1. B. Fraleigh, A first course in Abstract Algebra, Addison-wiley, 2003.
2. I. N. Herstein, Topics in Algebra, John Wiley & Sons, 2006.
3. Thomas W Hungerford, Abstract Algebra – An Introduction, Sauders College Publishing 1990.
4. Joseph A Gallian, Contemporary Abstract Algebra, Brooks/Cole Cengage Learning, 2016.
5. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	1	1	1
CO2	3	3	2	3	2	3	---	1	1
CO3	3	2	3	3	1	2	1	1	---

B.Sc. II (MATHEMATICS)

Detailed Syllabus

For

DIPLOMA COURSE

IN

MATHEMATICS

Programme: Diploma Class: B.Sc.	Year: II	Semester: III
Subject: Mathematics		
Course Code: BMA-C311	**Course Title: Differential Equations**	

Course Outcome	By the end of this course, students will be able to CO1: Understand linear ordinary differential equations of first and second order. CO2: Apply different methods to solve various types of differential equations. CO3: Understand basic concepts of linear and nonlinear partial differential equation of first order and their solutions.	
Unit No.	**Course Content**	**Hours**
I	Geometrical meaning of a differential equation. Exact differential equations, integrating factors. First order higher degree equations solvable for x, y, p, Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form. Singular solutions.	12
II	Linear differential equations of second order: Reduction to normal form. Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations. Reduction of order of a differential equation. Method of variations of parameters. Method of undetermined coefficients.	12
III	Ordinary simultaneous differential equations. Solution of simultaneous differential equations involving operators x (d/dx) or t (d/dt) etc. Simultaneous equation of the form dx/P = dy/Q = dz/R. Total differential equations. Condition for Pdx + Qdy +Rdz = 0 to be exact. General method of solving Pdx + Qdy + Rdz = 0 by taking one variable constant. Method of auxiliary equations.	12
IV	Linear partial differential equation: Formation of first order PDE, Cauchy's problems for the first order equations, Solution by Lagrange's Method.	12
V	Non-linear partial differential equation: Formation of first order PDE, Solution by Charpit's Method, Jacobi's method.	12

Suggested Readings:

1. M. D. Raisinghania: Ordinary and Partial Differential Equations (S. Chand).
2. Shepley L. Ross: Differential Equations (Wiley India).
3. I. N. Sneddon: Elements of Partial Differential Equations (Dover books on Mathematics).
4. S. G. Deo, V. Raghavendra, R. Kar, V. Laksmikanthan: Text book of Ordinary Differential Equations (McGraw Hill Education).
5. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	1	2	3	3	3
CO2	3	3	3	3	1	2	3	3	3
CO3	3	3	3	3	1	3	3	3	3

Programme: Diploma Class: B.Sc.	Year: II	Semester: III

Subject: Mathematics

Course Code: BMA-S311 | **Course Title: Analytical Geometry**

Course Outcome

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

CO1: Identify and trace different conics, equation of Sphere, find family of spheres passing through a circle, tangent planes and normal lines to a sphere.

CO2: Obtain equation of Cone, enveloping cone, cylinder, enveloping cylinder.

CO3: Find equation of tangent plane to different conicoid and enveloping cone of a conicoid.

Unit No.	Course Content	Hours
I	General equation of second degree. Tracing of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic. Polar equation of a conic, tangent and normal to the conic.	8
II	Sphere: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres. Co-axial system of spheres..	8
III	Cones: Right circular cone, enveloping cone and reciprocal cone. Cylinder: Right circular cylinder and enveloping cylinder	8
IV	Central Conicoid: Equation of tangent plane. Director sphere. Normal to the conicoid. Polar plane of a point. Enveloping cone of a conicoid. Enveloping cylinder of a conicoid.	8
V	Paraboloids: Circular section, Plane sections of conicoid. Generating lines. Confocal conicoid. Reduction of second-degree equations.	8

Suggested Readings:

1. Analytical Solid Geometry by Shanti Narayan and P. K. Mittal, Published by S. Chand & Company Ltd. 7th Edition.
2. A text book of Mathematics for BA/B.Sc. Vol 1, by V. Krishna Murthy & Others, Published by S. Chand & Company, New Delhi.
3. A text Book of Analytical Geometry of Three Dimensions, by P. K. Jain and Khaleel Ahmed, Published by Wiley Eastern Ltd., 1999.
4. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K. Y. Subrahmanyam, G. R. Venkataraman published by Tata-McGraw Hill Publishers Company Ltd., New Delhi.
5. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	1	2	2	3	3
CO2	3	3	2	3	1	2	2	3	3
CO3	3	3	2	3	1	2	2	3	3

Programme: Diploma Class: B.Sc.	Year: II	Semester: IV
Subject: Mathematics		
Course Code: BMA-C411	**Course Title: Real Analysis**	

Course Outcome	By the end of this course, students will be able to **CO1:** Understand basic concept of real numbers set, limit point of sets, sequence and series of real numbers and their properties. **CO2:** Understand the basic concepts of limit and continuity of single variable functions, sequences of real numbers and series. CO3: Classify and apply various tests for convergence.

Unit No.	Course Content	Hours
I	**Order Structure, Boundedness of set, Equivalence and Countability:** Concept of field Structure and order structure, Order completeness in R, Archimedean properties of real numbers (Only basic concepts), Dedekind's form of Completeness Property, Real valued function and absolute value of real numbers, Equivalent sets and countable sets (Denumerable sets), Bounded set, least upper bound (l.u.b.) and greatest lower bound (g.l.b.).	12
II	**Limit Point of Set:** Neighbourhood of a point, Deleted Neighbourhood, Interior points and interior of a set, open set, Isolated and Adherent points of set, Limit point of a set, Derive set, Perfect set, Bolzano-Weierstrass theorem (For sets), Closed set and Closures of a set, Dense set, Compact set and their properties, Open cover, Heine-Borel property and theorem.	12
III	**Limit and Continuity of Single Variable Function:** Limit of function, Algebra of limits of functions, Monotonic functions, Squeeze theorem (statement and example) Continuity and discontinuity of functions, Types of discontinuity, Algebra of continuity, Uniform Continuity, Borel's theorem (statement and example), Boundedness theorem (statement and example), Intermediate value theorem (statement and example), Derivative of function and examples.	12
IV	**Sequence of Real Numbers:** Sequence of real numbers, Bounded sequence, Limit of a sequence, Subsequence, Oscillating and Divergent sequences, Convergence sequence, Algebra of convergent sequences, Cauchy sequence, Limit inferior and limit superior, Bolzano-Weierstrass theorem for sequences (statement and examples), Cauchy general principle of convergence, Monotonic and nested sequences, Squeeze theorem (statement and examples), Cauchy's first and second theorem on limits (statement and examples).	12
V	**Infinite Series of Real Numbers:** Infinite series, Partial sum of series, Necessary condition for convergence, Cauchy's general principle of convergence for series and related theorem, Comparison test (First and second), Cauchy's root test and related theorem, Cauchy's condensation test, D'Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's integral test, Abel's test. Dirichlet's test, Alternating series, Leibnitz test, Absolute convergence and conditional convergence.	12

Suggested Books

1. R. R. Goldberg, Method of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International (P) Ltd Publishers.
3. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd..
4. R. G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd..
5. K. A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag.
6. E. Fischer, Intermediate Real Analysis, Springer Verlag.

Mapping of course outcomes with program outcomes & program specific outcomes:

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	2	1	1	1
CO2	3	3	3	3	2	3	1	1	1
CO3	3	2	3	2	1	2	1	1	1

Programme: Diploma Class: B.Sc.	Year: II	Semester: IV
Subject: Mathematics		
Course Code: BMA-S411	**Course Title: Vector Calculus and Mechanics**	

Course Outcome	By the end of this course, students will be able to CO1: Solve a variety of practical problems in science and engineering by applying the principles of vector calculus. CO2: Expose the foundations of mechanics to understand various physical phenomenon. CO3: Grasp various concepts of basic mechanics such as simple harmonic motion, cycloid, projectiles, virtual works and equilibrium.

Unit No.	**Course Content**	**Hours**
I	Vector Calculus: Vector identities, Differential operators, Vector differentiation, Vector integration, Gradient of a vector point function, Directional derivatives of a scalar point function, Divergence and curl of a vector point function, Theorems of Gauss, Green and Stokes.	8
II	Simple Harmonic Motion: Definition of simple harmonic motion (SHM) and examples, Equation of simple harmonic motion, Hook's law for horizontal and vertical strings.	8
III	Projectiles: Definitions of projectile (Trajectory, Velocity of projection, Angle of projection, Point of projection, Range, Time of flight and greatest height), Position of projectile at any time, Equation of trajectory, Maximum height, Maximum horizontal range of the projectile, Range and time of flight up an inclined plane.	8
IV	Virtual Work: Definitions of virtual displacement and virtual work done, Difference between work done and virtual work done with examples, the principle of virtual work, Work done by the tension and thrust of an extensible string during a small displacement.	8
V	Equilibrium: Stable and unstable equilibrium, Moments and couples and Varignon's theorem of moments.	8

Suggested Readings:

1. P. C. Matthew: Vector Calculus, springer Verlag London Limited, 1998.
2. R. C. Hibbeler: Engineering Mechanics-Statics, Prentice Hall Publishers.
3. R. C. Hibbeler: Engineering Mechanics-Dynamics, Prentice Hall Publishers.
4. M. Ray: A Textbook on Dynamics, S. Chand.
5. M. Ray: A Textbook on Statics, S. Chand.
6. A. Nelson: Engineering Mechanics Statics and Dynamics, Tata McGraw Hill.
7. J. L. Synge & B. A. Griffith: Principles of Mechanics, Tata McGraw Hill.
8. S. L. Loney: Dynamics of a particle and of rigid bodies, Cambridge University Press.
9. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1	2	3	3	3
CO2	3	3	3	3	2	2	2	3	3
CO3	3	3	3	3	1	2	3	2	3

B.Sc. III (MATHEMATICS)

Detailed Syllabus

For

B.Sc. Degree

IN

MATHEMATICS

Programme: B.Sc. Degree Class: B.Sc.	Year: III	Semester: V

Subject: Mathematics

Course Code: BMA-C511 | **Course Title: Numerical Analysis**

Course Outcome

By the end of this course, students will be able to
CO1: Understand approximate numbers and associated errors.
CO2: Find the roots of algebraic and transcendental equations with desired accuracy.
CO3: Apply various interpolation formulae to interpolate discretely defined functions.
CO4: Determine the numerical solution of a given system of linear equations.

Unit No.	Course Content	Hours
I	Approximate numbers and significant digits, rounding off a number, type of errors viz. inherent, truncation, absolute, relative and percentage errors, general error formula, error in addition, subtraction, multiplication, division and exponent of numbers, error in a series approximation.	12
II	Solution of algebraic and transcendental equations via Bisection, Iteration, Regula-Falsi, Newton-Raphson and Graeffe's root squaring methods.	12
III	Finite difference operators viz forward, backward, central, average, shift and divided difference operators, relation between finite difference operators, finite differences of a polynomial and transcendental functions, missing term technique, detection of errors by finite difference table.	12
IV	Newton's forward and backward interpolation formulae, Gauss's forward and backward difference interpolation formulae, Lagrange's interpolation and Newton's divided difference interpolation formulae for unevenly spaced points.	12
V	Numerical solution of a system of linear equations via matrix inversion, Gauss elimination, Gauss-Jordan, Cholesky and Crout methods (direct methods only).	12

Suggested Readings:

1. F. B. Hildebrand, Introduction to Numerical Analysis, McGraw-Hill, N.Y.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, Pvt. Ltd.
3. C. E. Froberg, Introduction to Numerical Analysis, Addison-Wesley.
4. M. K. Jain, S. R. K Iyengar and R. K. Jain, Numerical methods for Scientific and Engineering Computation, New Age International Pub.
5. R. V. Dukkipati, Applied Numerical methods, New Age International Pub.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3	3	2	2	2	2
CO2	3	3	3	3	3	3	3	3	3
CO3	1	2	3	3	3	3	2	3	3
CO4	2	3	3	3	3	2	2	3	3

Programme: B.Sc. Degree Class: B.Sc.	Year: III	Semester: V
Subject: Mathematics		
Course Code: BMA-S511	**Course Title: Linear Programming**	

Course Outcome	By the end of this course, students will be able to CO1: Formulate real world problems as different types of linear programming problems. CO2: Solve different types of linear programming problems by employing various techniques. CO3: Analyse the effect of changes in various parameters on the optimal solutions of LPP.	
Unit No.	**Course Content**	**Hours**
I	Linear programming problems, Mathematical formulation of real-world problems, Convex sets, Supporting and separating hyper-planes, extreme points, Graphical solution of two variable Linear Programming Problems.	8
II	Basic feasible solutions, Theory of simplex method, Feasibility and optimality conditions, Simplex algorithm, Simplex method in tableau format, Artificial variable techniques: two-phase method, Big-M method, Cases of different types of solutions.	8
III	Duality Theory, Formulation of the Dual Problem, Primal-Dual Relationship, Duality and Simplex Method, Dual Simplex Method, Sensitivity Analysis.	8
IV	Transportation problem and its mathematical formulation, triangular basis, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, UV algorithm for solving transportation problem.	8
V	Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem, Travelling salesman problem.	8

Suggested Readings:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research,* 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, *Operations Research, An Introduction,* 8th Ed., Prentice-Hall India, 2006.
4. P. K. Gupta, Kanti Swarup & Man Mohan, Operations Research, Sultan Chand & Co.
5. S. D. Sharma, Operations Research, Kedar Nath Ram Nath.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	2	3	3

Programme: Degree Class: B.Sc.	Year: III	Semester: V
Subject: Mathematics		
Course Code: BMA-S512	**Course Title: Programming In C**	

Course Outcome	By the end of this course, students will be able to **CO1:** Write algorithms for problem solving. **CO2:** Use the basic concepts of C programming in problem solving. **CO3:** Apply appropriate control statements and user defined functions. **CO4:** Identify and apply appropriate programming constructs such as arrays, structures, unions etc. for problem solving.

Unit No.	Course Content	Hours
I	Algorithms for problem solving, Structure of a C program, Pre-processor directives, Character set, Tokens in C, Keywords and identifiers, Constants, Variables, Data types, Arithmetic operators, Relational operators, Logical operators, Assignment operator, Conditional operator, Operator precedence and associativity, expressions, Declaration and initialization of variables, Reading and writing characters, Reading and writing strings, Data I/O, Qualifiers, Coercion, Manipulators, Comments, Library functions.	8
II	Branching and looping decisions, Decision making with IF, IF-ELSE, Nesting of IF-ELSE, ELSE-IF ladder, switch statement, 'for' loop, 'while' loop, 'do' loop, break, continue and goto statements.	8
III	Simple functions, Passing arguments to functions and returning values from functions, Recursion, Reference arguments, Storage classes, Scope and visibility of local and global variables	8
IV	Arrays Fundamentals, One-dimensional arrays, Two-dimensional arrays, Multi-dimensional arrays, Nesting of arrays, Passing arrays to functions, Strings, String handling functions, Array of strings.	8
V	Structures, Arrays and structures within structures, Array of structures, Passing structures to functions, Unions, Enumerations, typedef, Pointers, Pointers and arrays, Pointers and strings, Array of pointers, Reading from a file and writing in a file.	8

Suggested Readings:

1. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall.
2. Byron S. Gottfried, Schaum's Outline of Theory and Problems of Programming with C, McGraw Hill.
3. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill.
4. Yashwant Kanitkar, Let us C, B. P. B. Pub.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3	3	3	3	2	3	3
CO2	1	1	3	3	3	3	2	3	3
CO3	1	1	3	3	3	3	2	3	3
CO4	1	1	3	3	3	3	2	3	3

Programme: B.Sc. Degree Class: B.Sc.	Year: III	Semester: VI

Subject: Mathematics

Course Code: BMA-C611 | **Course Title: Linear Algebra**

Course Outcome

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

CO1: Understand the concepts of vector spaces, subspaces, bases, dimension and their properties,

CO2: Understand the concepts of linear transformations, rank, nullity and algebra of linear transformations.

CO3: Relate matrices and linear transformations; compute Eigen values and Eigen vectors of linear transformations.

Unit No.	Course Content	Hours
I	Elementary transformations, Echelon and normal forms, Rank of a matrix, Application of matrices to solve a system of linear (both homogeneous and non-homogeneous) equations, Consistency and general solutions.	12
II	Vector space: Introduction, subspaces, Linear combinations, linear spans, Sums and direct sums, Linear dependence and independence, Bases and dimensions, Dimensions and subspaces, Coordinates and change of bases.	12
III	Linear transformations: Linear transformations, rank and nullity, Linear operators, Algebra of linear transformations, Invertible linear transformations, Isomorphism.	12
IV	Matrix of a linear transformation relative to ordered bases of finite-dimensional vector spaces. Correspondence between linear transformations and matrices, Linear functional: Linear functional, Dual space and dual basis, Double dual space, Annihilators, Transpose of a linear transformation.	12
V	Eigen values and Eigen vectors: Eigen vectors and Eigen values of a matrix, product of characteristic roots of a matrix and basic results on characteristic roots, Cayley-Hamilton theorem and its use in finding inverse of a matrix.	12

Suggested Readings:

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence: *Linear Algebra,* 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. David C. Lay: *Linear Algebra and its Applications,* 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. S. Lang: *Introduction to Linear Algebra,* 2nd Ed., Springer, .
4. Gilbert Strang: *Linear Algebra and its Applications*, Thomson, 2007.
5. Hoffman and Kunze: Linear Algebra, Prentice Hall of India, New Delhi, 1972.
6. H. Helson: Linear Algebra, Hindustan Book Agency, New Delhi, 1994.
7. S. Lipschutz, M. Lipson, Linear Algebra, Schaum's outline series, McGraw Hill.
8. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3
CO2	3	3	3	2	2	3	3	2	3
CO3	3	3	3	3	3	3	3	2	3

Programme: Degree Class: B.Sc.	Year: III	Semester: VI
Subject: Mathematics		
Course Code: BMA-S611	**Course Title: Mathematical Modelling**	

Course Outcome	By the end of this course, students will be able to CO1: Understand fundamental mathematical concepts and skills to deal with real world problems. CO2: Understand a mathematical model and the steps involved in Mathematical Modeling Process. CO3: Understand the techniques to develop various mathematical models through geometry, algebra and ordinary differential equations of first order.	
Unit No.	**Course Content**	**Hours**
I	Mathematical Modelling: Definition, Need, Classification, Simple Situations Requiring Mathematical Modelling, The Technique of Mathematical Modelling, Classification of Mathematical Models, Some Characteristics of Mathematical Models.	8
II	Mathematical Modelling through Geometry, Mathematical Modelling through Algebra, Mathematical Modelling through Trigonometry, Mathematical Modelling through Calculus, Limitations of Mathematical Modelling.	8
III	Linear growth and decay models: Population growth model, Effect of immigration and Emigration on population size, decrease of temperature, diffusion, Change of price of a commodity, Non-linear growth and decay model: Simple logistic model, Logistic model for non- isolated population, Simple compartment models.	8
IV	Mathematical modeling of Epidemics: Basic concept, Simple Epidemic model through system of ordinary differential equation of first order- A simple epidemic model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration.	8
V	Economics based models: Domar Macro model, Domar first debt model, Momar's second debt model, Samuelson's investment model.	8

Suggested Readings:

1. J. N. Kapur: Mathematical Modelling (New Age International Private Limited).
2. B. Barnes, G. R. Fulford: Mathematical Modelling -with Case Studies: Using Maple and MATLAB (CRC Press).
3. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	1	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3

Programme: B.Sc. Degree Class: B.Sc.	Year: III	Semester: VI

Subject: Mathematics

Course Code: BMA-S612	Course Title: Laplace and Fourier Transforms

Course Outcome	By the end of this course, students will be able to **CO1:** Describe the ideas of Fourier and Laplace Transforms and indicate their applications. **CO2:** Use Fourier series for solving boundary value problems. **CO3:** Solve differential equations with initial conditions using Laplace transform.

Unit No.	Course Content	Hours
I	Laplace transforms of some standard functions, Existence conditions for the Laplace transform Shifting theorems, Laplace transform of derivatives and integrals, Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function.	8
II	Inverse Laplace transforms and their properties, Shifting theorems, Inverse Laplace transform of derivatives and integrals, Heaviside expansion theorem, Convolution theorem.	8
III	Applications of Laplace transform to solve Ordinary and Partial differential equations, Applications of Laplace transform to solve integral equations.	8
IV	Fourier series: Trigonometric Fourier Series and its convergence, Fourier series of even and odd functions, Gibbs phenomenon, Fourier half-range series, Parseval's identity, Complex form of Fourier series.	8
V	Fourier Transforms: Fourier integrals, Fourier sine and cosine transforms and their properties Fourier transform of derivatives and integrals, Convolution theorem, Application of Fourier transforms to Boundary Value Problems.	8

Suggested Readings:

1. E. Kreyszig. Advance Engineering Mathematics, John Wiley & amp; Sons.2011.
2. R. K. Jain and S. R. K. lyenger, Advanced Engineering Mathematics, Narosa Publishing House, 2009.
3. F. B. Hildebrand, Methods of Applied Mathematics, Courier Dover Publication, 1992.
4. L. Debnath and D. Bhatta, Integral Transforms and their Applications. 2nd Ed. Taylor and Francis Group, 2007.
5. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	2	3	3	2	3
CO2	3	3	3	1	2	3	3	2	3
CO3	3	3	3	1	2	3	3	2	3

B.Sc. IV (MATHEMATICS)

Detailed Syllabus

For

B.Sc. (Hons.) COURSE

IN

MATHEMATICS

Programme: B.Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VII
Subject: Mathematics		
Course Code: BMA-C711	**Course Title: Abstract Algebra**	

Course Outcome

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

CO1: Understand the concepts of abstract mathematics, normal subgroups, finite groups, class equation of a group and its consequences.

CO2: Understand the concept of homomorphism in groups.

CO3: Identification and comparison of properties of rings, integral domains, ideals, Euclidean rings, principal ideal rings, fields and vector spaces.

CO4: Understand relationships among polynomial rings, roots of polynomials and extension fields.

CO5: Understand the concept of fixed field, Galois group of a polynomial over a field and constructible numbers.

Unit No.	Course Content	Hours
I	Normal subgroups, Simple groups, Conjugacy, Normalizer, Centre of a group, Class-equation of a group and its consequences, Theorems for finite groups, Cauchy's theorem, Sylow's theorem.	12
II	Homomorphisms, Endomorphisms, Automorphisms, Inner automorphisms, Group of automorphisms and Inner automorphisms, Maximal subgroups, Composition series, Jordan-Holder theorem, Normal series, Commutator subgroups, Solvable groups, Direct-Products.	12
III	Rings, Subrings, Integral domain, Ideals, Principal ideals, Maximal and Prime ideals, Euclidean rings, Vector spaces, Subspaces, Linear span, Basis and dimension.	12
IV	Extension fields, Transitivity of finite extensions, Algebraic element, Algebraic field extensions, Minimal polynomials, Roots of polynomials, Multiple roots, Splitting field, Existence of SF of a polynomial.	12
V	Automorphism of a field, Fixed field, Group of Automorphism of a field K relative by a subfield F of K, Galois group of a Polynomial over a field, Construction with straight edge and Compass.	12

Suggested Books

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd.
2. J. Fraleigh, A First Course in Abstract Algebra, Pearson Education.
3. MacDonald, Theory of Groups and Fields, Clarendon Press.
4. Khanna and Bhambari, A Course in Abstract Algebra (Vikash Pub., III Edition).
5. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	3	3
CO2	3	3	2	3	1	3	3	3
CO3	3	3	2	3	1	3	3	2
CO4	3	3	3	3	1	3	3	2
CO5	3	3	2	3	1	3	3	2

Programme: B. Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VII
Subject: Mathematics		
Course Code: BMA-C712	**Course Title: Mathematical Statistics**	

Course Outcome	By the end of this course, students will be able to **CO1:** Describe probability, moments, expectation. **CO2:** Solve problems related to Binomial, Poisson, Geometric, Exponential and Normal distributions. **CO3:** Estimate basic population parameters. Construct and interpret confidence intervals to estimate means & proportions for population. **CO4:** Determine the relation between data sets by means of correlation and regression.

Unit No.	Course Content	Hours
I	Probability: Sample space and Events, Axioms of Probability, Conditional Probability, Baye's theorem, Expectations, Moments, moment generating functions, characteristic functions.	12
II	Probability Distributions: Random Variables, Distribution functions, Probability density function, Discrete Random Variable, Bernoulli's Distribution, Binomial Distribution, Poisson distribution.	12
III	Continuous Distributions: Continuous random variable, Normal Distribution, Uniform & Exponential distribution, sampling, types of Sampling, Test the significance, critical reason and level of significance, Null hypothesis, Test of hypothesis, Testing the significance of sample mean and difference between means of two samples.	12
IV	Pt. Estimation, Interval Estimation, Methods of Estimation, Max Likelihood method, Method of moments, Unbiasedness, Efficiency, Consistency, Sufficiency.	12
V	Curve Fitting, Method of Least squares, Simple linear regression, Correlation, Multiple correlation.	12

Suggested Readings:

1. Miller and John Freund, Probability and Statistics, Prentice Hall.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
3. M. R. Spiegel, Probability and Statistics, Schaum's Outline Series.
4. Ray, Sharma and Chaudhary, Mathematical Statistics, Ram Prasad Pub.
5. R. E. Walpole, R.H. Myers, S.l. Myers and K.Ye, Probability and Statistics for Engineers and Scientists, Pearson Pub.
6. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	3	2
CO2	3	3	3	3	1	3	3	2
CO3	3	3	2	3	1	3	3	2
CO4	3	3	3	3	1	3	3	2

Programme: B. Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VII
Subject: Mathematics		
Course Code: BMA-C713	**Paper: Advanced Real Analysis**	

Course Outcome

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

CO1: Understand the basic concepts of Sequences and series, point-wise and uniform convergence of sequences of functions.

CO2: Understand the concepts of Lebesgue measurability of a given set.

CO3: Understand the concepts of measurable functions and their properties.

CO4: Determine the Lebesgue integrals of bounded, non-negative and measurable functions.

Unit No.	Course Content	Hours
I	Sequences and series of real valued functions, Pointwise and uniform convergence of sequences of functions, Pointwise and uniform convergence of series of functions, Continuity, Integrability and differentiability by means of uniform convergence.	15
II	Equivalent sets, Countable and uncountable sets, Length of sets, Lebesgue outer measure of sets, Lebesgue measurable sets and their properties, Boolean algebra of sets, $\sigma-$Boolean algebra, Borel sets and their measurability, Further properties of measurable sets, Characterization of measurable sets.	15
III	Measurable functions and their properties, Algebra of Measurable functions, Step function, Max and min functions, Positive and negative parts of a function, Characteristics function, Simple function, Continuity of a function over measurable sets, Sets of measure zero, almost everywhere property, Egoroff's theorem, Lusin theorem, Frechet theorem, Convergence in measure, Riesz theorem, Fundamental in measure.	15
IV	Lebesgue Integral of a bounded function, Relation between Riemann and Lebesgue integrals, Properties of Lebesgue integrals on bounded measurable functions, Bounded convergence theorem, Integral of nonnegative measurable function, Fatou's lemma, Monotone convergence theorem, Integrable functions, General Lebesgue integral, Lebesgue dominated convergence theorem.	15

Suggested Books

1. Walter Rudin, Principles of Mathematical Analysis, McGraw Hill.
2. Robert Bartle, the elements of integration and Lebesgue measure, Wiley Classics Library.
3. Gerald Folland, Real Analysis, Modern Techniques and Their Application, Wiley.
4. S. C. Malik and S. Arora, Mathematical Analysis, New Age International.
5. W. A. Sutherland, Introduction to metric and topological spaces (Second Edition), Oxford University Press, New York.
6. M. O. Searcoid, Metric spaces (Springer Undergraduate Mathematics Series), Springer, New York.
7. E. T. Copson, Metric Spaces, Phoenix Public Library, New York.
8. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	3	3
CO2	3	2	3	3	2	2	3	3
CO3	2	2	3	3	2	3	3	3
CO4	3	2	3	3	2	3	3	3

Programme: B. Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VIII

Subject: Mathematics

Course Code: BMA-C811 | **Course Title: Complex Analysis**

Course Outcome	By the end of this course student will be able to **CO1:** Understand the fundamental concepts of continuity, differentiability, analytic function and construction of an analytic function. **CO2:** Integrate complex functions using Cauchy's theorem. **CO3:** Expand the analytic complex functions in the form of power series. **CO4:** Understand the concepts of singularities, residues, and their use in determining the complex integration.

Unit No.	Course Content	Hours
I	Continuity and differentiability of complex functions, Branch points, Analytic and regular functions, Cauchy-Reimann equations, Necessary and sufficient conditions for a function to be analytic, some properties of conjugate functions, Construction of an analytic function, Milne Thomson's method.	12
II	Complex integration, Cauchy Goursat theorem, Cauchy's theorem, Morera's theorem, Cauchy's integral formulae, Cauchy inequalities, Liouville's theorem.	12
III	Gauss mean value theorem, Maximum & minimum modulus theorems, The Argument theorem, Rouche's theorem, Poisson's integral formulae.	12
IV	Power series, The circle of convergence of the power series, Taylor's series, Laurent's series, The zeros of an analytic function, Types of singularities, Introductory conformal mapping (Bilinear transformation).	12
V	Residue at a single pole, Residue at a pole a of order greater than unity, Residue at infinity, Cauchy's residue theorem, Evaluation of real definite integral, Integral round the unit circle.	12

Suggested Readings:

1. J. W. Brown & R.V. Churchill, Complex Variables and Applications, McGraw Hill.
2. J. B. Conway, Functions of One Complex Variable, Springer.
3. Shanti Narayan, Function of Complex Variable, S. Chand.
4. S. Ponnusamy, Functions of Complex Analysis, Narosa Pub.
5. J. H. Methews & R. W. Howell, Complex Analysis for Mathematics & Engineering, Narosa Pub.
6. M. R. Spiegel, S. Lipschutz, J. J. Schiller & D. Spellman, Complex Variables, Schaum's Outline Series, McGraw Hill.
7. L. V. Ahlfors, Complex Analysis, McGraw Hill.
8. Z. Nehari, Conformal Mapping, Dover Pub.
9. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	2	3	3
CO2	3	3	3	3	1	3	3	3
CO3	3	3	3	3	1	3	3	3
CO4	3	3	3	3	1	3	3	3

Programme: B.Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VIII
Subject: Mathematics		
Course Code: BMA-C812	**Paper: Topology**	

Course Outcome	By the end of this course, students will be able to **CO1:** Understand the concepts of metric spaces and topological spaces. **CO2:** Describe basic results about the completeness, compactness, connectedness, continuity and convergence within these structures. **CO3:** Differentiate between topological spaces T1, T2, T3, T4 and T5.

Unit No.	Course Content	Hours
I	Metric space and examples, Neighbourhood point, Open sets, Limit point, Derive set, Closed sets, Boundary of Set, Diameter of set, Convergence, Cauchy sequence, Completeness, Continuity of function in metric space, Some basic properties of continuity, Cantor intersection theorem.	12
II	Topological space and examples, Some elementary concept, Neighbourhood point, Basis and Sub-basis for a topology, Elementary concept of basis, Subspace topology and some basic concept, Definitions of Weak topology, Strong topology and Product topology.	12
III	Interior and exterior points of topological space, Limit and isolated points, Interior and closure of sets, Elementary concept of Interior and closure of sets, Boundary of set, Dense and it's elementary, Perfect set and examples.	12
IV	Continuity of function in topological space, Continuity theorems for open and closed sets, Homeomorphism and its examples, Connected space and examples, Elementary of connectedness, Connected spaces of the real lines, Definition of path, Components and locally connected space, Totally disconnected space.	12
V	Compact space and examples, Elementary of compactness, Compact spaces of the real lines Limit point compactness, Sequentially compact space, Local compactness, Continuity and compactness, Tychonoff theorem. First and second countable space, T_1-Space, Hausdorff spaces, Regular spaces, Normal spaces, Completely normal space, Completely regular space, Uryshon Lemma.	12

Suggested Books

1. C. A. R. Franzosa, Introduction to Topology, Narosa Pub.
2. G. F. Simmons, Introduction to Topology, McGraw Hill.
3. J. Munkers, Topology, Prentice Hall of India.
4. Marwin J. Greenberg and J. R. Harper, Algebraic Topology, Westview Pr. (for Unit-V).
5. Schaum's outline series, General Topology, McGraw Hill Pub.
6. Colin Adams, Introduction to Topology Pure & Applied, Pearson.
7. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	3	1
CO2	3	3	2	2	1	3	3	1
CO3	3	3	2	2	1	3	3	1

Programme: B.Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VIII
Subject: Mathematics		
Course Code: BMA-C813	**Course Title: Advanced Differential Equation**	

Course Outcome	By the end of this course, students will be able to CO1: Obtain the solution of first order ordinary differential equation by Picard's Methods and basic knowledge of linear differential equations of second order. CO2: Understand the ordinary and singular points and power series solution. CO3: Analyse the Legendre and Bessel polynomials and their properties. CO4: Obtain the solution of Linear partial differential equations with constant coefficients CO5: Obtain the solutions of boundary value problems together with wave, heat and Laplace equations.	
Unit No.	**Course Content**	**Hours**
I	The Existence and Uniqueness of solutions: The method of successive approximation, Picard's Existence and Uniqueness theorem, Ordinary and regular singular points, Power series solution, Series solution (Frobenius method) of first and second order linear equations.	12
II	Legendre and Bessel Functions and their recursion formulae, Integral representation and properties.	12
III	Solution of linear partial differential equations of second order with variable coefficients, Applications to the vibrational mechanical systems.	12
IV	Linear homogeneous boundary value problems : Inner product and orthogonality of two functions, Gram-Schmidt process of Orthonormalization, Sturm-Liouville equation, Eigen-values, Eigen-functions and its applications.	12
V	Wave equation, Laplace equation and heat conduction equation, their solutions by method of separation of variables.	12

Suggested Readings:

1. M. D. Raisinghania: Advanced Differential Equations, S. Chand.
2. Shepley L. Ross: Differential Equations, Wiley India.
3. I. N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Book Company.
4. S. G. Deo, V. Raghavendra, R. Kar, V. Laksmikanthan: Text book of Ordinary Differential Equations, McGraw Hill Education.
5. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	3	3
CO2	3	3	3	3	1	2	3	3
CO3	3	3	3	3	1	2	3	3
CO4	3	3	3	3	1	2	3	3
CO5	3	3	3	3	1	2	3	3

Programme: B.Sc. (Hons.) Class: B.Sc.	Year: IV	Semester: VIII

Subject: Mathematics

Course Code: BMA-S811 | **Course Title: OPTIMIZATION TECHNIQUES**

Course Outcome	By the end of this course, students will be able to **CO1:** determine the optimal sequence of jobs on machines to minimize the processing time. **CO2:** determine optimum game strategies. **CO3:** solve different inventory models.

Unit No.	Course Content	Hours
I	Sequencing Theory: Introduction, Processing n-jobs on two machines, n-jobs on three machines, n-jobs on m-machines, Concept of jobs blocks, Processing two jobs on m-machines.	6
II	Game Theory: Saddle point, Solution of 2 x 2 games, Algebraic method, Graphical method for 2 x n and m x 2 games.	9
III	Inventory Management: Inventory control, Types of inventories, Cost associated with inventories, Factors affecting inventory control, Single item deterministic problems with and without shortages, Inventory control with price breaks, Inventory control for one period without setup cost with uncertain demands.	15

Suggested Readings:

1. H. A. Taha, Operations Research: An introduction, Macmillan Publishing Company.
2. P. K. Gupta, Kanti Swarup & Man Mohan, Operations Research, Sultan Chand & Co.
3. R. L. Ackoff and N. W. Sasieni, Fundamental of Operations Research, John Willy, New York.
4. S. D. Sharma, Operations Research, Kedar Nath Ram Nath.
5. A.M. Natarajan, P. Balasubramani and A. Tamilarasi,, Operations Research, Pearson Education, India.
6. Suggested online platform: NPTEL/SWAYAM/MOOCs.

Mapping of course outcomes with program outcomes & program specific outcomes

CO's No.	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	3	2	3
CO2	3	3	3	3	1	3	2	3
CO3	3	3	3	3	1	3	3	3