Polba Mahavidyalaya, Polba, Hooghly
Session: 2023-2024

SEMESTER I and II COURSE WISE CREDIT DISTRIBUTION STRUCTURE UNDER CCFUP AS PER NEP, 2020

Semester	Course Type with Code	Level	Course Title	Credit	Lect.	Tuto.	Pract./ Viva-voce	Full Marks	Distribution of Marks		
									Theory	Pract./ Viva-voce	Internal Assessment
I	Major/DS Course (Core) Code: MATH1011	100-199	Calculus, Geometry & Vector Calculus	4	3	1	0	75	60	0	15
	Minor Course Code: MATH1021	100-199	Calculus, Geometry & Vector Calculus	4	3	1	0	75	60	0	15
	Multi/Inter disciplinary Code: MATH1031		Trigonometry and Coordinate Geometry	3	2	1	0	50	40	0	10
	Ability Enhancement Course (AEC) [L_1-1 MIL] Code: AEC1041		Arabic/ Bengali/ Hindi/ Sanskrit/ Santali/ Urdu or Equvlnt. Course from SWAYAM /Any other UGC recognized platform	2	2	0	0	50	40	0	10
	Skill Enhancement Course (SEC) Code: MATH1051		Graph Theory	3	2	1	0	50	40	0	10
	Common Value Added (CVA) Course Code: CVA1061		Environmental Science/ Education	4	3	0	1	100	60	20	20
	Total			**20**				**400**			

Semester	Course Type with Code	Level	Name of the Course	Credit	Lect.	Tuto.	Pract./Viva-voce	Full Marks	Distribution of Marks		
									Theory	Pract./Viva-voce	Internal Assessment
II	Major/DS Course (Core) Code: MATH2011	100-199	Introductory Algebra & Number Theory	4	3	1	0	75	60	0	15
	Minor Course Code: MATH2021	100-199	Introductory Algebra & Number Theory	4	3	1	0	75	60	0	15
	Multi/Interdisciplinary Code: MATH2031		Algebra	3	2	1	0	50	40	0	10
	Ability Enhancement Course (AEC)[L_2-1] Code: AEC2041		English or Equvlnt. Course from SWAYAM/ /Any other UGC-recognized platform	2	2	0	0	50	40	0	10
	Skill Enhancement Course (SEC) Code: MATH2051		Programming in C	3	2	1	0	50	40	0	10
	Common Value Added (CVA) Course Code: CVA2061		Understanding India/Digital & Technological Solutions/Health & Wellness, Yoga Education, Sports & Fitness	4	3/3	1/0	0/1	100	80/60	0/20	20
Skill based vocational course (addl. 4 Cr) during summer term for 8 weeks, who will exit the programme after securing 40 cr.											
For UG Certificate 40 cr + Additional 4 cr (work based vocational course) = 44 cr. Students are allowed to re-enter within 3 years and complete the program within the stipulated max. period of 7 years											
	Total			**20**				**400**			

DETAILED SYLLABUS

SEMESTER – I

MAJOR COURSES

Course Code: MATH1011
Course Name: Calculus, Geometry &Vector Calculus
(Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives

To study calculus, geometry and vector calculus

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. higher order derivatives and its applications, concavity of curves, asymptotes and curve tracing techniques.
ii. reduction formula for integration of functions like $\sin nx$, $\sin^m x \sin^n x$ etc., area of surface of revolution, parametric curves etc.
iii. classification of conics and conicoids, polar equation of conics.
iv. vector valued functions and vector calculus.

Skills: The students would be able to

i. parametrize curves, sketch functions and plot them.
ii. visualize standard quadratic surfaces like cone, ellipsoid etc.
iii. apply calculus on vector valued functions.
iv. find gradient of scalar functions, divergence and curl of vector valued functions.

General competence: The students would gain

i. a general idea of advance calculus and its applications.
ii. the idea of solving complex problems using vector calculus and geometry.
iii. analytical and reasoning skills, which improve their thinking power and enhance their problem-solving ability.

Contents:

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax+b)^n sinx, (ax+b)^n cosx$, indeterminate forms, L'Hospital's rule, concavity of curves, points of inflection, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves. **[L-12H & T-4H]**

Reduction formulae, derivations and illustrations of reduction formulae for the integration of $sinnx$, $\cos nx$, $tannx$, $secnx$, $(logx)^n$, $\sin^n x \sin^m x$, parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution. **[L-10H & T-3H]**

Reflection properties of conics, translation and rotation of axes, general equation of second-degree, classification of conics, polar equations of conics, spheres, cylindrical surfaces. central conicoid, paraboloids, plane sections of conicoid, generating lines, classification of quadrics. **[L-11H & T-4H]**

Triple product of vectors, introduction to vector functions, algebraic operations on vector-valued functions, limits and continuity of vector functions, differentiation and partial differentiation of vector functions, gradient of a scalar function, divergence and curl of vector functions. [L-**12H & T-4H]**

Reading References:

Text Books:

1. Calculus - G.B. Thomas and R.L. Finney, 9th Ed., (Pearson Education, Delhi, 2005).
2. Calculus - M.J. Strauss, G.L. Bradley and K. J. Smith, 3rd Ed., (Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007).
3. Integral Calculus - K.C. Maity and R. K. Ghosh., (New Central Book Agency (P) Limited, 1999).
4. An Elementary Treatise on Coordinate Geometry of three-Dimensions–R.J.T. Bell, (MacMillan & Co.).
5. The Elements of Coordinate Geometry-S.L. Loney, (MacMillan & Co.).
6. Vector Analysis- K.C. Maity and R. K. Ghosh, (New Central Book Agency (P) Ltd. Kolkata, 1999).

Reference Books:

1. Calculus- T. M. Apostol, (Volumes I and II. Vol-I, 1966, Vol-II, 1968).
2. Calculus- H. Anton, I. Bivens and S. Davis, 7th Ed., (John Wiley and Sons (Asia) P. Ltd., Singapore, 2002).
3. Introduction to Calculus and Analysis - R. Courant and F. John, (Volumes I & II), (Springer-Verlag, New York, Inc., 1989).
4. Analytical Geometry of two and three-dimensions- N. Dutta and R. N. Jana, (Shredhar Prakashani).
5. Calculus and Mathematical Analysis- S. Goldberg, 1989.
6. Vector Calculus- J. Marsden, and Tromba, (McGraw Hill, 1987).
7. Schaum's outline of Vector Analysis- M.R. Spiegel, (McGraw Hill, 1980).
8. Vector Analysis with Applications - A. A. Shaikh and S. K. Jana, (Alpha Science International Ltd., 2009).

MINOR COURSES

Course Code: MATH1021
Course Name: Calculus, Geometry &Vector Calculus
(Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives

To study calculus, geometry and vector calculus

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. higher order derivatives and its applications, concavity of curves, asymptotes and curve tracing techniques.
ii. reduction formula for integration of functions like $\sin nx$, $\sin^m x \sin^n x$ etc., area of surface of revolution, parametric curves etc.
iii. classification of conics and conicoids, polar equation of conics.
iv. vector valued functions and vector calculus.

Skills: The students would be able to

i. parametrize curves, sketch functions and plot them.
ii. visualize standard quadratic surfaces like cone, ellipsoid etc.
iii. apply calculus on vector valued functions.
iv. find gradient of scalar functions, divergence and curl of vector valued functions.

General competence: The students would gain

i. a general idea of advance calculus and its applications.
ii. the idea of solving complex problems using vector calculus and geometry.
iii. analytical and reasoning skills, which improve their thinking power and enhance their problem-solving ability.

Contents:

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b} \sin x$, $e^{ax+b} \cos x$, $(ax+b)^n sinx, (ax+b)^n cosx$, indeterminate forms, L'Hospital's rule, concavity of curves, points of inflection, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves. **[L-12H & T-4H]**

Reduction formulae, derivations and illustrations of reduction formulae for the integration of $sinnx$, $\cos nx$, $tannx$, $secnx$, $(logx)^n$, $\sin^n x \sin^m x$, parametric equations, parametrizing a curve, arc length, arc length of parametriccurves, area of surface of revolution. **[L-10H & T-3H]**

Reflection properties of conics, translation and rotation of axes, general equation of second-degree, classification of conics, polar equations of conics, spheres, cylindrical surfaces. central conicoid, paraboloids, plane sections of conicoid, generating lines, classification of quadrics. **[L-11H & T-4H]**

Triple product of vectors, introduction to vector functions, algebraic operations on vector-valued functions, limits and continuity of vector functions, differentiation and partial differentiation of vector functions, gradient of a scalar function, divergence and curl of vector functions. [L-**12H & T-4H]**

Reading References:

Text Books:

1. Calculus - G.B. Thomas and R.L. Finney, 9th Ed., (Pearson Education, Delhi, 2005).
2. Calculus - M.J. Strauss, G.L. Bradley and K. J. Smith, 3rd Ed., (Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007).
3. Integral Calculus - K.C. Maity and R. K. Ghosh., (New Central Book Agency (P) Limited, 1999).
4. An Elementary Treatise on Coordinate Geometry of three-Dimensions–R.J.T. Bell, (MacMillan & Co.).
5. The Elements of Coordinate Geometry-S.L. Loney, (MacMillan & Co.).
6. Vector Analysis- K.C. Maity and R. K. Ghosh, (New Central Book Agency (P) Ltd. Kolkata, 1999).

Reference Books:

1. Calculus- T. M. Apostol, (Volumes I and II. Vol-I, 1966, Vol-II, 1968).
2. Calculus- H. Anton, I. Bivens and S. Davis, 7th Ed., (John Wiley and Sons (Asia) P. Ltd., Singapore, 2002).
3. Introduction to Calculus and Analysis - R. Courant and F. John, (Volumes I & II), (Springer-Verlag, New York, Inc., 1989).
4. Analytical Geometry of two and three-dimensions- N. Dutta and R. N. Jana, (Shredhar Prakashani).
5. Calculus and Mathematical Analysis- S. Goldberg, 1989.
6. Vector Calculus- J. Marsden, and Tromba, (McGraw Hill, 1987).
7. Schaum's outline of Vector Analysis- M.R. Spiegel, (McGraw Hill, 1980).
8. Vector Analysis with Applications - A. A. Shaikh and S. K. Jana, (Alpha Science International Ltd., 2009).

MULTIDISCIPLINARY COURSES

Course Code: MATH1031
Course Name: Trigonometric functions and coordinate geometry
(Credit: 3, Marks: 50)
Total Hours: Lecture - 30, Tutorial – 15

Objectives

To present the concepts of Trigonometric Functions, Straight Lines, Conic Sections and Introduction to Three - dimensional Geometry.

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. Trigonometric Functions.
ii. Straight Lines.
iii. Conic Sections.
iv. Introduction to Three - dimensional Geometry.

Skills: The students would be able to

i. solve the problem of Trigonometric Functions.
ii. solve the problem of Straight Lines.
iii. solve the problem of Conic Sections.
iv. solve the problem of Three - dimensional Geometry.

General competence: The students would gain

i. general idea of Trigonometric Functions, Straight Lines, Conic Sections and Introduction to Three - dimensional Geometry.
ii. analytical and reasoning skills, which improve their thinking power.

Contents:

Trigonometric Functions: Measurement of trigonometric angles, trigonometric functions and standard angles, trigonometric functions of associated angles, trigonometric functions of compound angles, transformations of sums and products of trigonometric functions, trigonometric functions of multiple angles, trigonometric functions of submultiple angles, general solution of the equations of trigonometric functions, properties of triangles. **[L-12H & T-6H]**

Two-dimensional geometry:

Straight line, circle, parabola, ellipse, hyperbola. **[L-12H & T-6H]**

Three - dimensional Geometry:

Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points. **[L-6H & T-3H]**

Reading references:

Text Books:

1. Mathematics Part I - Textbook for Class XII, NCERT Publication
2. Mathematics Part II - Textbook for Class XII, NCERT Publication
3. Mathematics Exemplar Problem for Class XI, Published by NCERT
4. Elements of Mathematics - A. P. Baisnab and B. N. Ghatak, Oriental Book Company Pvt. Ltd.

Reference Books

1. Mathematics Exemplar Problem for Class XII, Published by NCERT
2. Mathematics for Class 12, R D Sharma, Dhanpat Rai Publications (P) LTD.
3. Mathematics for class 12, S.N.DE, Chhaya Prakashani Limited
4. Mathematics Class XII, Sandeep Garg, Dhanpat Rai Publications
5. Elements of Mathematics For Class XII (Vol-I and Vol-II), M.L. Bhargava, G.K Kharbanda, Anil Kathuria, Jeevan sons Publications

SKILL ENHANCEMENT COURSES

Course Code: MATH1051
Course Name: Graph Theory
(Credit: 3, Marks: 50)
Total Hours: Lecture -30, Tutorial – 15

Objectives

To study the basics of Graph theory and its applications.

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. undirected and directed graphs.
ii. ismorphism of graphs.
iii. Eulerian graphs, Hamiltonian graphs.
iv. various characterizations of trees with applications.
v. bipartite graph and its characterization.
vi. planar and non-planar graphs.
vii. colouring of a graph.
viii. matrix representation of graphs.

Skills: The students would be able to

i. assimilate various graph theoretic concepts and familiarize with their applications.
ii. efficiency in handling with discrete structures.
iii. efficiency in notions of matrix representation of graph, planarity.
iv. efficiency in solving concrete graph colouring problems.
v. solve real world problems that can be modelled by graphs.

General competence: The students would gain

i. general idea of graph theory and its real-life applications.
ii. understanding about graphic sequence.
iii. experience to apply Euler's formula.
iv. ability to use graphs for various map colouring problems.
v. idea about the application of graphs in computer science.

Contents

Definition, examples and basic properties of graphs, complete graphs, Havel-Hakimi theorem (Statement and its application), bi-partite graphs, isomorphism of graphs. **[L-8H & T-3H]**

Königsberg bridge problem, Eulerian graph, Hamiltonian graph, Representation of a graph by a matrix, the adjacency matrix, incidence matrix, weighted graph. **[L-9H & T-3H]**

Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm. **[L-9H & T-3H]**

Planar and non-planar graphs, Euler's formula, colouring of graphs, four colour problem, five colour theorem. **[L-4H & T-1H]**

Reading references:

Text Books:

1. Graph Theory-N. S. Deo, (Prentice-Hall, 1974).
2. Introduction to Graph Theory - D. S. Malik, M. K. Sen & S. Ghosh, (Cengage Learning Asia, 2014).

Reference Books

1. A First Look at Graph Theory - J. Clark & D. A. Holton, (Allied Publishers Ltd., 1995).
2. Introduction to Graph Theory- Douglas Brent West, (Prentice Hall, 2001).
3. Graph Theory- Frank Harary, (Addison-Wesley, 1971).
4. Graph Theory with Applications- J. A. Bondy & U.S.R. Murty, (Macmillan, 1976).

SEMESTER – II

MAJOR COURSES

Course Code: MATH2011
Course Name: Introductory Algebra and Number Theory (Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives

To present a systematic introduction to number theory and basic course on algebra.

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. number theory which has wide applicability in advanced mathematics and also in various practical field, e.g., cryptography, computer science and many competitive exams.
ii. complex number and its properties which are equally indispensable tools for advanced studies and different practical field.
iii. a basic introduction to modern algebra which has wide applicability in different branch of sciences.

Skills:

The students would be able to

i. access and also generate different tricky examples and counter examples involving integers during their advanced study of ring theory and field theory.
ii. simplify a mathematical problem in different field of science using complex number.
iii. motivate themselves for future research after getting the glimpse of gateway of modern algebra from classical algebra and number theory and relate use of group, ring and field in different field of science.

General competence: The students would gain

i. descriptive idea of various properties of complex number.
ii. knowledge of richness in number theory.
iii. understanding in basic concepts of group, ring and field.
iv. expertise in solving many tricky problems in number theory, complex numbers.

Contents:

Algebra

Complex Numbers: De Moivre's theorem for rational indices and its applications.

Theory of equations: Fundamental Theorem of Algebra (Statement), Relation between roots and coefficients, Transformation of equation, Descarte's rule of signs, Cubic and biquadratic equations, Reciprocal equation, separation of the roots of equations, Strum's theorem.
Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality. [L-**10H & T-4H]**

Partial order, total order relations, partitions of a set and its connection with equivalence relation, greatest lower bound, least upper bound, maximal, minimal elements, lattice, bounded lattice, modular lattice, distributive lattice, complemented lattice, statement of Zorn's lemma.

[L-**5H & T-2H]**

Semigroups, Monoids, Groups – examples including permutation group, Matrix groups $(M_{n\times n}(\mathbb{R}), GL_n(\mathbb{R}), SL_n(\mathbb{R}))$, Z_n, elementary properties of groups, generators and relations, order of an element of a group, Subgroups and examples of subgroups, cosets, normal subgroup, center of a group, cyclic groups, Lagrange's theorem, Rings, subrings, Ideals (left, right and two sided), integral domain, field, subfield – examples and basic properties, characteristic of a ring and field.

[L-**10H & T-4H]**

Number Theory

Well ordering principle of set of natural numbers, pigeon-hole principle, division algorithm, greatest common divisor (gcd), Euclidean algorithm, least common multiple (lcm), Linear Diophantine equation, prime numbers, relatively prime numbers and related properties including Euclid's lemma, fundamental theorem of arithmetic and its applications, perfect square and square free integers, congruences, solution of congruences, Binary and decimal representation of integer, Chinese remainder theorem and its application. Fermat's little theorem, Wilson's theorem, sum of two squares, Arithmetic function-$\phi(n), d(n), \sigma(n)$. [L-**20H & T-5H]**

Reading References:

Text books:

1. Classical Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
2. Topics in Abstract Algebra – M.K. Sen, S. Ghosh, P. Mukhopadhyay, S. K. Maity, 3rd Edition (University Press).
3. Higher Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
4. An introduction to Theory of Numbers- Niven, Ivan,S. Zuckerman Herbert, L. Montogomery Hugh,5th Edition, (Willey).
5. Elementary Number Theory- D. M. Burton, (Mc Graw Hill Education).

Reference Books:

1. Topics in Algebra – I. N. Herstein,2nd Edition, (Wiley).
2. Contemporary Abstract Algebra - Gallian, A. Joseph, Standard Edition, (Cengage India Private Limited).
3. Higher Algebra - S. Barnards, J. M. Child, (Arihant).
4. Algebra - M. Artin, 2nd Edition, (Pearson Education, India).
5. A first course in Abstract Algebra - J. B. Fraleigh7th Edition, (Pearson Education, India).

MINOR COURSES

Course Code: MATH2021
Course Name: Introductory Algebra and Number Theory
(Credit: 4, Marks: 75)
Total Hours: Lecture -45, Tutorial – 15

Objectives

To present a systematic introduction to number theory and basic course on algebra.

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. number theory which has wide applicability in advanced mathematics and also in various practical field, e.g., cryptography, computer science and many competitive exams.
ii. complex number and its properties which are equally indispensable tools for advanced studies and different practical field.
iii. a basic introduction to modern algebra which has wide applicability in different branch of sciences.

Skills:

The students would be able to

i. access and also generate different tricky examples and counter examples involving integers during their advanced study of ring theory and field theory.
ii. simplify a mathematical problem in different field of science using complex number.
iii. motivate themselves for future research after getting the glimpse of gateway of modern algebra from classical algebra and number theory and relate use of group, ring and field in different field of science.

General competence: The students would gain

i. descriptive idea of various properties of complex number.
ii. knowledge of richness in number theory.
iii. understanding in basic concepts of group, ring and field.
iv. expertise in solving many tricky problems in number theory, complex numbers.

Contents:

Algebra

Complex Numbers: De Moivre's theorem for rational indices and its applications.

Theory of equations: Fundamental Theorem of Algebra (Statement), Relation between roots and coefficients, Transformation of equation, Descarte's rule of signs, Cubic and biquadratic equations, Reciprocal equation, separation of the roots of equations, Strum's theorem.

Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality. [L-**10H & T-4H]**

Partial order, total order relations, partitions of a set and its connection with equivalence relation, greatest lower bound, least upper bound, maximal, minimal elements, lattice, bounded lattice, modular lattice, distributive lattice, complemented lattice, statement of Zorn's lemma.

[L-**5H & T-2H]**

Semigroups, Monoids, Groups – examples including permutation group, Matrix groups $(M_{n\times n}(\mathbb{R}), GL_n(\mathbb{R}), SL_n(\mathbb{R}))$, Z_n, elementary properties of groups, generators and relations, order of an element of a group, Subgroups and examples of subgroups, cosets, normal subgroup, center of a group, cyclic groups, Lagrange's theorem, Rings, subrings, Ideals (left, right and two sided), integral domain, field, subfield – examples and basic properties, characteristic of a ring and field.

[L-**10H & T-4H]**

Number Theory

Well ordering principle of set of natural numbers, pigeon-hole principle, division algorithm, greatest common divisor (gcd), Euclidean algorithm, least common multiple (lcm), Linear Diophantine equation, prime numbers, relatively prime numbers and related properties including Euclid's lemma, fundamental theorem of arithmetic and its applications, perfect square and square free integers, congruences, solution of congruences, Binary and decimal representation of integer, Chinese remainder theorem and its application. Fermat's little theorem, Wilson's theorem, sum of two squares, Arithmetic function-$\phi(n), d(n), \sigma(n)$. [L-**20H & T-5H]**

Reading References:

Text books:

1. Classical Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
2. Topics in Abstract Algebra – M.K. Sen, S. Ghosh, P. Mukhopadhyay, S. K. Maity, 3rd Edition (University Press).
3. Higher Algebra- S. K. Mapa,8th Edition, (Sarat Book House).
4. An introduction to Theory of Numbers- Niven, Ivan, S. Zuckerman Herbert, L. Montogomery Hugh,5th Edition, (Willey).
5. Elementary Number Theory- D. M. Burton, (Mc Graw Hill Education).

Reference Books:

1. Topics in Algebra – I. N. Herstein,2nd Edition, (Wiley).
2. Contemporary Abstract Algebra - Gallian, A. Joseph, Standard Edition, (Cengage India Private Limited).
3. Higher Algebra - S. Barnards, J. M. Child, (Arihant).
4. Algebra - M. Artin, 2nd Edition, (Pearson Education, India).
5. A first course in Abstract Algebra - J. B. Fraleigh7th Edition, (Pearson Education, India).

MULTIDISCIPLINARY COURSES

Course Code: MATH2031
Course Name: Algebra (Credit: 3, Marks: 50)
Total Hours: Lecture - 30, Tutorial – 15

Objectives

To present the concepts of Principle of Mathematical Induction, Complex Numbers and Quadratic Equations, Linear Inequality, Permutation and Combinations, Binomial Theorem, Sequence and Series, Matrices and Determinants.

Learning outcomes

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about

i. Principle of Mathematical Induction.
ii. Complex Numbers and Quadratic Equations.
iii. Linear Inequality, Permutation and Combinations.
iv. Binomial Theorem.
v. Sequence and Series.
vi. Matrices and Determinants

Skills: The students would be able to

i. solve the problem by using Principle of Mathematical Induction.
ii. solve the problem of Complex Numbers and Quadratic Equations.
iii. solve Linear Inequality, Permutation and Combinations.
iv. calculate Binomial Theorem, Sequence and Series.
v. calculate Matrices and Determinants.

General competence: The students would gain

i. general idea of Principle of Mathematical Induction, Complex Numbers and Quadratic Equations, Linear Inequality, Permutation and Combinations, Binomial Theorem, Sequence and Series, Matrices and Determinants.
ii. analytical and reasoning skills, which improve their thinking power.

Contents:

Mathematical induction, laws of indices, logarithm, complex numbers, quadratic equations, linear inequations, permutation and combination, binomial theorem, sequence and series. [**L-20H & T-10H]**

Matrices:

Types of matrix, operations on matrices, determinant, adjoint and inverse of a matrix, solution of linear simultaneous equations by matrix method **[L-10H & T-5H]**

Reading references:

Text Books:

1. Mathematics Part I - Textbook for Class XII, NCERT Publication
2. Mathematics Part II - Textbook for Class XII, NCERT Publication
3. Mathematics Exemplar Problem for Class XI, Published by NCERT
4. Elements of Mathematics - A. P. Baisnab and B. N. Ghatak, Oriental Book Company Pvt. Ltd, 2022.

Reference Books

1. Mathematics Exemplar Problem for Class XII, Published by NCERT
2. Mathematics for Class 12, R D Sharma, Dhanpat Rai Publications (P) LTD.
3. Mathematics for class 12, S.N.DE, Chhaya Prakashani Limited
4. Mathematics Class XII, Sandeep Garg, Dhanpat Rai Publications
5. Elements of Mathematics For Class XII (Vol-I and Vol-II), M.L. Bhargava, G.K Kharbanda, Anil Kathuria, Jeevansons Publications

SKILL ENHANCEMENT COURSES

Course Code: MATH2051
Course Name: Programming in C
(Credit: 3, Marks: 50)
Total Hours: Lecture -30, Tutorial – 15

Objectives

To learn the basics of C programming and its different features viz. branching & looping, array, user defined functions, structures and pointers

Learning outcomes

On completion of the course, the student should have the following outcomes defined in terms of knowledge, skills and general competence:

Knowledge: The students would gain knowledge about the

i. basics of C programming i.e., basic structure, keywords, identifiers, operators with operator precedence and associativity, input-output statements.
ii. concepts of branching & looping and array.
iii. user defined functions and their use.
iv. use of structures and pointers.

Skills: The students would be able to

i. learn the keywords, identifiers, different types of operators with precedence and associativity, use of formatted and non-formatted input-output statements.
ii. use branching and looping statements for decision making.
iii. learn the concepts of array, string handling arrays.
iv. use library and user-defined functions along with string handling functions.
v. write programs using structures and pointers.

General Competence: The students would gain

i. general idea about the writing of different C programs using branching & looping statements, arrays, functions, structures and pointers.
ii. program writing and reasoning skills which improve their thinking power.

Contents:

Introduction, basic structures, character set, keywords, identifiers, constants, variable-type declaration, operators: arithmetic, relational, logical, assignment, increment, decrement, conditional. [L- 3H & T- 1H]

Operator precedence and associativity, arithmetic expression, evaluation and type conversion, character reading and writing, formatted input and output statements. [L- 3H & T-1H]

Decision making (branching and looping): Simple and nested *if, if – else, switch, while, do-while, for* statements. [L- 5H & T-3H]

Concept of array variables, string handling with arrays – reading and writing, string handling functions. [L- 4H &T-2H]

User defined functions, call-by-value, call-by-reference functions and their uses, return values and their types, nesting of functions, recursion. [L- 5H & T-3H]

Structures: Declaration, initialization, nested structures, array of structures, array within structures. [L- 4H & T- 2H]

Pointers: Declaration, initialization, accessing variables through pointer, pointer arithmetic, pointers and arrays. [L- 6H & T-3H]

Reading references:

Text Books:

1. Programming in ANSI C-E. Balaguruswamy, (TMH, 2011).
2. Programming with C-B. S. Gottfried, (TMH, 2011).

Reference Books:

1. Programming with C-K. R. Venugopal and S. R. Prasad, (TMH, 1997).
2. The C Programming Language -Brian W. Kernighan and Dennis Ritchie, (Pearson Education India, 2015).
3. C Language and Numerical Methods-C. Xavier, (New Age International (P) Ltd. Pub, 2007).
4. The C Programming Language-Brian W. Kernighan / Dennis Ritchie, (Pearson Education India, 2015).

B.Sc. GENERAL (MATHEMATICS)

Course Structure: Semester III, IV, V and VI Courses (as per CBCS)

Program Outcome:
After completion of the B.Sc. General program (as per CBCS), the students will be able to

PO No.	Program Outcomes
PO 1	Develop numerical and analytical skills and critical thinking that enable them to solve day-to-day problems
PO 2	Develop scientific, communicative, and numerical skills and make rewarding careers in science and education by facing challenging competitive exams.
PO 3	Gain scientific knowledge and skills that enable them to undertake further studies in an inter-disciplinary branch of science
PO 4	Apply scientific knowledge of principles, concepts, and results to their day-to-day life
PO 5	Enhance problem-solving skills

Programme Specific outcome

After the successful completion of this course, the student will be able to:

PSO1	Recall basic facts of mathematics and display knowledge of conventions such as notations, and terminology.
PSO2	Equipped with mathematical skills and techniques which can be applied in both academic and non-academic areas of work.
PSO3	Construct mathematical modeling of many physical phenomena.
PSO4	Face competitive examinations confidently using the acquired numerical skills and knowledge.
PSO5	Develop interest and a positive attitude towards mathematics as an interesting and valuable subject of study.

Semester	Course Code	Title	Credits
III	BMG3CC1C	Real Analysis	6
IV	BMG4CC1D	Algebra	6
Discipline Specific Electives (DSE) **Choices for DSE1A (Choose any one)**			
V	BMG5DSE1A1	Matrices	6
	BMG5DSE1A2	Mechanics	6
	BMG5DSE1A3	Linear Algebra	6
Choices for DSE1B (Choose any one)			
VI	BMG6DSE1B1	Numerical Methods	6
	BMG6DSE1B2	Complex Analysis	6
	BMG6DSE1B3	Linear Programming	6
Skill Enhancement Courses (SEC) **Choices for SEC1 (Choose any one)**			

III	BMG3SEC11	Logic and Sets	2
	BMG3SEC12	Analytical Geometry	2
	BMG3SEC13	Integral Calculus	2
Choices for SEC2 (Choose any one)			
IV	BMG4SEC21	Vector Calculus	2
	BMG4SEC22	Theory of Equations	2
	BMG4SEC23	Number Theory	2
Choices for SEC3 (Choose any one)			
V	BMG5SEC31	Probability and Statistics	2
	BMG5SEC32	Mathematical Finance	2
	BMG5SEC33	Mathematical Modeling	2
Choices for SEC4 (Choose any one)			
VI	BMG6SEC41	Boolean Algebra	2
	BMG6SEC42	Transportaion and Game Theory	2
	BMG6SEC43	Graph Theory	2
	GRAND TOTAL		40

Semester-wise detailed syllabus

SEMESTER – III	
Name of the Course: **Real Analysis**	
Course Code: **BMG3CC1C**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG3CC1C)

The prime objectives of the course are:

- Students will be able to describe the real line as a complete, ordered field.
- Learn to use the definitions of convergence as they apply to sequences, series, and functions.
- Students will be able to determine the continuity, differentiability, and integrability of functions defined on subsets of the real line.

Course Outcomes (BMG3CC1C)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	CO1 Explain the primary concepts of sets, sequences, and series of real Numbers.	PSO2
CO 2	Understand the concepts of convergence of sequences and series	PSO1
CO 3	Understand the importance of convergence of sequence and series	PSO1
CO 4	Find the sum of infinite terms with different methods using the concepts of sequence and series.	PSO4

SEMESTER – IV	
Name of the Course: **Algebra**	
Course Code: **BMG4CC1D**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG4CC1D)

The prime objectives of the course are:

- Students will recognize and use properties of real numbers.
- They will perform basic arithmetic operations on algebraic expressions and simplify algebraic expressions involving exponents and radicals.

Course Outcomes (BMG4CC1D)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Learn the basic concepts of countable sets, metric space, connectedness, and compactness of metric spaces, which are the backbone of real analysis.	PSO5
CO 2	Understand the techniques and examples in analysis, helps them to be well-prepared for courses like Topology, Measure theory and Functional analysis.	PSO3
CO 3	Using the concept of sequence and series find the sum of infinite terms with different methods.	PSO2
CO 4	Differentiate continuous functions and uniformly continuous functions.	PSO2
CO5	Understand iterative numerical methods to find the roots of an equation, which are based on the concept of sequence.	PSO4
CO6	Explain the applicability of mathematical models using the concepts of real analysis.	PSO1

Discipline Specific Electives (DSE)

Choices for DSE1A (Choose any one)

SEMESTER – V	
Name of the Course: **Matrices**	
Course Code: **BMG5DSE1A1**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG5DSE1A1)

The prime objectives of the course are:

- Work with matrices and determine if a given square matrix is invertible.
- Learn to solve systems of linear equations and application problems requiring them.
- Learn to compute determinants and know their properties.
- Learn to find and use eigenvalues and eigenvectors of a matrix.
- Learn about and work with vector spaces and subspaces.

Course Outcomes (BMG5DSE1A1)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Find the inverse of a square matrix.	PSO3
CO 2	Solve the matrix equation Ax = b using row operations and matrix operations.	PSO2, PSO4
CO 3	Find the determinant of a product of square matrices, of the transpose of a square matrix, and of the inverse of an invertible matrix.	PSO3
CO 4	Find the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.	PSO1, PSO5
CO 5	Determine if a given matrix is diagonalizable.	PSO3

SEMESTER – V	
Name of the Course: **Mechanics**	
Course Code: **BMG5DSE1A2**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG5DSE1A2)

The prime objectives of the course are:

- Understand the various concepts of physical quantities and the related effects on different bodies using mathematical techniques.
- Emphasize knowledge building for applying mathematics in the physical world.
- To understand the concept of different forces and moments and their equilibrium concerning a coordinate system.
- To widen appreciation of the variety of phenomena covered by mechanics and the techniques available to handle them.

Course Outcomes (BMG5DSE1A2)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Understand the virtual work, stable and unstable equilibrium.	PSO5
CO 2	Solve the problems on the stability of near orbit, motion in a particle in 3D, and motion on a smooth sphere, cone, and any surface.	PSO2

CO 3	Understand the degree of freedom, D'Alembert's Principle, compound pendulum, and conservation of momentum and energy.	PSO1

SEMESTER – V	
Name of the Course: **Linear Algebra**	
Course Code: **BMG5DSE1A3**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG5DSE1A3)

The prime objectives of the course are:

- To determine the eigen values and eigen vectors.
- To understand the concept of Algebra of linear transformations and matrices.
- Emphasize the application of techniques using the adjoint of linear operator and their properties to least squares approximation and minimal solutions to systems of linear equations.
- Understand the unique factorization domain and its applications, Cayley Hamilton theorem and its consequences, orthogonal projections and spectral theorem.

Course Outcomes (BMG5DSE1A3)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism.	PSO3
CO 2	Demonstrate the ability to graphically or analytically analyze prime and maximal ideals, homomorphism and isomorphism theorem on rings and vector spaces.	PSO4, PSO5
CO 3	Demonstrate knowledge of inner product space, least squares approximation, normal and self-adjoint operator, spectral theorem.	PSO1, PSO2
CO 4	Demonstrate the ability of unique factorization domain and its applications, Cayley Hamilton theorem and its consequences, orthogonal projections and spectral theorem.	PSO5

Choices for DSE1B (Choose any one)

SEMESTER – VI	
Name of the Course: **Numerical Methods**	
Course Code: **BMG6DSE1B1**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (UMTMGE04)

The prime objectives of the course are:

- To comprehend various computational techniques to find approximate value for possible root(s) of non-algebraic equations, to find the approximate solutions of system of linear equations and ordinary differential equations.
- Emphasise the use of Computer Algebra System by which the numerical problems can be solved both numerically and analytically, and to enhance the problem-solving skills.

Course Outcomes (UMTMGE04)

After completing the course, students will be able to

CO. No.	Course Outcome	PSOs Addressed
CO 1	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	PSO1
CO 2	Analyse and evaluate the accuracy of common numerical methods.	PSO2

SEMESTER – VI	
Name of the Course: **Complex Analysis**	
Course Code: **BMG6DSE1B2**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG6DSE1B2)

The prime objectives of the course are:

- To introduce the basic ideas of analysis for complex functions in complex variables with visualization through relevant practical.
- Understand Cauchy's theorems, series expansions, and calculation of residues.

Course Outcomes (BMG6DSE1B2)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties, and apply the concept and consequences of analyticity and the Cauchy Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra.	PSO1, PSO3

CO 2	Applies the theory to the application of the power series expansion of analytic functions, and understand the basic methods of complex integration and its application in contour integration.	PSO2
CO 3	Represent functions such as Taylor, power, and Laurent series, classify singularities and poles, find residues, and evaluate complex integrals using the residue theorem.	PSO4, PSO5

SEMESTER – VI	
Name of the Course: **Linear Programming**	
Course Code: **BMG6DSE1B3**	
Full Marks: 75	Credit: 6
Number of classes required: 60	

Course Objectives (BMG6DSE1B3)

The prime objectives of the course are:

- To develop the ideas underlying the Simplex Method for Linear Programming Problem, as an important branch of Operations Research.
- Understand the Linear programming problems with applications to transportation, assignment and game problem.
- Understand the application of linear programming problems in manufacturing resource planning and financial sectors.

Course Outcomes (BMG6DSE1B3)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Formulate optimization problems and solve them using different methods.	PSO3
CO 2	Place a Primal linear programming problem into standard form and use the Simplex Method or Revised Simplex Method to solve it and find the dual, and identify and interpret the solution of the Dual Problem from the final tableau of the Primal problem.	PSO1, PSO2
CO 3	Explains the Transportation Problem and Assignment Problem, formulate them as an LPP and hence solve the problem.	PSO4
CO 4	To understand the theory of games for solving simple games.	PSO1, PSO2

Skill Enhancement Courses (SEC)

Choices for SEC 1 (Choose any one)

SEMESTER – III
Name of the Course: **Logic and Sets**

Course Code: **BMG3SEC11**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG3SEC11)

The prime objectives of the course are:

- To properly use the vocabulary and symbolic notation of higher mathematics in definitions, theorems, and problems.
- To analyze the logical structure of statements symbolically, including the proper use of logical connectives, predicates, and quantifiers.
- Construct truth tables, prove or disprove a hypothesis, and evaluate the truth of a statement using the principles of logic.
- Solve problems and write proofs using the concepts of set theory, including the methods of Venn diagrams and truth tables.
- Solve problems and write proofs using the basic definitions and the fundamental properties of subsets and operations on the real numbers, integers, rational and irrational, even and odd, multiples or factors of whole numbers.

Course Outcomes (BMG3SEC11)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	To discuss connectives and well-formed formulas	PSO1, PSO2
CO 2	Learn to evaluate normal forms and illustrate theory of inference for statement calculus	PSO3
CO 3	To define different types of sets and operations on sets	PSO1
CO 4	To explain representation of Venn diagrams	PSO1, PSO3
CO5	To describe Cartesian products of sets explain partial ordered relations and posets	PSO4
CO6	To explain representation and associated terminology of relations	PSO4, PSO5

SEMESTER – III	
Name of the Course: **Analytical Geometry**	
Course Code: **BMG3SEC12**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG3SEC12)

The prime objectives of the course are:

- To get basic knowledge about Circle, Cone, Parabola, Hyperbola, Ellipse etc.
- To understand the concepts & advance topics related to two & three dimensional geometry.
- To study the applications of conics.
- To study the application of Sphere, cone and cylinder.
- To study how to trace the curve.

Course Outcomes (BMG3SEC12)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Understand geometrical terminology for angles, triangles, quadrilaterals and circles.	PSO1, PSO2
CO 2	Measure angles using a protractor.	PSO3
CO 3	Use geometrical results to determine unknown angles.	PSO4
CO 4	Recognise line and rotational symmetries.	PSO1, PSO5
CO 5	Find the areas of triangles, quadrilaterals and circles and shapes based on these.	PSO5

SEMESTER – III	
Name of the Course: **Integral Calculus**	
Course Code: **BMG3SEC13**	
Full Marks: 60	Credit: 2
Number of classes required: 40	

Course Objectives (BMG3SEC13)

The prime objectives of the course are:

- Compute limits, derivatives, and integrals.
- Analyze functions using limits, derivatives, and integrals.
- Recognize the appropriate tools of calculus to solve applied problems.

Course Outcomes (BMG3SEC13)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Use basic integration techniques to calculate area	PSO1
CO 2	Apply integrals to geometric application, physical application, and modeling problems	PSO2
CO 3	Perform additional integration calculations and approximations	PSO3
CO 4	Develop methods to solve differential equations	PSO3
CO 5	Understand infinite series and how to use them to evaluate functions	PSO4
CO 6	Represent functions using power series	PSO4

CO 7	Describing curves through parametric equations and polar coordinates	PSO5

Choices for SEC 2 (Choose any one)

SEMESTER – IV	
Name of the Course: **Vector Calculus**	
Course Code: **BMG4SEC21**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG4SEC21)

The prime objectives of the course are:

- To gain skills in linear transformation.
- To develop the ability to compute eigenvalues and eigenvectors of linear transformations.
- To find inner product spaces and determine orthogonality.

Course Outcomes (BMG4SEC21)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Solve first order differential equations arising in various engineering fields.	PSO2, PSO3
CO 2	Solve linear differential equations of higher order and use the knowledge to study certain problems in engineering.	PSO4, PSO5

SEMESTER – IV	
Name of the Course: **Theory of Equations**	
Course Code: **BMG4SEC22**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG4SEC22)

The prime objectives of the course are:

- To describe the graphical representation of a polynomial, maximum and minimum values of a polynomial,
- To acquire the concept of symmetric functions,
- To know the use of Newton's theorem to find the sums of power of roots, homogeneous products, limits of the roots of equation,

- Understand Sturm's theorem and its application.

Course Outcomes (BMG4SEC22)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Describe the relation between roots and coefficients	PSO1, PSO3
CO 2	Find the sum of the power of the roots of an equation using Newton's Method.	PSO3, PSO 5
CO 3	Transform the equation through roots multiplied by a given number, increase the roots, decrease the roots, removal of terms	PSO3, PSO4
CO 4	Solve the reciprocal equations and analyse the location and describe the nature of the roots of an equation.	PSO4, PSO5
CO 5	Obtain integral roots of an equation by using Newton's Method.	PSO 2
CO 6	Compute a real root of an equation by Horner's method.	PSO 3

SEMESTER – IV	
Name of the Course: **Number Theory**	
Course Code: **BMG4SEC23**	
Full Marks: 60	Credit: 2
Number of classes required: 40	

Course Objectives (BMG4SEC23)

The prime objectives of the course are:

- Learn to find quotients and remainders from integer division.
- Apply Euclid's algorithm and backwards substitution.
- Understand the definitions of congruences, residue classes and least residues.

Course Outcomes (BMG4SEC23)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Apply mathematical induction and other types of techniques to prove theorems or mathematical results.	PSO1
CO 2	Apply the concepts and results of divisibility of integers effectively.	PSO2
CO 3	Understand research problems related to number theory.	PSO4
CO 4	Learn various theorems on primes, congruence and residues which are used in cryptography.	PSO3
CO5	Solve problems related to Chinese remainder theorem, Fermat's Little theorem.	PSO2

Choices for SEC 3 (Choose any one)

SEMESTER – V	
Name of the Course: **Probability and Statistics**	
Course Code: **BMG5SEC31**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG5SEC31)

The prime objectives of the course are:

- To make the students familiar with the basic statistical concepts and tools which are needed to study situations involving uncertainty or randomness.
- To render the students to several examples and exercises that blend their everyday experiences with their scientific interests.
- To extend and formalize knowledge of the theory of probability and use of Baye's theorem.
- To inculcate the concepts of random variables, mathematical expectation and correlation.
- Fostering the concept of discrete and continuous probability distributions.

Course Outcomes (BMG5SEC31)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Compute probabilities and conditional probabilities in appropriate ways.	PSO1, PSO3
CO 2	Solve word problems using combinatorial analysis.	PSO2
CO 3	Represent and statistically analyse data both graphically and numerically.	PSO4
CO 4	Demonstrate the ability of conditional probabilities statistically analyse data both graphically and numerically by presentation.	PSO5

SEMESTER – V	
Name of the Course: **Mathematical Finance**	
Course Code: **BMG5SEC32**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG5SEC32)

The prime objectives of the course are:

- To provide an in-depth approach to credit risk modelling for the specific purpose of pricing fixed income securities and credit-risk derivatives.
- To explore the nature of factors underlying credit risk and develop models incorporating default risk.

Course Outcomes (BMG5SEC32)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Understand the mathematical foundations of quantitative finance	PSO1, PSO2
CO 2	Understand the standard and advanced quantitative methodologies and techniques of importance to a range of careers in investment banks and other financial institutions.	PSO2
CO 3	Create and evaluate potential models for the price of shares.	PSO3, PSO5
CO 4	Construct, evaluate and analyze models for investments and securities.	PSO3
CO 5	Apply scientific models and tools effectively.	PSO4

SEMESTER – V	
Name of the Course: **Mathematical Modeling**	
Course Code: **BMG5SEC33**	
Full Marks: 60	Credit: 2
Number of classes required: 40	

Course Objectives (BMG5SEC33)

The prime objectives of the course are:

- To introduce students to the elements of the mathematical modeling process;
- To present application-driven mathematics motivated by problems from within and outside mathematics;
- To exemplify the value of mathematics in problem solving; and
- To demonstrate connections among different mathematical topics.

Course Outcomes (BMG5SEC33)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Translate everyday situations into mathematical statements (models) which can be solved/analyzed, validated, and interpreted in context.	PSO1, PSO2
CO 2	Identify assumptions that are consistent with the context of the problem and which in turn shape and define the mathematical characterization of the problem.	PSO1

CO 3	Revise and improve mathematical models so that they will better correspond to empirical information and/or will support more realistic assumptions.	PSO2, PSO3
CO4	Assess the validity and accuracy of their approach relative to what the problem requires.	PSO4
CO5	Communicate mathematics in both oral and written form to a broad mathematical and lay audience, including the "end users" of a modeling problem, who may be utterly unfamiliar with the mathematics used.	PSO4, PSO5

Choices for SEC 4 (Choose any one)

SEMESTER – VI	
Name of the Course: **Boolean Algebra**	
Course Code: **BMG6SEC41**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG6SEC41)

The prime objectives of the course are:

- To discuss connectives and well-formed formulas
- To explain Boolean functions and free Boolean algebras
- To explain representation and minimization of Boolean functions

Course Outcomes (BMG6SEC41)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Define Boolean algebra and sub-algebra	PSO1
CO 2	Explain Boolean functions and free Boolean algebras	PSO3
CO 3	Explain representation and minimization of Boolean functions	PSO4, PSO5

SEMESTER – VI	
Name of the Course: **Transportation and Game Theory**	
Course Code: **BMG6SEC42**	
Full Marks: 50	Credit: 2
Number of classes required: 40	

Course Objectives (BMG6SEC42)

The prime objectives of the course are:

- To understand the Linear programming problems with applications to transportation, assignment, and game problems.

- To understand the application of linear programming problems in manufacturing resource planning and financial sectors.
- To determine optimality conditions by using the Simplex method.
- To explain the traveling salesman problem and the game theory.
- To explain mixed strategies using linear programming techniques and algebraic methods.

Course Outcomes (BMG6SEC42)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Explain the Transportation Problem and Assignment Problem, formulate them as an LPP, and hence solve the problem.	PSO1, PSO2
CO 2	Understand the theory of games for solving simple games.	PSO2
CO 3	Determine optimality conditions by using the Simplex method. explain the traveling salesman problem	PSO3, PSO5
CO 4	Explain mixed strategies using linear programming techniques and algebraic methods	PSO4

SEMESTER – VI	
Name of the Course: **Graph Theory**	
Course Code: **BMG6SEC43**	
Full Marks: 60	Credit: 2
Number of classes required: 40	

Course Objectives (BMG6SEC43)

The prime objectives of the course are:

- Students will achieve command of the fundamental definitions and concepts of graph theory.
- Students will understand and apply the core theorems and algorithms, generating examples as needed, and asking the next natural question.
- Students will achieve proficiency in writing proofs, including those using basic graph theory proof techniques such as bijections, minimal counterexamples, and loaded induction.
- Students will work on clearly expressing mathematical arguments, in discussions and in their writing.
- Students will become familiar with the major viewpoints and goals of graph theory: classification, extremality, optimization and sharpness, algorithms, and duality.

Course Outcomes (BMG6SEC43)

After completing the course, students will be able to:

CO. No.	Course Outcome	PSOs Addressed
CO 1	Understand the concept of Graphs, which is an important tool for Mathematical Modelling	PSO1
CO 2	Understand different types of graphs and operations on graphs.	PSO2
CO 3	Relate real life problems or events with mathematical graphs.	PSO6
CO 4	Understand the concept of trees and algorithms to find special spanning trees.	PSO3
CO5	Understand directed graphs and its applications.	PSO2