SYLLABUS FOR 3-YEAR DEGREE/4-YEAR HONOURS IN MATHEMATICS

Under Curriculum and Credit Framework

for

Undergraduate Programmes (CCFUP)

Effective from 2023-2024

The University of Burdwan
Burdwan-713104
West Bengal

Preamble

Undergraduate (UG) Programme is of either 3 or 4-year duration, with multiple entry and exit points and re-entry options, with appropriate certifications such as:

- UG Certificate after completing 1 year (2 Semesters) of study in the chosen fields of study,
- UG Diploma after 2 years (4 Semesters) of study,
- Bachelor's Degree after a 3-year (6 Semesters) programme of study,
- Bachelor's Degree (Honours) after a 4-year (8 Semesters) programme of study.
- Bachelor's Degree (Honours with research), if the students complete a rigorous research project/ dissertation in their major area(s) of study in the 4th year of a bachelor's degree.

The courses offered at the UG level are grouped into eight broad categories which along with the minimum credit requirements are as follows.

Category	**Minimum credit requirement**	
	3-year UG	**4-year UG**
Major (Core)	64	94
Minor	24	32
Multidisciplinary	09	09
Ability Enhancement Courses (AEC)	08	08
Skill Enhancement Courses (SEC)	09	09
Value Added Courses common for all UG students	08	08
Summer Internship	02	02
Research Project/Dissertation*	---	12
Total	124	174

*Honours students who will not undertake research will pursue three 4-credit major courses in lieu of a research project/Dissertation

Further details about the structure of UG programme are available in 'Curriculum and Credit Framework for Undergraduate Programmes' of The University of Burdwan. Courses in Mathematics discipline are offered under the four broad categories, namely major, minor, multidisciplinary and skill enhancement courses. Semester-wise credit distribution of various courses is as follows.

Sem	Major	Minor	Multi disciplinary	SEC
I	**MATH1011 (Cr: 4)** (Calculus, Geometry &Vector Calculus)	**MATH1021(Cr: 4)** (Calculus, Geometry &Vector Calculus)	**MATH1031 (Cr: 3)** (Trigonometry and Coordinate Geometry)	**MATH1051 (Cr: 3)** (Graph Theory)
II	**MATH2011 (Cr: 4)** (Introductory Algebra & Number Theory)	**MATH2021 (Cr: 4)** (Introductory Algebra & Number Theory)	**MATH2031 (Cr: 3)** (Algebra)	**MATH2051 (Cr: 3)** **(**Programming in C)
III	**MATH3011 (Cr: 5)** (Real Analysis I) **MATH3012 (Cr: 5)** (Linear Algebra)		**MATH3031 (Cr: 3)** (Calculus)	**MATH3051 (Cr: 3)** (Mathematical Modelling)
IV	**MATH4011 (Cr: 5)** (Metric Space) **MATH4012 (Cr: 5)** **(**Group Theory & Ring Theory) **MATH4013 (Cr: 5)** (Multivariate Calculus & Tensor Calculus			
V	**MATH5011 (Cr: 5)** (Riemann Integration & Series of functions) **MATH5012 (Cr: 5)** (Probability, Statistics & Linear Programming Problem) **MATH5013 (Cr: 5)** (Differential Equations and Vector Analysis)	**MATH5021 (Cr: 4)** (Linear Algebra & Ordinary Differential Equation)		
VI	**MATH6011 (Cr: 4)** (Numerical Analysis) **MATH6012 (Cr: 4)** (Real Analysis II) **MATH6013** (Partial Differential Equations)**(Cr: 4)** **MATH6014** **(**Mechanics)**(Cr: 4)**			
VII	**MATH7011 (Cr: 6)** **(**Operations Research, Integral Transforms & Integral Equations) **MATH7012 (Cr: 6)** **(**Complex Analysis) **MATH7013 (Cr: 6)** (Classical Mechanics) **MATH7014 (Cr: 6)** (General Topology)	**MATH7021(Cr: 4)** (Partial Differential Equation & Tensor Calculus)		
VIII (Hons. With Research)	**MATH8011 (Cr: 6)** (Numerical Analysis & Practical) **MATH8091 (Cr: 12)** **(**Research Project)	**MATH8021 (Cr: 4)** (Real Analysis)		
OR				
VIII	**MATH8011 (Cr: 6)** (Numerical Analysis &	**MATH8021 (Cr: 4)**		

(Hons. Without Research)	Practical)	(Real Analysis)		
	MATH8012 (Cr: 4) (Geometry of Curves and surfaces)			
	MATH8013 (Cr: 4) (Elements of Functional Analysis)			
	MATH8014 (Cr: 4) (Algebra)			

Objectives

- To impart teaching so that the students could develop higher-order thinking capacities about the fundamental aspects of mathematics.
- To train the students with mathematical knowledge and computational techniques so that they can deal with the problems faced in different walks of life.
- To impart sophisticated mathematical skills so that students can undertake self-employment initiatives.
- To make the students capable of pursuing research work in various emerging fields of mathematics and its applications.

Pre-requisite

For major, minor and skill development courses, the students should possess the knowledge on the mathematics courses at (10+2) level. For multidisciplinary courses the students should possess the knowledge on the mathematics courses at secondary level.

Programme Outcomes

- Development of critical thinking for solving complex problems.
- Skills to characterise problems, formulate a hypothesis, evaluate and validate outcomes, and draw reasonable conclusions thereof.
- Development of the effective scientific and technical communications in both oral and written forms.

Programme Specific Outcomes

- Understanding the fundamental axioms in mathematics, and capability of developing ideas based on them.

- Development of mathematical reasoning and an understanding of the underlying fundamental structures of mathematics (i.e., sets, relations and functions, logical structure), and the relationship among them.

- Motivation for research studies in mathematics and related fields with real life applications.
- Knowledge in a wide range of mathematical techniques and applications of mathematical methods/tools in other scientific and engineering domains.
- Nurturing problem solving skills, thinking, creativity through assignments, tutorials.
- Preparing for various competitive examinations at the national and international levels.

DETAILED SYLLABUS

SEMESTER – I

MAJOR COURSES

Course Code: MATH111
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 $sin\, nx$, $\cos nx$, $tan\, nx$, $sec\, nx$, $(log\ x)^n$, $\sin^n x \sin^m x$, 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: MATH121
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 $sin\, nx$, $\cos nx$, $tan\, nx$, $sec\, nx$, $(log\, x)^n$, $\sin^n x \sin^m x$, 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).

MULTIDISCIPLINARY COURSES

Course Code: MATH131

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, ChhayaPrakashani 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: MATH151
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: MATH211
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-**7H & T-3H]**

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-**4H & T-1H]**

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, integral domains, field. [L-**7H & T-3H]**

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, Quadratic residues, quadratic reciprocity, Jacobi symbol, sum of two squares, Arithmetic function- $\phi(n), d(n), \sigma(n), \sigma_k(n), \omega(n), \Omega(n)$, Möbius inversion formula. [L-**27H & T-8H]**

Reading References:

Text books:

1. Classical Algebra- S. K. Mapa,8thEdition,(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, 8thEdition,(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: MATH221
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-**7H & T-3H]**

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-**4H & T-1H]**

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, integral domains, field. [L-**7H & T-3H]**

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, Quadratic residues, quadratic reciprocity, Jacobi symbol, sum of two squares, Arithmetic function- $\phi(n), d(n), \sigma(n), \sigma_k(n), \omega(n), \Omega(n)$, Möbius inversion formula. [L-**27H & T-8H]**

Reading References:

Text books:

1. Classical Algebra- S. K. Mapa,8thEdition,(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, 8thEdition,(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: MATH231
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, ChhayaPrakashani 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: MATH251
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).